European Commission

Synopsis of RFCS Projects 2016 – 2019

Full list of projects co-financed by the Research Fund for Coal and Steel of the European Union

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Research and Innovation

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Technical Group Coal 1

Coal mining operation, mine infrastructure and management, unconventional use of coal deposits

The scope TGC1 includes:

- Modern techniques for surveying deposits
- Integrated mine planning
- Highly efficient, largely automated excavation and mining technologies corresponding to the geological characteristics of EU hard coal deposits
- Appropriate support technologies
- Transport systems
- Power supply services, communication and information, transmission, monitoring and process control system
- Health and safety in mines, gas control, ventilation and air conditioning, occupational health safety
- Reduction of greenhouse emissions from coal deposits
- Return to the mine of mining waste, fly ash, desulphurisation, other forms of waste
- Refurbishment of waste heaps and the industrial use of residues from coal production and consumption
- Protection of water tables and the purification of mine drainage water
- Protection of surface installation against the effects of subsidence in the short and long term CO2 geological storage
- Upgrading coal deposits; coal bed methane, enhanced coal bed methane, underground gasification, others

847338 (2019)	**DD-MET** *Advanced methane drainage strategy employing underground directional drilling technology for major risk prevention and greenhouse gases emission mitigation*			
Info	Type of Project	Pilot&Demonstration	Duration (months)	13
	Total Budget	€ 5,217,586,.55	Start Date	01/07/2019
	EU Contribution	€ 1,440,074.54	End date	31/12/2022

Abstract

The primary objective of the proposed project is to demonstrate application of long reach underground directional boreholes drilled above mined coal seams as a novel methane drainage technology in longwall mining of coal. The project aims at demonstration of alternative methane drainage technology (not used in Europe) which will contribute to increased mine safety and productivity, reduction of methane emissions and hazards mitigation costs. The project will be conducted in Poland and in Russia. The implementation of proposed technology will be supported by research (laboratory experiments, numerical modelling and extensive field testing) to assure adjustment to field conditions and technology optimisation. The aim of performing two field pilots in different geological and mining conditions of largest Polish and Russian hard coal basins will provide the opportunity to compare the results of individual tasks and will make this technology even more credible and universal. Project will develop a cost effective and environmentally friendly technology to perform methane drainage during coal seam exploitation using in-mine directional drilling replacing very expensive methane drainage galleries developed above mining coal panels, as well as other auxiliary methane drainage methods. The project assumptions will be confirmed in the field and, as a result, best practices will be derived, which will cover technical, technological, environmental and economic aspects, which should be considered in decision making for implementation of proposed drainage technology.

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847299 (2019) RAFF

RISK ASSESSMENT OF FINAL PITS DURING FLOODING

Info				
	Type of Project	Research	Duration (months)	
	Total Budget	€ 3,417,553.95	Start Date	01/06/2019
	EU Contribution	€ 2,050,532.37	End date	31/05/2022

Abstract

The RAFF project aims to research issues related to pit lakes, which is one of the most common uses of post exploitation voids. Up to now, in Europe, there is no precedent for the creation of a pit lake of a brown coal open pit mine of the volume c.a. 1,5 billion cubic meters. There are many examples of flooded smaller final pits and in some of these, during the process of filling with water, serious geotechnical problems have been encountered. It is expected that during reclamation of open pits of volume 1,5 billion m3 the scale of geotechnical problems will be significant and may impede the process of filling the voids with water.

Almost all such artificial lakes are currently (and in the future) dedicated to recreational purposes. To ensure safe utilization of these localities by the public, it is necessary to assess the risk of instability of these areas, and evaluate the long-term monitoring. The main objectives for monitoring the abandoned open-pit mines are: geotechnical stability of the close vicinity and especially the slopes (both under the water level and the final slopes around the lake); the quality of water (chemical composition), not only in the lake itself but also in the close vicinity and all water feeding into the lake.

The main aims of the project are connected with the creation of comprehensive models that can be used for risk assessment purposes. Innovative outcomes of the project will contribute to methodologies and guidelines to improve the safety, security, and environment aspects of flooded open pit mines. The project will carry out in-situ investigation, laboratory tests, and numerical and physical modelling to achieve the objectives.

Thirteen deliverables are planned to be developed within the RAFF project, especially methodologies, numerical models and guidelines.

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847253 (2019)	**BUSDUCT** *Increase of mines efficiency and health protection through the innovative transport system based on BUSDUCT*			
Info	Type of Project	Research	Duration (months)	
	Total Budget	€ 1,900,159.90	Start Date	01/06/2019
	EU Contribution	€ 1,140,095.94	End date	30/11/2022

Abstract

The transport routes in mines are becoming longer in a result of need to reach the coal seams, which are more and more distant from the shaft, thus efficient transport system is very important for the effective functioning of mines. Widely used transport systems based on suspended locomotives, powered by diesel engines, provides a speed up to 2m/s. Furthermore diesel locomotives are onerous due to exhaust gases and heat emission in confined space. Limited speed extends the exposure time of miners to exhaust gases and results in a significant shortening of their effective worktime.

Development of innovative mine transportation system based on three-phase busduct, integrated with the suspended monorail track, for powering the suspended locomotives, is the project objective. Possibility of using the busduct system in the coal mining industry in workings of “a”, “b” or “c” degree of methane explosion hazard and in workings of “A” or “B” class of coal dust explosion hazard is the main innovation. Current collectors which contacts with busduct at speed over 4 m/s, has to be isolated from the mine atmosphere. For that purpose inerting of the power collector working zone within the busduct by inert gas is planned, preventing against ingress of explosive atmosphere.

Special nitrogen agregate subassebly of the suspended locomotive, is planned to be developed for this purpose. Operation of the current collectors of the suspended locomotive will be controlled by a series of sensors. It is planned to apply several levels of safety of current collectors operation, eliminating the possibility of explosion ignition.

The following factors guarantee stable market demand for the new product:

• necessity of using the effective transportation systems in mines,

• disadvantages of present systems due to emission of exhaust gases and heat,

• advantages of the new transport system, especially health protection, higher transportation speed and lower energy consumption.

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847250 (2019)	TEXMIN *The impact of EXtreme weather events on MINing operations*			
Info	Type of Project	Research	Duration (months)	
	Total Budget	€ 3,076,469.90	Start Date	01/06/2019
	EU Contribution	€ 1,845,881.94	End date	31/05/2022

Abstract

Whilst extreme weather events that are consequence of climate change has been a well-researched subject for many years, it is only recently that the subject has appeared on the radar of the international mining industry. Some mines have already faced issues relating to increased severe weather events so this issue needs to be addressed. The scenarios of climate change indicate that this types of events will be more frequent and violent.

TEXMIN project will identify and evaluate environmental impacts on operating, closed and abandoned mines caused by short term increases in extreme weather events and long-term climate change. Climate change scenarios will be calculated from regional climate models and climate baseline review. Impacts brought about by increases in precipitation, temperature and sudden changes in atmospheric pressure will be identified and evaluated with respect to mines across Europe. These will focus on issues such as minewater, gas emissions and structural stability. Risks will be assessed, adaptation & monitoring strategies and tool will be proposed and developed to mitigate current and future impacts. Some of the remedial actions proposed for shafts and spoil dumps will be applied and tested in pilot scale.

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847227 (2019)	SUMAD *Sustainable Use of Mining Waste Dumps*			
Info	Type of Project	Research	Duration (months)	
	Total Budget	€ 3,370,664.65	Start Date	01/07/2019
	EU Contribution	€ 2,022,398.79	End date	30/06/2022

Abstract

The SUMAD project unties European experts to investigate the future use of made-ground consisting of coal-mining spoil with a focus on the geotechnical, sustainability, environmental, socio-economic and long-term management challenges.

Advanced risk analysis and physical and numerical modelling will be applied to different sustainable rehabilitation schemes with a particular focus on the technical viability for the development of renewable energy infrastructure. Tip operators and developers as well as authoritative bodies involved in the project will provide valuable input to ensure the maximum possible impact. A case-study site will be used as a test-bed for the concepts developed during the project.

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847205 (2019)	RECOVERY *RECOVERY of degraded and transformed ecosystems in coal mining-affected areas*			
Info	Type of Project	Research	Duration (months)	
	Total Budget	€ 1,980,327.10	Start Date	01/07/2019
	EU Contribution	€ 1,188,196.26	End date	30/06/2023

Abstract

RECOVERY project focuses on land rehabilitation and ecological restoration of coal mining-affected areas, aiming to accelerate the recovery of degraded and transformed ecosystems to a good ecosystem status.

It will assess the contribution of these ecosystems to human wellbeing by means of the "ecosystem-services" concept, evaluating the consequences of alternative courses of action in order that their capacity to provide benefits to society will not be diminished.

To achieve these goals, the major aim of the project is to increase the impact of rehabilitation and ecological restoration actions on society and environment, demonstrating the opportunities to improve overall public welfare.

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800711 (2018) Draft	**PICTO** *Production Face Environmental Risk Minimisation in Coal and Lignite Mines*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 2,467,612.10	Start Date	01/09/2018
	EU Contribution	€ 1,480,567.26	End date	31/08/2021

Abstract

The main objective of the PICTO project proposed is to develop an ICT system to eliminate or minimise undesired and unplanned production stoppages due to increased gas emissions at coal faces through the use of Integrated production process and environmental monitoring and control systems". The project objective will be achieved through: • Systematic testing and monitoring of underground gas emission and ventilation conditions at faces and numerical modelling to optimise face monitoring and environmental control designs. • Systematic monitoring of gas drainage performance of drainage boreholes and numerical modelling to optimise face and tailgate gas monitoring and environmental control designs • Development of an ICT software tool and demonstration of the control procedures.

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PREMOGOVNIK VELENJE DD	SI	Dr Janez ROŠER
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800757 (2018)	**HYDROCOAL PLUS** *Development and demonstration of Hydro Borehole Technology to improve the competiveness of brown coal excavating techniques worldwide and to minimize their environmental impact.*			
Info	Type of Project	Pilot&Demonstration	Duration (months)	42
	Total Budget	€ 2,455,582.00	Start Date	01/06/2018
	EU Contribution	€ 1,227,791.00	End date	30/11/2021

Abstract

The primary objective of proposed project is to demonstrate Hydro Borehole Mining Technology and develop prototype, novel hydro-mining tool, which will contribute to the competitiveness of brown coal excavation techniques worldwide and address such environmental hazards during and after mine operation like: storage of waste material from overburden removal, preventing the ground level subsidence, keeping undisturbed the level of potable water resources in the ground.

The project aims to: investigate the potential for implementation of hydro borehole brown coal mining technology in the industrial scale, analyze the roof stability using the backfilling, calculate its economics, determine environmental impacts and risks. HydroCOAL Plus project's objectives drew attention of the largest European brown coal producers like: Polish Energy Group Mining and Conventional Power Generation joint stock company (PGE GiEK), Czech Severočeské doly a.s. (SD), which confirm pertinence and importance for the industry of project aspects.

Above partnership guaranties direct dissemination of project results among leading European industrial partners. HBM-technology is considered to be applicable in deposits, which are either sterilised due to environmental concerns, unmined due to mine design limitations and mine closure requirements and what is even more common - in numerous cases, where significant brown coal deposits are covered by previously removed overburden.

HBM technology has a number of advantages comparing with conventional opencast mining in such domains like: safety- it practically excludes human from the coal extraction process, minimal environmental impact, small work force, selectivity, low capital and operating costs, universal applicability. Above advantages provide HBM technology highest level of innovative value in coal mining - largest European brown coal producers confirm this.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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POLTEGOR INSTYTUT INSTYTUT GORNICTWA ODKRYWKOWEGO-POLTEGOR INSTITUTE INSTITUTE OF OPENCAST MINING	PL	Dr Jacek SZCZEPIŃSKI
TECHNISCHE UNIVERSITÂT BERGAKADEMIE FREIBERG	DE	Prof. Carsten DREBENSTEDT

TGC1 : Coal mining operation, mine infrastructure and management, unconventional use of coal deposits

800689 (2018)	I2MON *Integrated Mining Impact Monitoring*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 2,225,344.00	Start Date	01/07/2018
	EU Contribution	€ 1,353,206.00	End date	30/06/2022

Abstract

i2MON joins highly recognized European institutions to develop an integrated monitoring service for identification and assessment of ground and slope movements related to coal mining. The service comprises innovative monitoring tools including terrestrial laser and radar technology as well as space- and airborne remote sensing. To understand the physical movement processes and in order to minimize mining impact, extensive predictive modelling will be directly integrated with the monitoring information. Finally merged into an integrated web-based system the service will substantially improve monitoring quality and costs and deliver the mining industry a key evaluation and decision making instrument.

Coordinator	*Country*	*Scientific person in charge*
DMT GMBH & CO. KG	DE	Dr Karsten ZIMMERMANN

Partners

EFTAS FERNERKUNDUNG TECHNOLOGIETRANSFER GMBH	DE	Dr Andreas MÛTERTHIES
INSTYTUT MECHANIKI GOROTWORU - POLSKIEJ AKADEMII NAUK*IMG PAN	PL	Prof. Krzysztof TAJDUS
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HOSCHULE MAINZ UNIVERSITY OF APPLIED SCIENCES	DE	Dr Jörg KLONOWSKI
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AIRBUS DEFENCE AND SPACE GMBH	DE	Dr Oliver LANG
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754205 (2017)	**ROCD** *Reducing risks from Occupational exposure to Coal Dust*			
Info	Type of Project	Research	Duration (months)	39
	Total Budget	€ 3,400,906.25	Start Date	01/07/2017
	EU Contribution	€ 2,040,543.75	End date	30/09prass III/2020

Abstract

Despite international efforts to limit worker exposure, coal mine dusts continue to impact the health of thousands of miners across Europe. Modern, practicable assessment tools and devices are urgently needed to improve risk models, control dusts and protect workers, particularly from the fine fraction (PM2.5) which is increasingly implicated in human disease. These issues will be addressed through 5 integrated work packages by a world-leading interdisciplinary consortium of 10 institutions from 5 European countries. Global dissemination of developed protocols and training modules, and production of new monitoring and suppression devices will greatly reduce incidences of coal mining-related disease.

Coordinator	*Country*	*Scientific person in charge*
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JASTRZEBSKA SPOLKA WEGLOWA SA	PL	Mr Kamil DEBOWSKI

754169 (2017)	INESI *Increase Efficiency and Safety Improvement in Underground Mining Transportation Routes*			
Info	Type of Project	Research	Duration (months)	39
	Total Budget	€ 2,634,755,25	Start Date	01/07/2017
	EU Contribution	€ 1,550,725,65	End date	30/09/2020

Abstract

There has been a rapid development of auxiliary transportation systems in the European mines in the last two decades. It mainly concerned the solutions, in which the auxiliary transportation means were equipped with their own drives. It has been observed that at the same time the length of tracks on which people are transported is all-time extended. Such situation leads to reduction of effective work time of miners during one shift. There is also a necessity to equip people and equipment/material with tracking systems in dangerous environments. The main objectives of INESI "Increase Efficiency and Safety Improvement in Underground Mining Transportation Routes" project are as follows: increasing the speed and safety of underground auxiliary transportation systems; development and testing of transportation systems adapted to increased speed; elaboration of low energy consumption ventilation of underground transportation routes; development of fully automated system for identification of human's presence on underground conveyors; development of process optimization with persons and equipment tracking.

Coordinator	*Country*	*Scientific person in charge*
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ELMECH KAZETEN SPOLKA Z OGRANICZONA ODPOWIEDZIALNOSCIA	PL	Mr Jan FEIFER
BECKER-WARKOP SPZOO	PL	Mr Krzysztof SZYMICZEK
PREMOGOVNIK VELENJE DD	SI	Mr Matjaž KAMENIK
DTEK ENERGY LIMITED LIABILITY COMPANY	UA	Mr Aleksey ZHUKOVSKIY

754077 (2017) METHENERGY PLUS

Methane recovery and harnessing for energy and chemical uses at coal mine sites

Info				
	Type of Project	Research	Duration (months)	36
	Total Budget	€ 2,734,327.80	Start Date	01/07/2017
	EU Contribution	€ 1,640,596.68	End date	30/06/2020

Abstract

Methane emissions associated with coal extraction are an environmental and safety risk, but also a potential source of clean energy and chemicals. The scope of the present work is to develop an integrated approach for upgrading this methane in ventilation emissions of working shafts (VAM) as well as those emissions coming from abandoned mines (AMM). This strategy includes the evaluation of concentrations and flow rates in terms of the shaft geological and operational features (working or flooded) and the design of separation processes and chemical reactors, either for methane combustion or for transforming this methane into useful chemicals, such as hydrogen or methanol.

Different strategies are proposed: optimization of the mine operation for providing valuable flow rates and methane concentrations, the development of methane concentration procedures (adsorption, membranes; using nanomaterials with tailored properties); use of advanced reactors and combustion devices (thermal/catalytic reverse flow reactors, membrane reactors, etc.) able to deal with these low concentrations. The final goal of the project is to propose integrated approaches from the optimization of VAM and AMM extraction procedures to the fully upgrading of the methane contained in these streams. For this purpose, the project includes in-situ geological studies, experimentation at lab scale, and computer-aided simulation and optimization processes.

Coordinator	*Country*	*Scientific person in charge*
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SPOLKA RESTRUKTURYZACJI KOPALN SA	PL	Mr Marek TOKARZ
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752504 (2017)	**PRASS III** *Productivity and safety of shield support*			
Info	Type of Project	Research	Duration (months)	39
	Total Budget	€ 3,105,889.85	Start Date	01/07/2017
	EU Contribution	€ 1,863,533.63	End date	30/09/2020

Abstract

Deeper and deeper mining of hard coal seams causes that mining crew and equipment are exposed to greater natural hazards. At present progress in the field of automation of mechanized longwall systems does not include monitoring of roof behaviour and preventing against disadvantageous phenomena associated with roof behaviour, such as roof falls to the longwall face or lack of roof fall beyond the shield support leading to local dynamic loading to the working.

It is assumed that by monitoring both shield support behaviour (leg pressures, geometry and tip to face distance) and geotechnical conditions in longwall in real time, warnings about significant improper shield support behaviour and formation of roof instabilities, such as roof cavities/falls or shield closure, will be given several hours in advance. This advance warning allows miners to take preventive action which in turn can reduce longwall downtime and exposure to hazards. Such on-line solutions are not used at present.

Development of Shield Support Monitoring System (SSMS), which will enable monitoring of roof condition in real time, through monitoring the parameters of shield support, as well as development of Longwall Mining Conditions Prediction System (LMCPS) for prediction of roof falls hazards and generation of information about indispensable corrective measures, is the project objective.

LMCPS will be developed on the basis of the geomechanical models and tests of SSMS in real conditions. Geomechanical models are developed from three sources. The physical models, the numerical models (to date with qualitative aspects) and the underground measurement data, which hitherto should not be at variance with the developed theory.

The suggested research work will be undertaken by a well-balanced, interdisciplinary consortium of underground control system developers and manufacturers, shield support designers, mining institutes and mining company complemented by assistance of one University.

Coordinator	*Country*	*Scientific person in charge*
INSTYTUT TECHNIKI GORNICZEJ KOMAG	PL	Dr Darek JASIULEK
Partners		
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BECKER-WARKOP SPZOO	PL	Mr Rafał SZOŁTYSIK
JASTRZEBSKA SPOLKA WEGLOWA SA	PL	Mr Kamil DEBOWSKI

748632 (2016)	**INDIRES** *Information Driven Incident Response*			
Info	Type of Project	Research	Duration (months)	39
	Total Budget	€ 3,139,998.90	Start Date	01/07/2017
	EU Contribution	€ 1,883,997.57	End date	31/12/2020

Abstract

INDIRES addresses the crucial issue of rapidly acquiring and providing information which is a key necessity in the effective response to a serious mining incident. As such, it will facilitate Information Driven Incident Response. The primary objective is to enable information to be gathered and exchanged, without reliance on a mine's fixed power or communication networks, while planning, and during the execution of, a response to an incident that could jeopardize the lives of personnel and the future operation and profitability of the mine. Research will be conducted into two resilient and novel methods of communications that are independent of fixed networks, one operating through rock, the other using a readily deployable cable. These will be key enablers of other technologies developed in INDIRES and will also provide a vehicle for person-to-person voice or textual exchanges for rescue personnel, mine management and trapped miners. Environmental sensors will be developed that are resilient to incidents such as explosions or fires and which can provide immediate access to environmental data in the aftermath of the accident. Small unmanned vehicles – employing a flying, climbing and/or crawling concepts – will be developed for very early reconnaissance of areas affected by an incident before deploying personnel. These vehicles will carry environmental sensors plus thermal imaging cameras for detecting life signs. Highly efficient drilling technology using a torsional torque converter will be researched and props produced using new composite materials. These will provide a self-contained, lightweight solution for drilling exploratory tunnels to facilitate communication with affected areas and access to robotic vehicles, and could potentially allow trapped minders to be released. Simulations will be used to augment live data with information on environmental conditions and probable escape routes.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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INSTYTUT TECHNIKI GORNICZEJ KOMAG	PL	Mr Arkadiusz TOMAS
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INSTYTUT TECHNIK INNOWACYJNYCH EMAG	PL	Mr Wojciech KORSKI
PREMOGOVNIK VELENJE DD	SI	Mr Matjaž KAMENIK

709868 (2016)	CERES *Co-processing of coal mine and electronic wastes: Novel resources for a sustainable future*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 3,946,526.00	Start Date	01/07/2016
	EU Contribution	€ 2,001,503.37	End date	30/06/2019

Abstract

CEReS aims to introduce a series of technological improvements to reduce the risks associated with managing existing and future coal production wastes. Virtually all European coal miners have to manage AMD production when processing coal with relatively high sulfur content; to be able to maintain economically viable production they must adopt sustainable solutions for their wastes. CEReS will develop a generic technological approach for AMD generating wastes.

The co-processing approach proposed by CEReS employs AMD-generating coal production wastes as a cheap source of leaching solution (lixiviant) to recover metals from e-wastes. The novel flow-sheet will (i) remove the AMD-generating potential of coal wastes, ensuring their long term environmental stability while expanding avenues for their safe reuse; and (ii) enable selective recovery of base metals from waste PCBs, while concentrating precious and critical as well as rare earths into enriched substrates. Compared to best available technologies CEReS has numerous economic and environmental benefits by bringing together two waste streams from opposite ends of the supply chain; harvesting each as a novel resource for a single, coherent 'grave-to-cradle' process.

CEReS will use Poland as a case study region and will select and characterise suitable acidogenic coal wastes and obtain PCBs from regional e-waste processers. A cross-mapping exercise will identify the extent to which CEReS can be applied across the entire EU. A bioleaching circuit will be developed and optimised for acid and ferric iron lixiviant production and reuse options for leached residues elaborated. A PCB pyrolytic pre-processing step will be optimised, producing a metal-rich char. A char leaching reactor system will be developed to leach the metals using the biolixiviant from the coal wastes. These processes will be proven at lab (mini-pilot) scale and integrated through modelling and simulation to demonstrate the viability of the CEReS concept.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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UNIVERSITY OF CAPE TOWN	ZA	Ms Sue HARRISON

Technical Group Coal 2

Coal preparation, conversion and upgrading

The scope TGC2 includes:

- Coal beneficiation
- Cokemaking
- Coal-derived carbon materials
- Coal gasification (hydrogen, syngas, synthetic natural gas etc.), including chemical and process aspects of underground coal gasification
- Coal liquefaction
- Environmental issues associated with coal upgrading processes

847333 (2019)	**ODYSSEUS** *Coal-to-liquids supply chain integration in view of operational, economic and environmental risk assessments under unfavourable geological settings*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 3,307,453.85	Start Date	01/06/2019
	EU Contribution	€ 1,964,060.31	End date	31/05/2022

Abstract

ODYSSEUS aims at Coal-to-Liquids Supply Chain (CLSC) integration and enhanced assessment of operational, economic and environmental risks during or after mine operation in unfavourable geological settings for potential high coal production areas in European medium- to low-grade coal deposits.

For that purpose, technological CLSC integration and optimisation are the main project tasks, supported by experimental activities on upgrading coal-derived liquids and by-product beneficiation, integration of conventional and innovative mine development as well as enhanced techno-economic and environmental risk management.

Best-practices guidelines and workshops will support decision makers and stakeholders in increasing EU-wide resources utilization and employment, while reducing import dependency.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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800774 (2018)	**MEGAPlus** *Unconventional MEthane Production from Deep European Coal Seams through combined Coal Bed Methane (CBM) and Underground Coal GAsification (UCG) technologies*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 2,899,260.70	Start Date	01/06/2018
	EU Contribution	€ 1,739,556.42	End date	31/05/2021

Abstract

MEGA+ aims at evaluation of the use of deep lying methane rich coal deposits for coalbed methane and enhanced coalbed methane recovery using horizontal wells, coupled with subsequent high pressure SNG-oriented UCG through the reuse of the same horizontal wells and permanent storage of CO2. Since, the project takes a radical and holistic approach to coupled CBM-UCG process, beyond state-of-the-art, high-pressure gasification tests, advanced numerical simulations and techno-economic assessments will be developed and employed to investigate site-specific CBM-UCG implementations. Project findings will be compiled in best practices serving as guideline for deep CBM-UCG operations in Europe and world-wide.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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CARDIFF UNIVERSITY	UK	Prof. Hywel THOMAS
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INSTITUT NATIONAL DE L ENVIRONNEMENT ET DES RISQUES INERIS	FR	Dr Stephane LAFORTUNE
TATA STEEL UK LIMITED	UK	Dr Chris WILLIAMS
POLSKA GRUPA GORNICZA SA	PL	Mr Bartłomiej BEZAK

800659 (2018)	I3UPGRADE *Integrated and intelligent upgrade of carbon sources through hydrogen addition for the steel industry*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 3,319,740.35	Start Date	01/06/2018
	EU Contribution	€ 1,991,844.21	End date	30/11/2021

Abstract

i3upgrade aims at the intelligent and integrated upgrade of carbonaceous by-products in coal conversion industries through hydrogen intensified synthesis processes.

In contrast to established synthesis technologies, the consortium will develop direct methanation and methanol synthesis of coal-based by-product gases in integrated steel works (blast furnace gas, converter gas, coke oven gas) under dynamic and transient conditions. The proposed concept adds hydrogen from an electrolyzer to these CO2/ CO rich gases to adjust stoichiometry and to convert them into intermediate fuels. This reduces the overall coal-based CO2 emissions of the steel work and opens ideal opportunities for balancing the electrical grid. Advanced process control and operational strategies on component-, site- and system level will minimize operational costs and evaluate the thermodynamic and economic performance of the proposed concepts for different market scenarios.

In part A of the proposal, the partners target the development and evaluation of technical key innovations: new reactor concepts for the methanation and methanol synthesis will be characterized for real steel gases under dynamic operation conditions. Part B focuses on the integration and flexible operation of the syntheses within the complete steel production chain based on advanced control concepts. The final proof-of-concept demonstrates the new control strategies and reactor concepts with real bottled steel mill gases as well as with complex gas matrix from an existing coal gasifier, based on transient data from the steel work in Linz, Austria. Agent based modelling of the complete process chain will evaluate the opportunities for reduction of coal-based CO2 emissions in steel works and the benefits to the electric grid in the framework of new emerging volatile markets. The interdisciplinary consortium will elaborate business cases for European steel producers by integrating coal-based steel and synthetic fuel industries.

Coordinator	*Country*	*Scientific person in charge*
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SCUOLA SUPERIORE DI STUDI UNIVERSITARI E DI PERFEZIONAMENTO SANT'ANNA	IT	Dr Valentina COLLA
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AIR LIQUIDE FORSCHUNG UND ENTWICKLUNG GMBH	DE	Dr Holger SCHLICHTING

796585 (2018) Draft	**LIG2LIQ** *Cost Effective Conversion of Lignite and Waste to Liquid Fuels*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,917,063.60	Start Date	01/08/2018
	EU Contribution	€ 1,750,238.16	End date	31/01/2022

Abstract

The aim of this project is to develop an economically efficient concept for production of valuable substances, such as Fischer-Tropsch-fuels or methanol, from lignite and a variety of wastes including plastics and bio-wastes by means of the High Temperature Winkler (HTW) gasification technology. The costs for syngas cleaning are significantly reduced by an innovative acid gas removal stage for the subsequent synthesis step. The work programme starts with lab scale investigations regarding a) the feedstock properties relevant for fluidized bed gasification and b) the development of the acid gas removal stage. Then, the full process chain is tested at real conditions in a pilot plant with a size of 0.5 MWth feedstock input. The process is scaled up to industrial size using adequate models that have been validated at pilot scale. Finally, a techno-economic assessment and life cycle analysis is performed. The results of this project will be used by the project partners to evaluate the ecomomics of the concept and to assess the feasibilty of a future demonstation plant.

Coordinator	*Country*	*Scientific person in charge*
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RWE POWER AG	DE	Dr Thorsten LIESE
THYSSENKRUPP INDUSTRIAL SOLUTIONS AG	DE	Mr Ralf ABRAHAM

741659 (2017)	**ESTIVAL** *ESTImation of coal VALue-in-use in terms of CSR under different carbonization conditions*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,724,560.50	Start Date	01/07/2017
	EU Contribution	€ 1,034,736.30	End date	30/06/2020

Abstract

In addition to the usual characteristics of coals, Coke Strength after Reaction values (CSR) are more and more used in coal trade. The stated values are generally far from the industrial reality and often overestimated through favourable carbonization conditions. Laboratories worldwide use their own devised methodology for coke making, which is cause for concern since CSR results cannot be compared without difficulty. So there is a need to better understand the influence of coal carbonization conditions on coke CSR in order to be competitive in the coal market by means of correct coal value-in-use determination.

Coordinator	*Country*	*Scientific person in charge*
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710078 (2016)	**INNOWATREAT** *The innovative system for coke oven wastewater treatment and water recovery with the use of clean technologies*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 2,166,728.90	Start Date	01/07/2016
	EU Contribution	€ 1,300,036.84	End date	30/06/2019

Abstract

Cokemaking industry generates huge amounts of wastewater contaminated with a range of contaminants. Those streams contain substances, which are of classified as priority substance and priority hazardous substances due to European Water Framework Directive. Hence, their proper treatment and management is crucial for protection of aquatic systems, to which they are usually discharged. The main aim of the INNOWATREAT project is the development of the complex system for coke oven wastewater characteristics, treatment and utilization. The project programme includes testing of analytical procedures, adaptation and development of a range of wastewater treatment methods and investigations on water recovery by means of clean technologies. Moreover, computational approach of the elaborated technological solutions as well as economic and environmental feasibility studies are involved to the project objectives. Project consortium comprises of partners, who possess wide experience and knowledge on the field of cokemaking, coke oven wastewater characteristics and wastewater treatment and utilization methods. The main principals of the project are elaborated on the basis of multiple consulting with cokemakers and coke oven wastewater treatment plants operators in order to approach the issue with the highest attention and further implementation to the industrial systems.

Coordinator	*Country*	*Scientific person in charge*
INSTYTUT CHEMICZNEJ PRZEROBKI WEGLA	PL	Dr Anna KWIECIŃSKA
Partners		
CESKE VYSOKE UCENI TECHNICKE V PRAZE	CZ	Prof. Pavel DITL
AKVOLUTION GMBH	DE	Dr Matan BEERY
POLITECHNIKA WROCLAWSKA	PL	Prof. Andrzej NOWORYTA
POLITECHNIKA KRAKOWSKA	PL	Prof. Michał DYLĄG

709741 (2016)	**PROMOTEE** *Functional porous carbon materials derived from coal tar for energy and environmental applications*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,208,607.30	Start Date	01/10/2016
	EU Contribution	€ 1,325,164.38	End date	31/03/2020

Abstract

In order to increase the viability and competitiveness of European coal tar distillation plants, it is essential that optimum use of coal-derived liquids is made. Attaining this goal implies finding ways for the revalorization of liquids that are currently of low value and are not used in high-end applications (e.g., creosotes, phenolic oils and rejects obtained from the purification of high value coal tar fractions).

To address this issue, PROMOTEE has been created as a complex European project aiming at the development of novel porous carbon materials for energy and environmental applications using low value coal-derived liquids as the carbon precursors. The following specific objetives are sought after:

• To maximize the use of coal-derived liquids as novel carbon material precursors with a view to their revalorization;

• To synthesize ordered mesoporous carbons via hard-templating from creosotes and rejects;

• To produce new carbon gels via sol-gel routes from phenolic oils;

• To understand the effect of coal tar-derived liquids on the characteristics of the carbon materials;

• To evaluate the performance of these new carbon materials in energy and environmental applications;

• To assess the feasibility of industrial applications of the porous carbons and compare them with commercial carbons.

PROMOTEE incorporates industrial participation from both ends of the value chain (coal tar distillers and porous carbon manufacturers) to ensure that a significant impact of the project results on relevant stakeholders is attained.

Coordinator	*Country*	*Scientific person in charge*
AGENCIA ESTATAL CONSEJO SUPERIOR DEINVESTIGACIONES CIENTIFICAS	ES	Dr Juan Ignacio PAREDES

Partners		
UNIVERSITE DE LIEGE	BE	Dr Nathalie JOB
SILCARBON AKTIVKOHLE GMBH	DE	Dr Robert SMIT
BILBAINA DE ALQUITRANES SOCIEDAD ANONIMA	ES	Dr Enrique ESPARZA
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	FR	Dr Vanessa FIERRO
HERIOT-WATT UNIVERSITY	UK	Prof. Mercedes MAROTO-VALER

709493 (2016)	**DIRPRIMCOAL** *Direct Primary Coal Liquefaction via an Innovative Co-processing Approach with Waste and Petroleum Feedstocks*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 3,435,163.55	Start Date	01/07/2016
	EU Contribution	€ 2,061,098.13	End date	30/06/2019

Abstract

The main goal of the proposed research is to improve the viability and environmental performance of direct coal liquefaction (DCL) by providing a framework where it can develop in the EU without the need for extremely large-scale plant and with a focus on low-rank and perhydrous coals that provide the highest conversions at lowest cost. The research will establish a distributed approach to DCL that will enable it to be introduced as a technology suitable for co-processing a variety of wastes, including plastics, tyres and bio-wastes which can thermally decompose into effective solvents.

The two primary conversion routes will be investigated to optimise the use of wastes and co-feeds are:

• The use of solvents with some H-donor properties without hydrogen pressure;

• The use of waste and non-donor solvents with added hydrogen pressure with means for in-situ generation being investigated.

The primary liquefaction products will then be assessed for co-processing with petroleum feedstocks in existing refinery facilities with a test programme involving both catalytic cracking and hydrocracking with hydro-isomerisation of the naphtha produced from both processes. The research will identify and implement the improvements that need to be made to existing catalysts to optimally co-processing heavy coal liquids and petroleum fractions. This flexible approach will enable plants to operate on relatively small scales (ca. < 200 tonne p.d.) to provide intermediate heavy oil products suitable for further processing in existing oil refinery operations, as well as minimising CO2 emissions from co-processing a range of bio-wastes. The results of the research programme will provide the basis for designing two specific DCL modules as the basis for pilot-scale operation, based on the use of solvents with hydrogen-donor capabilities and non-donor solvents with added hydrogen pressure.

Coordinator	*Country*	*Scientific person in charge*
THE UNIVERSITY OF NOTTINGHAM	UK	Prof. Colin SNAPE

Partners		
VYZKUMNY USTAV PRO HNEDE UHLI AS	CZ	Dr Petr SVOBODA
UNIPETROL VYZKUMNE VZDELAVACI CENTRUM AS	CZ	Mr Radek CERNY
ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	EL	Dr Angelos LAPPAS
MOTOR OIL (HELLAS) DIILISTIRIA KORINTHOU AE	EL	Mrs Maria EMMANOUILIDOU
SOLUCIONES CATALITICAS IBERCAT SL	ES	Dr Francisco VILA ORTIS
CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT	ES	Dr Jose Maria SANCHEZ
LABORATORIO NACIONAL DE ENERGIA E GEOLOGIA I.P.	PT	Dr Filomena PINTO
ESTRA ENERGY TECHNOLOGY STRATEGIES LTD	UK	Dr Flavio FRANCO
UNIVERSITY OF ULSTER	UK	Dr Ye HUANG

Technical Group Coal 3

Coal combustion, clean and efficient coal technologies, CO2 capture

The scope TGC3 includes:

- Clean and efficient coal combustion
- Integration of the coal chain, from mining to the final product (electricity, heat, hydrogen, coke)
- Carbon management strategy
- Reduction of the environmental impact of installations using EU coal, lignite and oil shale
- Reduction in emissions from coal utilization
- Clean and efficient coal technologies
- CO2 capture
- Co-combustion of coal with solid waste or biomass
- Zero emissions and high efficient power generation
- CHP from coal
- Coal contribution to global energy security

794369 (2018)	**COALTECH2051** *An RFCS Accompanying Measure on European coal research in light of EU policy objectives to 2050 and future global trends in coal use*			
Info	Type of Project	Accompanying Measures	Duration (months)	24
	Total Budget	€ 365,659.50	Start Date	01/07/2018
	EU Contribution	€ 365,659.50	End date	30/06/2020

Abstract

The “energy transition” gives new challenges, but also new opportunities, for exploiting coal in the EU – with lower CO2 emissions.

This Accompanying Measure proposal responds to current EU policy imperatives. It will promote the knowledge gained from the RFCS Research Programme and share experiences with the international research community.

The aim is to develop, with stakeholders, a strategic research agenda for the Programme that is aligned with the EU’s Energy Union vision for 2050 and to establish a European Network of Clean Coal Technologists that complements the European Commission’s targeted platforms to support the energy transition in the coal regions.

Coordinator	*Country*	*Scientific person in charge*
IEA COAL RESEARCH LIMITED	UK	Dr Andrew MINCHENER

Partners

ASSOCIATION EUROPEENNE DU CHARBON ET DU LIGNITE	BE	Brian RICKETTS
GLOWNY INSTYTUT GORNICTWA	PL	Dr Aleksandra KOTERAS
ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	EL	Dr Nikolaos KOUKOUZAS

TGC3 : Coal combustion, clean and efficient coal technologies, CO2 capture

754060 (2017)	**COALBYPRO** *Innovative management of Coal by-Products leading also to CO2 emissions reduction*			
Info	Type of Project	Research	Duration (months)	39
	Total Budget	€ 1,789,858.60	Start Date	01/07/2017
	EU Contribution	€ 1,073,915.16	End date	30/09/2020

Abstract

Coal ash is disposed of or used in different ways depending on: the type of by-product, the processes at the plant and the regulations the power plant has to follow. Some power plants may dispose of it in surface impoundments or in landfills.

Others may discharge it into a nearby waterway under the plant's water discharge permit. Coal ash may also be recycled into products like concrete or wallboard. Coal ash contains contaminants that without proper management, they can pollute waterways, ground water, drinking water, and the air. Therefore, the disposal of the by-products has become an important issue. Considering that coal combustion emits a great amount of CO2, the produced fly ash can be used as a material for on-site CO2 capture and storage (CCS).

In this proposal, a laboratory scale study of mineral carbonation of coal fly ash for CO2 sequestration will be made. The capture of CO2 in the zeolites will also be studied. The two methods (CO2 capture in fly ash and zeolites) will be compared and their carbonated products will be examined in regards to their leachability. The ultimate goal is to be used for the environmental management of coal mines after closure.

Coordinator	*Country*	*Scientific person in charge*
ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	EL	Dr Nikos KOUKOUZAS
Partners		
VYSOKA SKOLA CHEMICKO-TECHNOLOGICKA V PRAZE	CZ	Dr Marek STAF
VYZKUMNY USTAV PRO HNEDE UHLI AS	CZ	Dr Petr SVOBODA
UJV REZ, A.S.	CZ	Mr Jiri STEFANICA
TECHNISCHE UNIVERSITAET BERGAKADEMIE FREIBERG	DE	Prof. Bernd MEYER
GLOWNY INSTYTUT GORNICTWA	PL	Prof. Barbara BIALECKA

TGC3 : Coal combustion, clean and efficient coal technologies, CO2 capture

754032 (2017)	**FLEX FLORES** *Flexible operation of FB plants co-Firing low rank coal with renewable fuels compensating vRES*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,863,691.15	Start Date	01/07/2017
	EU Contribution	€ 1,718,214.69	End date	31/12/2020

Abstract

Main scope of the proposal is the development of new and innovative retrofitting concepts for Circulating Fluidized Beds (CFB) utilizing low rank fuels, allowing them to be more flexible. The proposed concepts are intended mainly for currently operating, not excluding new designed, CFB PPs expected to operate at faster ramp-up rates with an associated low environmental footprint (promotion of co-firing concepts). To meet these objectives, the following actions are foreseen:

• Evaluation and comparison of currently applicable biomass, including crushing and feeding systems, followed by the introduction of a new experimental methodology for the measurement of fuels flowability;

• Materials evaluation for the CFBs refractory lines and the introduction and testing of new super-alloys capable of withstanding the new-demanding flexible at both lab and pilot scale environments and in one industrial site;

• Definition of operational updates, mainly conducted by one of the very well established European CFB manufacturer. Towards this objective, specifications for the basic mechanical components will be derived, while new schemes of operation will be conceptually designed and evaluated in a dynamic mode (e.g. modular heat extraction from boiler, reheat cycles and thermal energy storage) numerically;

• Long-term combustion tests of Greek and German lignite with biomass as co-firing and/or ignition fuel at lab, pilot and industrial scale facilities for different thermal loads;

• CFD and dynamic process simulations for an associate partner utility reference CFB plant;

• Techno-economic and environmental assessment of the proposed concepts when compared to those already done for PFs, followed by business and exploitation plans.

Coordinator	*Country*	*Scientific person in charge*
CENTRO SVILUPPO MATERIALI SPA	IT	Dr Umberto MARTINI
Partners		
AMEC FOSTER WHEELER ENERGIA OY	FI	Dr Jenö KOVÁCS
ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	EL	Dr Nikos NIKOLOPOULOS
TECHNISCHE UNIVERSITAT DARMSTADT	DE	Dr Jochen STRÖHLE
TECKNOLOGIAN TUTKIMUSKESKUS VTT OY	FI	Mrs Satu TUURNA
PUBLIC POWER CORPORATION S.A.	EL	Mr Papapavlou CHARALAMPOS

709976 (2016)	NIBALO725 *Ni-based alloys for Operation of 725 °C Power Plants*			
Info	Type of Project	Research	Duration (months)	54
	Total Budget	€ 2,893,589.00	Start Date	01/09/2016
	EU Contribution	€ 1,736,153.40	End date	28/02/2021

Abstract

In order to further increase the efficiency of coal fired power plants and reduce emissions higher steam temperatures and materials with improved mechanical properties under high temperatures are required.

Aim of the project is to implement Ni-based alloys in coal fired power plants in order to obtain maximum steam temperatures of > 700 °C in the steam cycle. A numerical assessment of stresses and material investigations of small and large scale specimen will be performed. A field test in a 725 °C test rig (GKM Project HWT III) will demonstrate the feasibility of the implementation of these materials.

Coordinator	*Country*	*Scientific person in charge*
UNIVERSITAET STUTTGART	DE	Dr Johannes SCHLEYER
Partners		
GE BOILER DEUTSCHLAND GMBH	DE	Mr Frank KLUGER
GROSSKRAFTWERK MANNHEIM AG	DE	Mr Klaus METZGER
ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	EL	Dr Nikos NIKOLOPOULOS
CENTRO SVILUPPO MATERIALI SPA	IT	Ms Arianna GOTTI
SPECIAL METALS WIGGIN LIMITED	UK	Dr Steve MCCOY

709954 (2016)	DP700-PHASE 1 *Preparation for Commercial Demonstration Plant for 700 °C Operation*			
Info	Type of Project	Accompanying Measures	Duration (months)	21
	Total Budget	€ 2,269,929.95	Start Date	01/07/2016
	EU Contribution	€ 1,361,957.97	End date	31/03/2018

Abstract

PF-fired hyper super critical (HSC), also known as advanced ultra super critical (A-USC), power plant is able to reach 50-55% net (LHV) efficiency thereby decreasing the specific power plant CO2 emissions; however HSC plant development entails large technical and commercial risk. This project aims to bring together EU knowledge and experience on high temperature boiler materials and components suitable for HSC operation, thereby reducing these risks.

This consolidation of knowledge will lead into the design, build and operation of a full scale 1000MW demonstration plant, under a follow on project, allowing EU companies to have a head start in these new markets.

Phase 1 is the knowledge capture phase with Phase 2 being the design build and operation of a full scale 1000MW demonstration plant. Phase 2 will be subject of a follow on project from this Phase 1 project.

Coordinator	*Country*	*Scientific person in charge*
DOOSAN BABCOCK LIMITED	UK	Dr Peter BARNARD
Partners		
TECHNISCHE UNIVERSITAET GRAZ	AT	Prof. Bernhard SONDEREGGER
TECHNISCHE UNIVERSITAT DARMSTADT	DE	Dr Alfred SCHOLZ
TECHNISCHE UNIVERSITAET CHEMNITZ	DE	Prof. Peter MAYR
TEKNOLOGIAN TUTKIMUSKESKUS VTT OY	FI	Dr Maria OKSA
CENTRO SVILUPPO MATERIALI SPA	IT	Mr Sandro NOTARGIACOMO
DEKRA CERTIFICATION BV	NL	Mr Arthur STAM
CRANFIELD UNIVERSITY	UK	Prof. John OAKEY

709629 (2016)	FLEXICAL *Development of flexible coal power plants with CO2 capture by Calcium Looping*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 2,452,365.95	Start Date	01/07/2016
	EU Contribution	€ 1,471,419.57	End date	30/06/2019

Abstract

Coal power plants undergo flexible operation with load changes and partial load operation due to the increasing amount of renewable energy. The main objective of this proposal is to evaluate and enhance the flexibility of power plants with CO2 capture by post combustion Calcium Looping. Two novel process options (a highly load flexible plant concept and a system using an energy storage using CaO/CaCO3) are experimentally investigated at pilot scale to evaluate operational limits. Data on load changes and energy storage are used to validate dynamic system and reactor models in order to scale up efficient and flexible Calcium Looping systems.

Coordinator	*Country*	*Scientific person in charge*
AGENCIA ESTATAL CONSEJO SUPERIOR DEINVESTIGACIONES CIENTIFICAS	ES	Dr Borja ARIAS

Partners		
UNIVERSITAET STUTTGART	DE	Mr Heiko DIETER
HULLERAS DEL NORTE SA	ES	Mr Luis DIAZ
POLITECNICO DI MILANO	IT	Dr Matteo ROMANO
EDF POLSKA SPOLKA AKCYJNA	PL	Mr Piotr CZUPRYNSKI

Technical Group Steel 1

Ore agglomeration and Ironmaking

The scope TGS1 includes:

- Ore agglomeration, sintering and pelletising processes
- New and improved iron-ore reduction processes (including DRI & C-free reduction)
- Ironmaking processes and operations including slag treatment
- Standardisation of testing and evaluation methods
- Maintenance and reliability of production lines
- Reduction of emissions, energy consumption and improvement of the environmental impact
- Instrumentation, modelling and control of processes

847332 (2019)	**Rihanne** *Reliable Blast Furnace Hearth Management*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 3,938,822.95	Start Date	01/06/2019
	EU Contribution	€ 2,363,293.77	End date	30/11/2022

Abstract

The “Rihanne” project focusses on a more reliable blast furnace (BF) hearth management in order to improve the productivity, process stability as well as material and energy efficiency. This is enabled by longer periods between the intermediate hearth repairs, prolonged hearth life time, lower need for extra coke to prevent metal break-out and less deviations from the optimal tapping praxis.

Measurements from innovative on-line devices and comprehensive novel models of lining wear, hearth flow, liquid levels and taphole flow will be integrated via Big Data Methodology to yield straight-forward operator guidelines for smooth and reliable BF hearth operation

The proposed work in Rihanne will be carried out by a consortium of 10 partners from steel making companies, research institutes and universities. This guarantees both the quality of the research and the practical implementation in industry. The research institutes and universities will work in close cooperation with the industrial sites for efficient transfer of data and process knowledge and for implementing the developed tools.

All tasks are divided between the partners in a way to avoid duplication of work, but to benefit from complementary skills and resources. The developed tools will be implemented at one or several blast furnaces. Application of multiple blast furnaces is required for ensuring that the current state-of-art is utilised and that the methods are generally applicable, but also to compare different technologies to determine the best practice.

Coordinator	*Country*	*Scientific person in charge*
TATA STEEL NEDERLAND TECHNOLOGY BV	NL	Gerard LOUWERSE
Partners		
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Yalcin KAYMAK
AKTIEN-GESELLSCHAFT DER DILLINGER HÜTTENWERKE	DE	Dr Ing. Rongshan LIN
ABO AKADEMI	FI	Prof. Henrik SAXEN
RUHR-UNIVERSITAET BOCHUM	DE	Dr Siegmar WIRTZ
ARCELORMITTAL EISENHÜTTENTSTADT GMBH	DE	Dr Jörg MERNITZ
SWEREA MEFOS AB	SE	Prof. Lena SUNDQVIST
UNIVERSITEIT VAN AMSTERDAM	NL	Rudolf SPRIK
ARCELORMITTAL MAIZIERES RESEARCH SA	FR	Sophie CLAIRAY
SSAB EMEA AB	SE	Bo SUNDELIN

847322 (2019)	TACOS *Towards A zero CO2 Sintering*			
Info	Type of Project	Research	Duration (months)	43
	Total Budget	€ 3,457,004.45	Start Date	01/06/2019
	EU Contribution	€ 2,074,202.67	End date	31/12/2022

Abstract

In order to allow steelmakers to comply with ever stringent environmental constraints, TACOS project aims at evaluating solutions bringing significant decrease of CO2 with consequently decrease of others main pollutants (a.o. NOx, SOx, VOC's, dioxins and dust emissions) :

- High bed heights operation for improved process internal thermal efficiency;
- Waste gas recirculation (selective and non-selective);
- Use of alternative heat inputs :

  (i) Alternative solid fuels (such as biomass) with or without pre-processings (gasification, hydrothermal conversion, torrefaction and pyrolysis);

  (ii) Combustible gases for injection at strand surface in combination with Waste Gas Recirculation to take profit of the recirculation hood;

  (iii) High temperature fumes produced in an external combustion chamber. It is a CRM breakthrough technique which, combined with WGR (VeLoSint original lay-out) could reach theoretically up to 50% solid fuel saving.

For evaluation of the impact of these solutions on sintering process performances and emissions, tasks consists in modelling work (mathematical model, DEM), lab trials, sinter pot trials and industrial measuring campaigns and trials.

These solutions have significant impacts on Blast Furnace process, so a special focus is also placed on their impact on sinter quality (especially on its vertical segregation) and BF performances. For that purpose a a very wide set of complementary tools not use in usual industrial practise will be used and Multi-Point Vertical Probing's will be carried out.

There are 5 partners participating to the project : CRM (BE - coordinator) ,ArcelorMittal Maizières (FR), Tata Steel IJmuiden (NL), RINA-CSM (IT) and Arvedi Siderurgica Triestina (IT).

Coordinator	*Country*	*Scientific person in charge*
CENTRE DE RECHERCHES METALLURGIQUES ASBL	BE	Frédéric VAN LOO
Partners		
ARCELORMITTAL MAIZIERES RESEARCH SA	FR	Ana-Maria IOSIF
TATA STEEL NEDERLAND TECHNOLOGY BV	NL	Maria MARTINEZ_PACHECO
RINA CONSULTING - CENTRO SVILUPPO MATERIALI SPA	IT	Filippo CIRILLI
ACCIAIERIA ARVEDI SPA	IT	Vincenzo DIMASTROMATTEO

847319 (2019)	SinByOSe *SINtering with high BY-products recycling rate and environmental Optimization by SElective preparation*			
Info	Type of Project	Research	Duration (months)	43
	Total Budget	€ 1,928,314.40	Start Date	01/06/2019
	EU Contribution	€ 1,156,988.64	End date	31/12/2022

Abstract

This project proposes and tests new technologies/methods to counterbalance the factors limiting their recycling at sinter plant :

- content in undesirable chemical elements (Cu, Zn, alkalis, S, etc.);

- negative impact on pollutants emissions at sinter plant (dust, SOx, dioxins, etc.);

- fine size distribution and thus mostly negative impact on productivity.

In this context, the objective of this project is to use selective granulation and pre-processing techniques to achieve the desired synergetic effects (phase formation, pseudo nuclei, reduction of dust and pollutants, etc) or to remove the detrimental components before integration in sinter preparation and to assess and understand their impacts on the sintering process.

Recently developed concept of stiff vacuum extrusion (SVE) can help the recycling of by-products in the sinter plant to prevent or reduce diffuse dust emissions by agglomerating fine materials and to lower the hydrocarbon content of the sinter feed

Stiff vacuum extrusion will be provide metallurgical properties of the BREX which meet the requirements of the sinter process with a lower level of the binder content compared with traditional briquetting technologies. Nevertheless this technique is not yet applied for the recycling of by-products at sinter plant. For this reason the new proposal aims to prove the recyclability of reverts and the use of lower grade iron ores at the sinter plant by reducing/avoiding their negative effects on the sintering process by using them.

The foreseeable benefits of this project are the following:

• increased competitiveness of European Steel Producers, by allowing a better use low quality raw materials and by-product recyclability;

• cost effective solutions for raw materials flexibility and productivity that can be easily selected through the use of the developed methodology within this project;

• improved resources efficiency by allowing a wider range of materials as input for the sinter mix

Coordinator	*Country*	*Scientific person in charge*
CENTRE DE RECHERCHES METALLURGIQUES ASBL	BE	Rafael CONTRERAS
Partners		
ARCELORMITTAL MAIZIERES RESEARCH SA	FR	Ana-Maria IOSIF
TATA STEEL NEDERLAND TECHNOLOGY BV	NL	Maria MARTINEZ_PACHECO

847293 (2019)	**SafeDewPoint** *Acid dew point and corrosion sensors for dynamic waste heat recovery from steel mill flue gases*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,365,558.00	Start Date	01/07/2019
	EU Contribution	€ 819,334.80	End date	31/12/2022

Abstract

Steel mill gases such as blast furnace gas, coke oven gas and basic oxygen furnace gas are used in coke plant, sinter plant, hot blast stoves, power plant and reheating furnaces. During the operation, fuel gas combinations can be changed every 30-60 minutes and the resulting sulphuric acid dew point temperature in the flue gas may vary between 80°C and 130°C. The flue gas temperature is usually fixed 10-20 K above the calculated maximal acid dew point (ADP) temperature to prevent corrosion damage. Thus valuable energy is lost in the periods with the lower ADP temperature. There is a potential to recover it and reuse for combustion air preheating.

The main objective of the proposal is to recover waste heat from combustion of steel mill flue gases by dynamic adjustment of the flue gas temperature above the acid dew point. For this inline monitoring of ADP temperature is required. In order to prevent damage to the heat exchangers and chimneys in case of measurement failure, inline corrosion monitoring is needed. Neither ADP nor corrosion rate monitoring has been applied in steel mill flue gases before.

In this project we will develop a novel inline ADP sensor with the reaction time of < 3 min. Furthermore, corrosion probes based on the measurement of resistance of a corroding wire will be adapted to steel mill flue gases to reach reaction time < 5 min and lifetime ≥ 7 days. Dynamic waste heat recovery concepts on basis of these measurement signals will be developed and validated in operational tests.

This innovation will enable improvement of energy efficiency of hot blast stoves, power plants and reheating furnaces by dynamic recovery of up to 20% waste heat from the flue gas using existing facilities. For the European steel industry it equals to savings of 3568 GWh/y or 107 million €/y and emission reduction of 720 ktCO2/y. It will support competitiveness and sustainability of European integrated steel plants.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Pavel IVASHECHKIN
Partners		
SALZGITTER FLACHSTAHL GMBH	DE	Thomas LAPP
AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	ES	Daniel DE LA FUENTE GARCÍA
ARCELORMITTAL ESPANA SA	ES	Juan Jose ARRIBAS RAMIREZ

847285 (2019)	MinSiDeg *Minimise sinter degradation between sinter plant and blast furnace exploiting embedded real-time analytics*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,646,869.60	Start Date	01/07/2019
	EU Contribution	€ 1,588,121.76	End date	31/12/2022

Abstract

High quality sinter produced with low costs and emissions is important for iron production. Stresses during transport generate return fines that must be processed again. Conventional sinter quality monitoring is slow and expensive.

In MinSiDeg, several innovative on-line methods for continuous quality monitoring will be established, and combined and exploited within new embedded real-time tools for machine supported quality control. The degradation during transport will be minimised by new transfer systems.

As a result, the losses due to transport will be minimised and high and stable quality sinter will be produced with low costs and energy consumption.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr Thorsten HAUCK

Partners		
THYSSENKRUPP STEEL EUROPE AG	DE	Stefan WIENSTRÖER
DK RECYCLING UND ROHEISEN GMBH	DE	Carsten HILLMANN
VOESTALPINE STAHL DONAWITZ GMBH	AT	Elman SCHUSTER
MONTANUNIVERSITAET LEOBEN	AT	Dr Michael PRENNER
K1-MET GMBH	AT	Bernhard KÖNIG

800771 (2018)	**SPARERIB** *Semi-coke Particles Evolution and Raceway Instrumentation at the Blast Furnace*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,782,883.65	Start Date	01/12/2018
	EU Contribution	€ 1,669,730.19	End date	30/06/2022

Abstract

Semi-coke particles Evolution and Raceway Instrumentation at Blast Furnace. Coal behaviour in the shaft is unknown but highly important because of its influence on permeability, melting and smelting behaviour and therefore productivity.

Sensors and instrumentation techniques need to be developed and used in raceway/shaft models for understanding.

There have been numerous investigations on coal conversion in the raceway, but much less about the relationship between raceway and consequences on the shaft performance. There should be more measurements available: Shaft information can be gained from AreclorMittal's vertical probings at the EBF and industrial Hearth/raceway/dripping zone carbon/char built up from EBF and thyssenkrupp Steel core drills Raceway model development with ArcelorMittal, Tata Steel and Mefos

Coordinator	*Country*	*Scientific person in charge*
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800643 (2018)	LOWCARBONFUTURE *Exploitation of projects for Low-Carbon future steel industry*			
Info	Type of Project	Accompanying Measures	Duration (months)	24
	Total Budget	€ 1,132,519.45	Start Date	01/04/2018
	EU Contribution	€ 1,132,519.45	End date	31/03/2020

Abstract

The Accompanying Measure activity "LowCarbonFuture" summarizes, evaluates and promotes research projects and knowledge dealing with CO2 mitigation in iron and steelmaking. Current pan-European research is focused on the three pathways Carbon Direct Avoidance (CDA), Process Integration (PI) and Carbon Capture, Storage and Usage (CCU).

"LowCarbonFuture" will generate a roadmap stating research needs, requirements and boundary conditions for breakthrough technologies and a new CO2 lean steel production to guide the EU steel industry towards the world's climateagreeements and the EU climate goals, e.g. by implementing the key findings in the strategic research agenda of the European Steel Technology Platform (ESTEP). Furthermore, "LowCarbonFuture" will contribute to an update of the steel roadmap for a low carbon Europe 2050 and the current Big-Scale initiative of EUROFER.

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754200 (2017)	**REMOCOAL** *Real Time Monitoring of coal composition in closed systems for fast process control*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,787,968.20	Start Date	01/01/2018
	EU Contribution	€ 1,072,780.92	End date	30/06/2021

Abstract

To optimize cost and process of the hot metal production real time information as well as fast data processing of the composition/quality of the raw and burden materials charged are necessary. With this knowledge the blast furnace (BF) can be better adjusted to optimum conditions in terms of reducing agent rate as main driver of operating costs. For competitive hot metal production high pulverised coal injection rates under minimized low coke rate conditions are aimed. Actual there is a lack of real time analyses techniques as well as data evaluation to obtain secure short time information of the actual properties of injected coal blend in the blast furnace. The real time analysis and data evaluation of the injected pulverised coal blend before injection in the BF gives the opportunity to detect unexpected or prompt deviation in coal blend composition and enables an optimized total BF fuel rate, a reduction of fuel cost of hot metal production and subsequently decreasing CO2 emission. A solution called Neutron Probe (NP) can be delivered by adapting an in situ analyzing technology based on Pulsed Fast and Thermal Neutron Activation. By applying this technology on a basis of the design of an existing downhole tool used for exploration and the modification of the real time data evaluation software an innovative approach for prompt analysis of the pulverised coal blend can be provided. The main objective of this project is to realise the mentioned adaption and to demonstrate the high benefit for industrial application by better adjusting/controlling the pulverised coal injection rate and improve the production process both from an economical and ecological point of view.

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754055 (2017)	**DUMICO** *Dust minimisation and control at the blast furnace*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 4,411,209.50	Start Date	01/07/2017
	EU Contribution	€ 2,646,725.70	End date	31/12/2020

Abstract

The blast furnace operators continuously face new challenges to improve process efficiency and increase PCI rates while using raw materials of fluctuating and lower quality. BF dust is generated mechanically and chemically, e.g. from raw material handling, charging and disintegration during burden descent as well as during combustion and reduction. Of specific importance is the source of C, from coke or coal, as well from which region in the BF C and Fe origin, these parameters could e.g. indicate low efficiency of injected coal and unfavourable gas distribution. By applying knowledge of the relationships between dust characteristics, descibed by an innovative BF dust fingerprint approach, and blast furnace stability combined with new and more rapid dust characterisation techniques, the blast furnace process control can be improved.

More stable operation and reduction in dust will reduce energy consumption, CO2 emissions, reduce losses of C and Fe units in dust and improve flexibility in raw materials selection.

The objectives of the project are to improve blast furnace stability and reduce BF dust generation by:

• Introducing innovative off-line/in-line/on-line monitoring allowing rapid identification of dust origin and cause;

• Establishing the link between operational conditions including charging and injection on dust amount and characteristics, including fundamental mechanisms of dust formation;

• Developing and validating operational control strategies for disturbance mitigation and dust control.

Developed methods and strategies are due to the wide approach after required adaptation transferable to other BFs in Europe.

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749809 (2017)	ACTISLAG *New Activation Routes for Early Strength Development of Granulated Blast Furnace Slag*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 2,880,450.75	Start Date	01/07/2017
	EU Contribution	€ 1,721,070.45	End date	30/06/2021

Abstract

ActiSlag global objective is to define efficient activation routes based on a two-step process to produce a "second generation GGBS" (Ground Granulated Blast Furnace Slag) which will be assessed in formulations for concrete or dry-mix mortar. The target is to reach 80% GGBS addition in cement while keeping the specifications of CEM II (20% of classical GGBS). Such products will be more than welcome by construction material players having to combine improved environmental footprint, competitive costs and better quality concretes and mortars.

After implementation of project results and opening of new markets and products, steel producers will thus become more independent from the main GBS customers (cement makers). Prices will not be pressured anymore by cement makers and marketing diversification will become more flexible. Thus, ActiSlag will strengthen the competitiveness of EU steelmaking industry by reducing the market pressure and by increasing the value of this ironmaking by-product material.

This study will be supported by fundamental investigations to further understand slag multi-scale structural organization, reactivity and behavior during early strength development which remains problematic with standard GGBS. We aim to overcome this drawback by finding the best combination of upstream (slag chemical composition, structural organization) and downstream modification (chemical activation system, curing temperature, GGBS fineness) routes.

The key findings will enable to validate the concepts and define the scope of a pilot project. The gained experience also allows improving the quality of existing slag based products.

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709816 (2016)	**STACKMONITOR** *Online Blast Furnace Stack Status Monitoring*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,813,216.89	Start Date	01/07/2016
	EU Contribution	€ 1,087,930.13	End date	31/12/2019

Abstract

The decreasing and fluctuating quality of raw materials and the aim to maximise PCI and decrease coke rates force European blast furnaces to operate closer to operational limits. At the same time productivity and efficiency must be raised to survive in global competition. High stack permeability and stable gas distribution become most important.

However, the analysis and control of the stack processes is difficult: Hundreds of measurement values are available nowadays, but they are distributed around the blast furnace and just show indirect “fingerprints" from outside instead of the real internal process information needed (e.g. position of process zones).

New measurement techniques deliver very fast, full 2D information of the top (acoustical gas temperature, burden profile radar), but they are not sufficiently validated and not investigated by research. Instead, the operators are overcharged with even more separate measurement data. No overall process information is available to decide about control actions.

The main idea of StackMonitor is to establish a new hybrid approach of data processing which couples statistical and kinetic process models with several online measurements. This new approach will provide industrial benefit even beyond iron making, since several industrial processes suffer from the mismatch between the vast amount of measurement data and its poor exploitation.

To achieve this aim, StackMonitor establishes the innovative coupled CFD-DEM simulation to support online process monitoring and control, validated with comprehensive high temperature lab trials. Thus, for the first time the interrelations between solids and gas in the upper stack can realistically be described: The percolation, mixing and degradation of material during descent and the corresponding layer permeability.

Online tools for process monitoring, analysis and control are developed and validated in collaboration with three industry partners covering different operational conditions.

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709424 (2016)	**DEPREX** *Early detection and prevention of tuyere damaging conditions for extension of tuyere life time at blast furnaces*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,080,690.75	Start Date	01/07/2016
	EU Contribution	€ 1,248,414.45	End date	31/12/2019

Abstract

The damage of a blast furnace tuyere is an incident, which happens in average 30 up to 120 times a year at normal blast furnace operation. Each single tuyere damage causes a stoppage of the whole blast furnace of about two hours, in some case up to eight hours. Although, the hot blast is stopped and no hot metal is produced, coke is consumed and additional coke has to be charged. Energy is spent without any benefit. In order to reduce the unplanned BF stoppages due to tuyere damages the objectives of the proposed RFCS project are:

• To generate advanced knowledge about tuyere damage mechanisms by analysis of tuyere material properties during tuyere life time (chronology of degradation);

• To develop advanced operational tuyere monitoring systems for monitoring of BF tuyeres during operation as industrial standard application for all tuyeres;

• To develop a BF tuyere damage risk assessment system for early detection of BF tuyere damaging conditions;

• To define practical countermeasures for BF operators to go against tuyere damaging conditions and to extend BF tuyere life time.

The decrease of the number of unplanned blast furnace stoppages due to tuyere damages enables a significant reduction of energy consumption and costs in blast furnace operation. Furthermore, it decreases the risk for the occupational health due to e. g. contact of BF staff with toxic CO gas and hot metal during tuyere exchange. Therefore, each single tuyere damage, which can be prevented, helps to increase safety of BF staff. Consequently, the proposed project contributes to the RFCS programme objectives (Council Decision 2008/376/EC):

1. New and improved steelmaking and finishing techniques

• Process instrumentation, control and automation

• Maintenance and reliability of production lines

2. Conservation of resources and improvement of working conditions

• Occupational health and safety

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847256 (2019) HydroPick

Analysis and control of hydrogen content during steelmaking

Info				
	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,533,750.75	Start Date	01/06/2019
	EU Contribution	€ 920,250.45	End date	30/11/2022

Abstract

The objective of the research project is to enhance the control of the hydrogen content during the different steps of liquid steelmaking, to reliably achieve low target hydrogen contents in the final product under reduced energy and resource consumption.

For this purpose, detailed investigations on hydrogen pick-up and removal throughout the key processes of liquid steelmaking, i.e. secondary metallurgy and continuous casting, will be performed. They will be accompanied by dedicated measurement campaigns of the hydrogen content dissolved in liquid steel and the transfer into the as cast material based on novel in-situ measurement technologies. The results of these investigations will be used to derive correlations of hydrogen content evolution with the process conditions during the different treatment steps with focus on ladle treatment as well as casting via the tundish. On this basis dynamic process models for the relevant mechanisms and metallurgical reactions of hydrogen pick-up and removal will be set up. The models will be used in combination with optimised in situ measurements to monitor and predict the evolution of the hydrogen content dissolved in liquid steel throughout the complete process chain.

A combination of model-based advisory system, in situ measurement strategies and dynamic control of process parameters will be developed to apply optimal operational practices for the quality-dependent demands, for a reliable achievement of the target hydrogen content in the final product under minimum energy and resource consumption. The complete system will be tested and validated under industrial conditions in plant trials and established for operational practice for the production of different steel grade groups.

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Technical Group Steel 2

Steelmaking processes

The scope TGS2 includes:

- Electric arc furnace processes
- Physico-chemical metallurgy of liquid steel and slag
- Recycling of steel scrap
- Secondary metallurgy techniques
- Standardisation of testing and evaluation methods
- Maintenance and reliability of production lines
- Reduction of emissions, energy consumption and improvement of the environmental impact
- Instrumentation, modelling and control of processes

754197 (2017)	**FINES2EAF** *Cement-free brick production technology for the use of primary and secondary raw material fines in EAF steelmaking*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,624,989.35	Start Date	01/07/2017
	EU Contribution	€ 974,993.61	End date	31/12/2020

Abstract

Recent years have seen a world-wide change in the environmental policy towards integrated pollution prevention and control, taking into account all environmental media. It is estimated that steel-making activities in Europe produce about 80 million tonnes annually of by-products and waste, equivalent to half of the European steel production, of which more than 10 million tonnes is waste for disposal. This waste of resources and land area is not sustainable and has to be decreased in the future.

The Fines2EAF project aims to increase the value of steelmaking residues by internal recycling and (re)use in the form of cement-free bricks. The benefit of this strategy is threefold: improved utilization of residues, internal recovery of metals and reduction of the amount of dumped materials. Through demonstration by operational tests the technology of cement-free bricks could become more acceptable for the steel works.

The approach followed is the development of an innovative process to produce cement-free bricks on the basis of primary and secondary raw material fines, alternative binder systems and a hydraulic stamp press. The bricks have to possess sufficient cold compression strength for low-abrasion handling and, for self-reducing bricks, sufficient reduction behaviour and metallurgical performance. To achieve these goals the fundamental understanding of the bricks, their manufacturing and their subsequent use in the EAF is necessary.

Project activities will develop methods, processes and solutions for:

• Economic (re)using of low volume primary and secondary raw material fines in EAF steelmaking;

• Closing inter-sectoral material loops within the EAF steelmaking route by production of tailor-made high quality charge materials for the EAF;

• Recovery of metals in secondary raw material fines;

• Reducing the amount of waste materials, environmental impact and saving costs of raw materials.

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754113 (2017)	**SUPERCHARGEEAF** *Supervision of Charge Material Properties in EAF steelmaking Utilising Advanced Statistical Methods*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,281,833.40	Start Date	01/07/2017
	EU Contribution	€ 769,100.04	End date	30/06/2020

Abstract

A model relies on the quality and consistency of its input data. Normally estimations of charge material properties (such as chemical composition, specific energy consumption and yield coefficients) form the base for model-based EAF charge mix calculation and energy control. However, the material properties may vary over time resulting in decreased prediction accuracy of steel chemistry, slag chemistry, energy consumption and steel temperature. The same properties also affect the value in use of the materials. Ultimately, variations in material properties render existing material mix optimizations and process models obsolete.

Furthermore, as there is no reliable method available for on-line analysis of charge material properties, existing process models can never be fully reliable. This necessitates use of comprehensive safety margins regarding chemical composition and temperature of the steel. Since raw materials are the most expensive part in electrical steelmaking with 70-90 % of the total production cost and energy consumption constitutes the second largest cost with 10-15 %, an efficient use of raw materials and energy is of the outmost importance in order to keep the production costs at a competitive level.

This project intends to use advanced statistical methods to correlate systematic errors in model predictions (of steel and slag chemistry, energy consumption, etc.) to use of specific charge materials and thereby identify errors in estimated material properties. Hence, statistical methods will be applied to calculate the probability that the estimated material properties of individual materials are correct. The project will lead to a supervision system for early detection of charge materials in the EAF with incorrect properties; thereby, avoiding excessive use of alloy elements, high quality scrap and energy. Naturally, this will allow for significant savings in production cost and give a better platform for future price negotiations with suppliers.

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754064 (2017)	**OXYMON** *Optimisation of the oxygen use in EAF steelmaking by direct process monitoring of the chemical melt reactions*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,788,479.75	Start Date	01/07/2017
	EU Contribution	€ 1,073,087.85	End date	31/12/2020

Abstract

The EAF has a high demand on electric and chemical energy for melting scrap and superheating. In the EAF chemical energy is applied in different ways:

• By oxygen injection through bottom nozzles to decarburise the melt;

• By oxygen-natural gas burners during melting phase and;

• By oxygen jets to decarburise the melt, to promote slag foaming in combination with carbon injection and for post combustion.

All these contributions are hard to separate, thus the individual influence on the overall furnace performance and the efficiency of the different oxygen sources is difficult to determine and to optimise.

The objectives of the proposed project are to

• Investigate metallurgical reactions by injection of oxygen gas in the liquid steel bath;

• Optimise the use of oxygen at the bottom nozzle, as well as oxygen jets and gas burners;

• Determine optimal carbon additions to diminish iron oxidation;

• And thus to optimise the efficiency of chemical energy input while maximising productivity and resource efficiency and minimising maintenance effort.

To investigate and to optimise the efficiency of the different chemical energy sources, dedicated measurement and modelling tools are used:

• A local fibre optical liquid steel temperature measurement will be applied to measure the hot spot temperature of oxygen blowing directly in the process. This will be used to monitor in-situ the effect of relevant metallurgical reactions as decarburisation and metal oxidation on the local melt temperature;

• A detailed multi zone reaction model on the basis of thermodynamic and kinetic calculations will be developed to estimate the energy contribution and efficiency of the individual chemical reactions;

• A dynamic process model will be enhanced to calculate from a mass and energy balance based on cyclic process data the time evolution of the mean melt temperature and the oxidation status with carbon and oxygen content based on more precise and individual input.

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709923 (2016)	OSCANEAF *On-line slag composition analysis for electric arc furnaces*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,201,903.10	Start Date	01/07/2016
	EU Contribution	€ 721,141.86	End date	30/06/2019

Abstract

Electric steelmaking has fast gained ground in developed countries due to reduced CO2 emissions compared to blast furnace steelmaking and better production flexibility. Due to increased scrap usage, the quality of the scrap is getting worse and worse. This is reflected in the increase of non-metallic material in the scrap. Fluctuations in EAF scrap charge composition causes significant fluctuations in the EAF slag composition, since the non-metallic material in the scrap accumulates in the slag.

Fluctuation of slag composition causes many challenges in EAF steelmaking. In stainless steelmaking one of the most important goals in EAF is to keep the chromium content of the slag low, since it causes costs due to increased alloying additions and problems in recycling of slag. In carbon steelmaking it is important to ensure foaming slag conditions, which increases energy efficiency of the EAF. Due to the slag composition fluctuations the slag foaming is sometimes hindered when the slag composition drifts to the composition area with low foamability.

There are currently very few methods available for analysing slag composition in EAF. One of the most popular methods to gain information of slag composition is taking slag samples and analysing them in laboratory. Currently there is no method available to analyse slag composition in industrial EAFs on-line.

The objective of the proposal is the development of a continuous measurement system for EAF slag component analysis based on optical emission spectroscopy. The aim for stainless steel grades is the analysis of Cr2O3 and MnO content, while for carbon steel grades the aim is to analyse CaO, SiO2, Al2O3 and MgO content of the slag. The proposed technology will follow these criteria:

• Remote and continuous measurement system for slag component analysis;

• Low maintenance system design;

• Optimized operating practices based on continuous slag composition data increasing resource and energy efficiency.

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709740 (2016)	DISSTEC *Valorisation and dissemination of technologies for measurement, modelling, and control in secondary metallurgy*			
Info	Type of Project	Accompanying Measures	Duration (months)	18
	Total Budget	€ 365,683.55	Start Date	01/07/2016
	EU Contribution	€ 219,410.13	End date	31/12/2017

Abstract

The objective of this dissemination project is to revise the most important European projects related to Secondary Metallurgy technologies carried out in the last years. The basic idea is that an action of dissemination and valorisation of the most important results, based on an integrated critical analysis, is useful to valorise, disseminate and promote the exploitation of the results. Also this action is a necessary step for preparing and communicating a roadmap for future research activities and priorities. These general objectives can be broken down as follows:

• To promote the dissemination of the knowledge gained and the technological solutions introduced in relevant projects on Secondary Metallurgy;

• To identify present merits and limitations of the various technological solutions, as well as the spread of their implementation in the European steel plants;

• To identify most promising and most useful emerging development lines and to encourage the use of best results and innovative solutions, taking into account possible technological barriers;

• To identify future developments, to produce a clear and realistic picture of the future trends to be expected in Secondary Metallurgy technology;

• To supply guidelines for the next developments of Secondary Metallurgy technologies, to give indications on priorities for research subjects and activities;

• To suggest a clear road map for the technological development in this field.

The dissemination activities will comprise the following actions:

• Set-up of a web site to allow the access to the results of the project analysis, the presentations of seminars and workshops and the road map for future developments;

• Seminars on dedicated topics;

• Webinars with demonstration of successful applications;

• Workshops to provide the possibility for information exchange and open discussion, especially regarding the identification of future developments and definition of a road map.

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709620 (2016)	**PERMONLIST** *Continuous Performance Monitoring and Calibration of Model and Control Functions for Liquid Steelmaking Processes*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,688,369.30	Start Date	01/07/2016
	EU Contribution	€ 1,013,021.58	End date	03/06/2020

Abstract

The main objective of the research project is to improve, for the different stages of the liquid steelmaking process route, the continuous monitoring of the process performance as well as to ensure the permanent reliability of used dynamic process models and control rules. For this purpose, methods and tools will be developed involving the application of innovative and comprehensive performance indexes and strategies for automatic calibration of model and control parameters.

By these developments the following benefits shall be achieved for the liquid steelmaking processes:

• Improved on-line monitoring of the process performances, to be used by engineers and operators to decide about necessary countermeasures. Moreover, the increased knowledge about the process behaviour can be used to improve the operating practices;

• Long-term reliable operation of dynamic process models and rule based set-point calculations used for off-line process optimisation as well as on-line monitoring and process control, by continuous monitoring of model and control performance with automatic adaptation of related parameters (self- learning system). Results from process performance monitoring provide necessary input to the automatic calibration methods to assess the current reliability and relevance of measured data;

• Improved reliability and stability of the liquid steelmaking processes by enhanced performance of model- and rule-based control of analysis and temperature of the steel melt with reduced scatter and deviations from the desired target values;

• Minimisation of energy and resources consumption as well as treatment duration by enhanced reliability of Level-2 automation and process control functions.

The developed tools will be coupled to an integrated approach and tested exemplarily for the most important liquid steelmaking facilities of the electric steelmaking route, i.e. for EAF, LF, VD and AS plants.

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Technical Group Steel 3

Casting

The scope TGS3 includes:

- Continuous casting and near net shape casting techniques with or without direct rolling for flat and long products
- Chemistry and physics of solidification
- Ingot casting
- Maintenance and reliability of production lines
- Reduction of emissions, energy consumption and improvement of the environmental impact
- Standardisation of testing and evaluation methods
- Instrumentation, modelling and control of processes

847194 (2019)	VALCRA *Valorisation and dissemination of RFCS projects results and experience in steel surface quality issues: on as-cast cracks formation*			
Info	Type of Project	Accompanying Measures	Duration (months)	18
	Total Budget	€ 477,008.60	Start Date	01/06/2019
	EU Contribution	€ 477,008.60	End date	30/11/2020

Abstract

In the framework of the European Steel research programmes (ECSC and RFCS) many projects have been carried out on the formation of cracks in continuous casting, aiming at facing this occurrence and its harmful impact on surface and internal product quality. Within these projects, deep fundamental investigations, measurement technologies, process models and online control approaches were developed. The objective of this dissemination project is to analyse, valorise and disseminate the achieved knowledge and results obtained in the previous projects in the mentioned topics. Also a road map with future industrial targets and research needs will be defined.

Coordinator	*Country*	*Scientific person in charge*
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847269 (2019)	**OPTILOCALHT** *Optimisation of Local Heat Transfer in the CC Mould for Casting Challenging and Innovative Steel Grades*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 3,815,692.30	Start Date	01/07/2019
	EU Contribution	€ 2,289,415.04	End date	30/06/2023

Abstract

Currently, mould powder selection is a compromise between the conflicting requirements for controlling the rate of heat transfer and lubrication. OPTILOCALHT offers the opportunity to 'un-couple' these functions when casting crack-sensitive micro-alloyed and peritectic grades; as well as reducing the negative impact on infiltration and lubrication due to reactions between slag and Al and Ti present in innovative steel grades.

Four main approaches are proposed:

(1) Easy to apply "intumescent coating" that increases interfacial resistance only on specific areas of the mould and is removed with the strand at the end of the sequence. This creates the possibility of mild cooling in the meniscus region whilst maintaining lubrication or permitting higher rates of heat transfer lower in the mould, to allow faster casting.

(2) "Electrical methods" that induce local changes in the crystalline structure of the slag film to produce the required local heat flux for optimal strand solidification and changes in wettability and viscosity to control flux consumption and lubrication.

(3) Advanced numerical simulations to predict the ideal heat fluxes for given mould designs and casting process parameters.

(4) Advanced High-Resolution temperature measurements based on an Industry 4.0 platform capable of online display and analysis of heat transfer data combined with caster performance records.

Small-scale laboratory trials, cold finger tests, pilot plant trials and industrial trials on bloom and billet casters will be supported by the development of new and fast techniques for the characterisation of slag film properties relevant to heat transfer. In addition, virtual and augmented reality, digital twinning and remote access will be used to provide new insights into the continuous casting process and to evaluate the performance of the coating and electrical methods in modifying local heat transfer to improve product quality.

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847334 (2019)	**RealTimeCastSupport** *Embedded real-time analysis of continuous casting for machine-supported quality optimisation*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,100,785.65	Start Date	01/07/2019
	EU Contribution	€ 1,260,471.39	End date	31/12/2022

Abstract

The thermal and fluid-mechanical conditions in continuous casting moulds are not precisely known although highly relevant for the product quality. Manual process control is very difficult due to the big number of influencing factors which are often happening time-shifted. Therefore the aims of the proposed project are the optimised control and digitalisation of continuous casting machines aiming at an optimised product quality. Large data streams from different sources and of different types will be taken into account online in a Big Data environment. Assistance for the caster operators will be given by real-time support system. It will provide suggestions for adjusted casting conditions in real-time. Additionally predictions of defect probabilities will be estimated based on the current caster status and an intensified product inspection will be suggested if necessary.

These project aims will be supplemented by new measurement technologies for thermal and caster powder monitoring. Defect promoting scenarios will be identified by application of statistical data analytics and correlations with quality data of the heavy plates and cold-rolled strips. These scenarios will be represented with a digital twin of the continuous casting machine aiming at identification of thermal and fluid-mechanical reasons for the observed defects. The digital twin allows also the development of countermeasures aiming at the avoidance of decreasing rolled product quality.

The proposed work will lead to rules and guidelines which will be checked in real-time assessing the current status of the casting machine. The findings from the statistical data analytics as well as the developed countermeasures will be the basis for the rules and guidelines aiming at an optimised process control. Both will be integrated in the real-time support system and applied online. The effectivity of this approach will finally be verified in industrial trials.

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800644 (2018)	**PMAPIA** *Precipitation of Micro Alloy Particles in B and Mn alloyed steel grades and their Interaction between elements, segregation, and defects during continuous casting*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,061,162.00	Start Date	01/06/2018
	EU Contribution	€ 1,236,697.20	End date	30/11/2021

Abstract

Today, micro-alloyed steel grades represent 80% of the total production by European engineering steel mills. In parallel, European producers are working on next generation AHSS concepts with high Mn contents. Both classes of steels present many industrial problems related to solidification and cooling in the continuous casting (CC) process.

The overall objective of the PMAPIA project is to reduce yield loss and requirements for surface repair due to cracking defects in CC semis by optimization of micro alloying, steel composition, and casting parameters.

In engineering steels, B and S are added to micro-alloyed steels to increase hardenability and machinability, respectively. The earlier PMAP project (RFSR-CT-2012-00008) showed that B and S are responsible for micro-segregation, increasing the risk of cracking. S reduces hot ductility whereas B increases the sensitivity to cracking during tertiary cooling. Preventing B precipitation as BN markedly improves hot ductility. PMAP showed that Mn additions counteract the negative effect of S, however high Mn content degrades hot ductility. This is a problem in higher Mn steels. It was shown that MnS secondary precipitation impairs hot ductility. These findings opened new lines of investigation for making a step improvement in the cracking problems in these steels.

PMAPIA aims to alleviate B micro-segregation induced cracking by defining the interaction between B, S, Mn, and other elements. B and S compete at austenite grain boundaries, and their interaction needs to be quantified, as B is able to counteract grain boundary decohesion , meaning B can potentially have both negative and positive effects on cracking resistance. The project will perform laboratory and pilot scale investigation followed by in-field validation of the mechanisms of interaction between elements, their segregation, and cracking. The results of this validation will be new guidelines for safe industrial casting practices for these steels.

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799295 (2018)	**CONSOLCAST** *Comprehensive Modelling, Monitoring and Control of Solidification for Optimisation of Continuous Casting Process*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,096,193.70	Start Date	01/07/2018
	EU Contribution	€ 1,257,716.22	End date	31/12/2021

Abstract

In the continuous casting process there are several performance indicators which are of utmost importance, namely, safety, costs, productivity, yield, product quality and delivery on time. There is one event which can impact on all these performance indicators, that is, the strand breakout, which is defined as the rupture of the solidifying shell, resulting in the termination of casting on the affected strand and in some instances of the casting machine.

For all caster operators, the challenge is to cast both established and new steel grades at ever increasing casting speeds, whilst maximising prime cast product and ensuring the security of the casting machine, that is, no strand breakouts. To this end it is important to understand, monitor and control solidification from the casting mould to the crater end, to ensure the production of high quality cast product, e.g. in terms of minimisation of surface defects.

The reasons for caster breakout are many, thus making it more challenging to determine in all instances the root cause and thus to put measures in place to prevent a re-occurrence. The aim is to minimise significantly the likelihood of a breakout, as well as, surface defects, by determining the optimum casting conditions for the particular steel grade, to have appropriate on-line monitoring of strand solidification and real- time alarms to alert the caster operators to non-ideal casting conditions and thus make proactive decisions regarding the improvement of the casting conditions.

In this proposed collaborative project involving European Research Institutes and Steel Manufacturers the project objectives are to demonstrate that, by a combination of innovative measurement techniques monitoring the temperature distribution along the mould faces and the crater end position, with comprehensive model based monitoring and control of solidification, the secure production of prime continuously cast semi can be maximised and therefore the caster breakout avoided.

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754186 (2017)	NNEWFLUX *Non-Newtonian mould fluxes – a smart viscosity response to enhancing production flexibility of steel grades prone to slag entrapment*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,506,987.50	Start Date	01/07/2017
	EU Contribution	€ 904,192.50	End date	31/12/2020

Abstract

European steelmakers aiming to produce high quality steel grades for demanding applications, are impacted by quality issues linked to the mould powders used in continuous casting. A novel concept in mould flux behaviour offers a potential breakthrough in increasing the quality, cleanness, productivity, and competiveness of continuously cast steels.

When designing conventional mould fluxes there is often a conflict between the choice to use a high viscosity flux to minimise slag entrapment in the meniscus region and a low viscosity flux to enhance lubrication in the mould-strand gap. Recent studies from outside Europe indicate that the use of mould fluxes exhibiting non-Newtonian properties in response to shear stresses, i.e. shear-thinning, offer a possibility for achieving the different viscosities required at different parts of the mould.

A collaborative project involving European research institutes, steel manufacturers and a mould powder supplier is proposed to design suitable flux compositions and investigate the benefits of non-Newtonian mould fluxes for the continuous casting of advanced steel grades of keen interest to European steelmakers. Numerical and physical modelling, together with laboratory characterisation of mould fluxes, will be key to designing the required properties and compositions of the new fluxes. The mould powder supplier will refine the chemistries based on available raw materials and any health, safety or environmental concerns. The influence of shear-thinning on slag infiltration into the mould-strand gap will be investigated and optimal oscillation parameters predicted. Casting trials will be carried out using highly instrumented moulds to continuously monitor key parameters including heat transfer and mould friction. Once pilot tests validate the new flux concept, plant trials will be carried out by industrial partners on a wide range of production formats (e.g. billets and slabs) and operational windows optimised for product quality.

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754130 (2017)	**SUPPORT-CAST** *Supporting Control by Inspection of Surface Quality and Segregation on Cast Products through integration of Novel Online Monitoring and Advanced Modelling into an Accessible Cloud Access Platform*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 2,269,415.40	Start Date	01/07/2017
	EU Contribution	€ 1,361,649.24	End date	30/06/2021

Abstract

The project aims to develop online-monitoring systems and numerical models able to identify defects as well as support decision making to formulate guidelines that improve the quality of cast products. Sensors include strand-temperature monitoring, high-resolution visualization and topography-scanning integrated into a cloud-access-platform. These are combined with advanced numerical models to develop a regression database for defect prevention to assist operators and enhance process control. Moreover, the project identifies ideal locations for the sensors developed as well as assessing improvements in yield for stainless, carbon and micro-alloyed steels by reducing scarfing and/or grinding; thus, enhancing productivity.

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709830 (2016)	SHELL-THICK *Improvement of the continuous casting through a new system for the real-time measurement of Shell Thickness in several locations of the casting strand*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,453,482.85	Start Date	01/07/2016
	EU Contribution	€ 872,089.71	End date	30/06/2019

Abstract

Shell-Thick project aims at developing an innovative induction tomography system for metal solidification process. It provides a real-time and reliable measurement of the shell thickness in three billet cross-sections in the final region of the strand and the value of the metallurgical length for a better control of the process. Based on this information, the project will also implement a tool for the on-line and non-destructive detection of different surface defects and potential fails in the process. This will introduce a step change in solidification process with significant benefits in terms of quality, safety, productivity, costs and ultimately of competitiveness.

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Technical Group Steel 4

Hot and cold rolling processes

The scope TGS4 includes:

- Reheating furnaces
- Hot and cold rolling
- Thermal treatments
- Standardisation of testing and evaluation methods
- Maintenance and reliability of production lines
- Reduction of emissions, energy consumption and improvement of the environmental impact

Instrumentation, modelling and control of processes

847237 (2019)	**BURNER 4.0** *Development of a new burner concept: Industry 4.0 technologies applied to the best available combustion system for the Steel Industry.*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,991,506.15	Start Date	01/06/2019
	EU Contribution	€ 1,194,903.69	End date	30/11/2022

Abstract

Combustion systems and burners for the Steel Industry have been improved in the recent years focusing on energy saving, pollutant emissions reduction and process flexibility. Burner 4.0 Project is aimed to extend the present technological limits of the combustion systems concerning different areas (design, manufacturing, control & process optimization, operating life & maintenance) to new ones through a challenging combined application of the Industry 4.0 technologies. Additive manufacturing, Internet of Things, Smart Sensors, Big Data Analytics for process optimization and predictive maintenance will be introduced to the present burners leading to a break-through burner concept for the Steel Industry.

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800748 (2018)	**MASTERINGROLLSII** *Mastering work roll degradation II*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,631,738.35	Start Date	01/07/2018
	EU Contribution	€ 979,043.01	End date	31/12/2021

Abstract

This proposal aims to integrate an enhanced mastering of work roll degradation in hot rolling by applying new measurement technologies and innovative actuators developed in previous RFCS and internal research projects.

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800746 (2018)	FASTLOROLL *Fast simulation tool for long product rolling*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 1,337,800.60	Start Date	01/06/2018
	EU Contribution	€ 802,680.36	End date	31/05/2022

Abstract

The finite element methods for the simulation of the hot rolling processes of long products have been subject of research over the last three decades: further developments are nowadays marginal and the technology has come to a mature condition: the reliability of the results is proven. The FE models of the hot rolling process have initially been applied for research purposes which permitted to gain a deep understanding of the rolling process: it is now time for a technology-oriented use of such models, which is based on a massive application of the simulation for an almost complete replacement of plant setup operation for the achievement of the target mechanical properties based on plant trials, which are expensive, time consuming and source of CO2 emissions. Moreover, the capability of predicting the effect of inclusions and pores on the final integrity of rolled products is a significant advantage, especially for those defects that cannot be avoided as consequence of the upstream process.

An optimized rolling setup can contribute to reduce scrap or product downgrade so as to reduce the cost per ton of produced steel by time and energy savings estimated in around 0.1%. Moreover, it would also allow reducing CO2 emissions related to the plant trials – on average, 1.8 tonnes of CO2 are emitted for every tonne of steel produced in Europe. According to the Metal Bulletin Research, in 2013 the iron and steel industry accounted for approximately 5% of total EU CO2 emissions. Massive simulations call for two main requirements of the simulation software: easy use and fast response, reliable results. Aim of FastLoRoll is the development of a fast simulation software for the analysis of multistage hot rolling processes of long products, that allows to calculate: material flow and obtained shape, temperature development, austenite deformation and decomposition, mechanical properties, inclusion and pore evolution under temperature and strain sequence.

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800730 (2018)	**FLATBEND** *DP1000 steel press bending holistic process chain improvement by novel control techniques and through thickness residual stress tailoring*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,775,183.80	Start Date	01/04/2018
	EU Contribution	€ 1,066,310.28	End date	31/03/2021

Abstract

The roll levelling process is responsible for providing suitable strips without shape defects and residual stresses coming from rolling processes. Normally, roll levellers ensure a flatness quality between 5-10 I-Units. However, for those materials to be cut, bent or welded in downstream processes, customers request greater flatness qualities to control the final springback, especially when using AHSS.

It is well known that material with a proper flatness tolerance can get a distortion during the subsequent processes. This distortion is caused by the inhomogeneous distribution of the stresses in the material and thus, an optimum material has to present a distributed and regular stress profile. However, the in-situ residual stress measurement of the processed material is industrially not viable with the existing techniques. Thus, the effect the residual stress variability has in the subsequent forming processes is difficult to study and still unknown.

FLATBEND industrial partners cover the whole steel process chain, starting with the steel producer and finishing with the automotive components stamper, a TIER1. Their large experience has allowed them to identify the current unsolved challenges for the processing of AHSS, which will be solved in the different Work Packages of this project.

The primary aim of the FLATBEND project is to optimize the existing DP980 processing lines for the production of defect free precuts by developing disruptive roll levelling techniques and to study the influence the precuts production process has in the press-bending process of automotive profiles. Additionally, and after understanding the relation between the incoming material condition and final springback of the components, the project will try to tailor the precuts properties by using an extra small dimension straightener before the final forming presses to create a robust and stable forming process that will reduce the manufacturing costs and the scrap amount.

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800679 (2018)	**RADIFLAT** *Radar-based flatness measurement and control in strip rolling and processing lines*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,738,989.20	Start Date	01/06/2018
	EU Contribution	€ 1,043,393.52	End date	30/11/2021

Abstract

The worldwide first radar-based strip flatness measurement system, including strip edge detection and width measurement is developed for strip processing lines (rolling, levelling, quenching, ...). The basic technology consists of a multi-radar measurement system that is created to operate with high frequency/resolution (240–300GHz) and precisely work under the extreme conditions of strip processing in terms of dust, vapour, high temperatures, etc.

Sophisticated signal processing and process modelling methods will be developed to integrate the measurement technology in the process control and automation. The measurement system will also be made compact even for small space in existing lines, and tested in pilot and industrial mills.

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800672 (2018)	FLEXGAP *Industrial demonstration of novel adaptive flat bearing with adjustable thickness for flexible gap control in rolling mills*			
Info	Type of Project	Pilot&Demonstration	Duration (months)	42
	Total Budget	€ 704,699.75	Start Date	01/06/2018
	EU Contribution	€ 352,349.86	End date	30/11/2021

Abstract

Increasing demands for better product quality, thinner strips and greater flexibility of the production lines confront rolling mills with new challenges. The e-mobility sector in particular requires thinner sheets with even tighter thickness tolerances to increase efficiency of electric motors. Therefore, it is necessary to reduce vibration level at the rolling stands. For this purpose, the adaptive flat bearing for rolling mills was developed, which enables passive and active vibration damping. This pilot and demonstration project will be the first industrial test of the adaptive flat bearing. Installation will be performed on a cold rolling mill of thyssenkrupp Electrical Steel.

Coordinator	*Country*	*Scientific person in charge*
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754071 (2017)	**INFIRE** *Strategy to increase the hot strip rolling performance in terms of surface quality, final properties and reproducibility*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,936,879.50	Start Date	01/07/2017
	EU Contribution	€ 1,762,127.70	End date	31/12/2020

Abstract

InFire will increase the hot strip rolling performance in terms of final properties, surface quality and reproducibility.

High surface quality of hot rolled steel strip and reproducible rolling results are a major challenge today especially for high strength steel grades (AHSS, HSLA) prone to scale related failures and downgrades. Primary scale residues, secondary and tertiary scale formed during the rolling process lead to severe surface impairments and product downgrades while influences and interrelations of the process conditions on final product quality are poorly known. This situation is not acceptable for the new innovative steel grades whose demand is constantly increasing as the hot rolling conditions change while the limits in rolling are not fully known.

To improve the understanding of the limits in the process in order to achieve reproducible final properties with main focus on the minimisation of scale related effects on the final surface texture and strip mechanical properties the project Infire was setup by four European steel producer and three research institutes.

Conducting various investigations on scale evolution will lead to

• Description, determination and evaluation of the scale formation and oxide types formed after descaling and during rolling;

• Description of surface phenomena during cooling;

• Evaluation and determination of the interactions in the rolling process including the scale formation mechanisms;

• Understanding and conditioning of scale formation during rolling and cooling, its physical properties, evolution along the hot rolling process and the interdependencies with process liquids.

The concentrated approach will lead to an improved control of existing and new actuators, a model for predicting scale behaviour and guidelines for mastering surface defects in order to deliver high yield final products. The increased knowledge will enable existing plants to handle new kind of steel grades in a more efficient and reproducible way.

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709920 (2016)	REDUWEARGUID *Reduction of wear on guiding components in hot strip mill*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 2,086,787.50	Start Date	01/07/2016
	EU Contribution	€ 1,252,072.50	End date	31/12/2020

Abstract

The hot strip mill for flat products is still key part in the steel strip production. During the last decades, the plants were optimised and became more and more effective. Intensive work was done especially on the key process steps like mill stands, cooling sections, etc. Nevertheless some parts of the plant were not that much focused, like the guiding components. The project ReduWearGuid is aimed at reducing the wear on guiding components used in hot rolling mill (pinch roll, side guides, conveyor rolls) by the application of new type of lubricants, wear protective coatings or wear resistant materials for the guiding components. The main requirements for these guiding components are high resistance against abrasive and adhesive wear, thermal impact and corrosion.The increase of wear on the guiding components is a real problem because it induces:

• Plant downtimes for maintenance / repair / exchange of guiding components;

• Unnecessary downtimes due to unharmonised lifetime of the guiding components;

• Material defects caused by damage or by sticking of material;

• Lower product dimensional tolerance (damage on strip edge, etc.).

In order to develop individual solutions to reduce local mechanical and thermal wear, a multi-disciplinary approach will be used based on state-of-the-art characterisation, laboratory testing, modelling and production trials. The main objectives are the increased life time of guiding components, the reduction of production costs and downtimes and the reduction of surface defects on the strip.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr Delphine RECHE
Partners		
FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	DE	Dr Andreas KAILER
THYSSENKRUPP STEEL EUROPE AG	DE	Dr Ingolf JÄCKEL
FCT INGENIEURKERAMIK GMBH	DE	Dr Ulrich DEGENHARDT
SCUOLA SUPERIORE DI STUDI UNIVERSITARI E DI PERFEZIONAMENTO SANT'ANNA	IT	Dr Valentina COLLA

709504 (2016)	ROLLOILFREE *Steel cold rolling with aqueous oilfree lubricant*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,479,533.90	Start Date	01/07/2016
	EU Contribution	€ 1,487,720.34	End date	30/06/2020

Abstract

Lubricants applied in cold rolling processes aims to generate high surface aspects, cooling and cleaning as well as optimisation of the tribological system. This project is focused on the targeted development of aqueous oil free lubricants (OFLs) as substitute for the conventional oil based lubricants. As result of the former RFCS-projects Optilub and Lubwork polyalkyleneglycols (PAGs) have already shown comparable or even better rolling properties than conventional lubricants. The targeted development of OFL (PAGs, Polymers) for selected cold rolling processes is central aspect of the planned work programme. One route is set for PAG based lubricants focussing the positive outcome of the former RFCS-project, the other routes are open for other promising formulation based on other type of polymers. As this constitutes a step change in the rolling process, first of all a risk assessment e.g. compatibility of the new lubricant with the existing aggregates and process fluids is required as a work basis. Then the systematic development of oil free lubricants (OFL), their implementation, monitoring and handling measures will be covered by the project. Moreover, the impact of the new lubricant on subsequent processes will be studied in detail. The influence on cleaning, pickling, annealing and finishing will be examined too. Additionally control, care, environmental and ecological aspects will be covered as well. Based on these results OFLs composition will be continuously optimized. An equal substitute, with comparable rolling, cleaning and protective properties as conventional lubricants for both, steel cold rolling and hot alumium rolling, will generate a massive decrease of running care, costs for replenish and disposal, over 40% cost reduction and 50% lubricant savings are possible.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Mr Volker DIEGELMANN
Partners		
ARCELORMITTAL EISENHÜTTENTSTADT GMBH	DE	Dr Andreas POLLACK
CARL BECHEM GMBH	DE	Dr Heinz DWULETZKI
HYDRO ALUMINIUM ROLLED PRODUCTS GMBH	DE	Dr Kai KARHAUSEN
THYSSENKRUPP STEEL EUROPE AG	DE	Dr Martin RAULF
LUXCONTROL SA	LU	Dr Mohammed CHTAIB
SWEREA MEFOS AB	SE	Mr Andreas JOHNSON

Technical Group Steel 5

Finishing and coating

The scope TGS5 includes:

- Heat treatment technology
- Chemical treatments, finishing and coating techniques including new technologies
- Coating development, including new coatings
- Surface characteristics
- Corrosion properties
- Standardisation of testing and evaluation methods
- Maintenance and reliability of production lines
- Reduction of emissions, energy consumption and improvement of the environmental impact
- Instrumentation, modelling and control of processes

847341 (2019)	**CentriClean**[1] *Metallic coating bath cleaning by centrifugation*			
Info	Type of Project	Research	Duration (months)	43
	Total Budget	€ 1,379,954.90	Start Date	01/06/2019
	EU Contribution	€ 751,768.14	End date	31/12/2022

Abstract

Modern batch and continuous galvanizing processes still suffer from the production of large amounts of zinc ash, top dross and/or bottom dross that induce downgraded products, reduce productivity or demands frequent line stops for dross removal, as many sources of safety issues for operators to clean the bath.

The project will focus on:

• New concepts to reduce dross production and corrosion of immersed equipment,

• Cleaning of industrial melts by centrifuge means to separate the small abrasive solid particles from the corrosive base liquid metal (various Al content),

• Exploration of new upcycling ways for such depreciated wastes.

Coordinator	*Country*	*Scientific person in charge*
CENTRE DE RECHERCHES METALLURGIQUES ASBL	BE	Olivier BRÉGAND
Partners		
ARCELORMITTAL MAIZIERES RESEARCH SA	FR	Matthieu DIDIER
TATA STEEL NEDERLAND TECHNOLOGY BV	NL	Edzo ZOESTBERGERN
NV BEKAERT SA	BE	Lucia SUAREZ
REZINAL	BE	Kristiaan DECKERS
INTERNATIONAL ZINC ASSOCIATION - EUROPE	BE	Frank GOODWIN

[1] The Project has been transferred from TGS5 to TGA2 (see Annex I).

847318 (2019)	**CleanEx[2]** *On-line characterisation of the cleanliness of coils to be galvanised for exposed automotive parts*			
Info	Type of Project	Pilot&Demonstration	Duration (months)	42
	Total Budget	€ 1,451,868.30	Start Date	01/06/2019
	EU Contribution	€ 725,934.16	End date	30/11/2022

Abstract

Today, automotive steel customers are very demanding concerning the coating quality, especially for exposed parts for which no defect is allowed.

To satisfy this requirement at the exit of the galvanising line, the perfect cleanliness of the substrate surface after the cleaning section in terms of carbon pollution and iron fines must be ensured. Indeed, if carbon (as component of the mill oil) is still present at the surface when entering the furnace, furnace pollution will occur in the long term by production of soot that will not only stay on the furnace walls but will eventually lead to dirt falling on the rolls and/or on the strip.

On the other side, the iron fines can also lead to roll pick-up defects inside the furnace, to an increase of dross in the bath by combination with zinc and aluminium and also to a drift of the bath composition.

These phenomena will eventually result in aspect defects on the final product.

A direct on-line measurement is so mandatory to fully evaluate and control the surface cleanliness all along the coil and is more and more required by customers as an assurance of final product quality.

Using this cleanliness measurement, the cleaning section can be optimized by adjusting relevant parameters, such as the brushes pressure, the solution composition, the current applied if electrolytic cleaning is used.

As, today, no on-line method able to separately measure the mentioned pollutants exists on the market, this project aims at developing an on-line system using the LIBS principle. This will be realized by using an innovative approach that will allow reaching the measurement sensitivity required after the cleaning section.

This system will so constitute the basis for future tuning procedures of this section.

Coordinator	*Country*	*Scientific person in charge*
CENTRE DE RECHERCHES METALLURGIQUES ASBL	BE	Genevieve MOREAS
Partners		
TATA STEEL NEDERLAND TECHNOLOGY BV	NL	Christophe PELLETIER
SEGAL	BE	Michel MASSON
ARCELORMITTAL MAIZIERES RESEARCH SA	FR	Cyrielle ROQUELET
ARCELORMITTAL BELGIUM NV	BE	Joseph DI GIROLAMO

[2] The Project has been transferred from TGS5 to TGA2 (see Annex I).

847229 (2019)	**BIOFIRE** *Advanced Coated Steels for new demanding Biomass Firing environment having a high recycling behaviour and an improved service life*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 2,026,655.95	Start Date	01/06/2019
	EU Contribution	€ 1,215,993.57	End date	31/05/2023

Abstract

In case of firing of opportunity fuels, common solutions applied to limit risks of tube failure caused by metal loss are lowering boiler operating conditions, therefore limiting conversion efficiency, or adopting advanced boiler materials, therefore rising boiler operating costs.

Currently to increase the corrosion resistance of the boiler tubes, new steel grades are developed and this imply a possible long term application due to the stringent need of certification of the new materials for the relevant application.

The application of protective coatings which increase the harsh environment durability of the tubes onto an existing steel (e.g. T22, T91) to increase the service life of the boiler tube, on the contrary, guarantees a short term application, due to the fact that the base material has well known performances.

The coating treatments developed in BIOFIRE will enhance the environmental resistance of the existing fully qualified steels commonly used for boiler tubes for their use in power generation systems firing opportunity fuels by adopting low cost and easy handling thermochemical methods potentially applicable at industrial scale. Coating solutions, available for both inner (steam side oxidation) and outer (fireside corrosion) tubes, will lead an improvement of the boiler performance, both by reducing the outage time and maintenance expenditure resources.

The goal of this project is the development of diffusion coating treatments, to be included in the industrial manufacturing process of steel components, in order to increase the life time of the tubes up to 2 times compared to un uncoated component and the prediction of the lifetime of the coated tubes.

The project starts from a TRL5 (technology validated in relevant environment due to the experiences of the partner Flame Spray) and will arrive at TRL7 (system prototype demonstration in operational environment).

Coordinator	*Country*	*Scientific person in charge*
RINA CONSULTING - CENTRO SVILUPPO MATERIALI SPA	IT	Roberta VALLE
Partners		
FLAME SPRAY HUNGARY FEMIPARI SZOLGALTATO ES KERESKEDELMI KFT	HU	Andrea CHIERICHETTI
INSTYTUT METALURGII ZELAZA IM STANISLAWA STASZICA	PL	Krzysztof RADWANSKI
FUNDACION TEKNIKER	ES	Elena FUENTES
BONO ENERGIA S.P.A.	IT	Marco CARUGO
RWE POWER AG	DE	Simon HECKMANN
ONDERZOEKSCENTRUM VOOR AANWENDING VAN STAAL NV	BE	Serge CLAESSENS
MANNESMANN PRECISION TUBES GMBH	DE	MEISSNER

800769 (2018)	**HIGHSPEEDGALVANIZING**[3] *Towards galvanizing at higher speed through roll rotation improvements, strip stabilizing at wiping level and adapted dross skimming*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 3,119,235.75	Start Date	01/06/2018
	EU Contribution	€ 1,871,541.45	End date	30/11/2021

Abstract

Increasing the galvanizing line speed is challenging for reducing the production cost. A lot of galvanizing lines are presently reaching speed about 160 m/min depending on the strip format. However, steel customers are still more and more demanding for high coating quality without any surface defects.

Several issues, regarding the bath galvanizing area, are limiting the increase of line speed. In fact, running above 200 m/min is not of current practice in industrial lines. Among those topics, bath immersed hardware, intensive skimming and wiping are of major importance.

The objectives to be reached in this proposal are in short to face issues impeding galvanizing high line speed by:

• The development of new bearings giving a smooth roll rotation at high line speed with a low maintenance profile, through ball-bearings improvement and new “tight” bearing conception.

• The improvement of the dedrossing operation coherent with high production of surface scums.

• The development at a pilot stage of new co-wiping equipment.

Such kinds of development are in line with the constant increase of productivity of most HDGL. Of course, other parts of such complex production lines are susceptible of impeding line speed increase, but a lot of research work is also dedicated to these (increase of furnace capacity, cooling capacity increase, etc…).

Solutions brought in this research project will also help opening solutions for other types of metallic baths. In parallel with an increase of the line speed, effects are also awaited on the coating quality in terms of repeatability and stability. Better conditions for labor work are also expected.

Coordinator	*Country*	*Scientific person in charge*
CENTRE DE RECHERCHES METALLURGIQUES ASBL	BE	Mr Yves HARDY
Partners		
ARCELORMITTAL MAIZIERES RESEARCH SA	FR	Dr Pauline BRIAULT
ARCELORMITTAL BREMEN GMBH	DE	Mr Mitja KRAUSE
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr Jochen KURZYNSKI
THYSSENKRUPP STEEL EUROPE AG	DE	Mr Michael PETERS
COMTES FHT AS	CZ	Mr Michal DUCHEK
DUMA-BANDZINK GMBH	DE	Dr Daniel PLAETZER
TATA STEEL NEDERLAND TECHNOLOGY BV	NL	Dr Jaap VANEENNAAM
V2I	BE	Dr Daniel SIMON
UNIVERSITE DE LIEGE	BE	Prof. Jean-Claude GOLINVAL
HEEMSKERK INNOVATIVE TECHNOLOGY BV	NL	Dr Cock HEEMSKERK

[3] The Project has been transferred from TGS5 to TGA2 (see Annex I).

754144 (2017)	NOSTICKROLLS *Non Sticking furnace Rolls to improve service life and product quality in continuous annealing and galvanizing lines*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,059,465.00	Start Date	01/07/2017
	EU Contribution	€ 1,135,679.00	End date	31/12/2020

Abstract

The research project aims to prolong the service life of furnace rolls working in continuous annealing and galvanizing lines, bringing reduction of maintenance costs and increase of productivity by lengthening time-to-maintenance, and to improve the quality of steel strips with respect to surface defects that arise as a consequence of wear and build-up of oxides from steel product picked up by roll's surface. The most challenging issues regarding pick-up formation have arisen since the need to increase strip's running speed and/or annealing temperature and the need to process critical steel products for automotive industry, such as advanced high strength steels containing elevated levels of Mn and/or Si. The Projects objectives will be achieved by a stepwise methodological approach intended to

• Acquire systematic knowledge on the thermochemical interaction phenomena of materials in contact (roll/strip) as a function of process variables that affect the entity/rate of pick-up formation in selected industrial cases;

• Design and develop improved coating solutions using a combination of new material composition and/or new coating concepts (i.e. functionally graded coatings, multiple layered) and/or advanced and new in the field deposition techniques able to tailor all the necessary coating properties;

• Test in laboratory and pilot plant the surface functionalities of the candidate roll materials, such as pick-up, wear and thermal shock resistance, with a variety of unique in house developped testing facilities;

• Scale-up and validate the most promising solutions compared to currently used roll materials by industrial trials in CAl and CGL.

Coordinator	*Country*	*Scientific person in charge*
CENTRO SVILUPPO MATERIALI SPA	IT	Dr Nicoletta ZACCHETTI
Partners		
CENTRE DE RECHERCHES METALLURGIQUES ASBL	BE	Mr Louis BORDIGNON
FLAME SPRAY SPA	IT	Dr Walter CERRI
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Mr Emanuel THIENPONT
LWK-PLASMACERAMIC GMBH	DE	Dr Tiberius VILLICS
THYSSENKRUPP STEEL EUROPE AG	DE	Dr Marc BLUMENAU
ARCELORMITTAL ESPANA SA	ES	Mr Ramón LASO

749632 (2017)	DUPLEXWASTE *Lean Duplex Stainless Steel for Urban and Industrial Waste Water*			
Info	Type of Project	Research	Duration (months)	40
	Total Budget	€ 1,483,673.55	Start Date	01/09/2017
	EU Contribution	€ 890,204.13	End date	31/12/2020

Abstract

The project is dedicated to evaluating the application of lean duplex stainless steel materials for urban and industrial wastewater. Issues concerning different types of corrosion in wastewater units will be investigated by means of laboratory and field exposures. A life cycle cost assessment will be performed to assess the environmental impact of the steel types. The results will enable to establish engineering diagrams and guidelines for material selection in urban and industrial wastewater units. The project will considerably increase the market share of lean duplex stainless steels for wastewater treatment units.

Coordinator	*Country*	*Scientific person in charge*
INSTITUT DE LA CORROSION SAS	FR	Dr Dominique THIERRY
Partners		
KATHOLIEKE UNIVERSITEIT LEUVEN	BE	Prof. Barbara ROSSI
APERAM STAINLESS FRANCE SA	FR	Dr Audrey ALLION
VEOLIA ENVIRONNEMENT-VE	FR	Mr Benoit EMO
CONSIGLIO NAZIONALE DELLE RICERCHE	IT	Dr Marco FAIMALI
ENDURES BV	NL	Dr Job KLIJNSTRA
OUTOKUMPU STAINLESS AB	SE	Dr Lena WREGELIUS

709694 (2016)	MACO PILOT *Optimisation of the mixed acid online monitoring and control in stainless steel pickling plants*			
Info	Type of Project	Pilot&Demonstration	Duration (months)	42
	Total Budget	€ 1,920,363.40	Start Date	01/07/2016
	EU Contribution	€ 960,181.71	End date	31/12/2019

Abstract

The European steel sector is under strong economic pressure due to the difficult global market conditions. This demands high flexible and favourable production while maintaining high product quality standards. The customized production of small lots of a wide range of special stainless steel grades distinguishes the European competitive advantage. Especially the pickling step is of high importance for stainless steel production as the product surface quality is a very essential attribute for the customers. In conjunction with the demanded high process flexibility the fast adjustment of defined concentrations in industrial mixed-acid pickling baths is of great importance for achieving consistently high product qualities and plant productivity. Available mixed acid concentration analysis techniques aren´t capable to achieve these requirements. Thus, there is a great demand for advanced mixed acid online concentration supervision and pickling plant process control techniques. Within the RFCS project FLEXPROMUS an innovative method for continuous HF-HNO3-mixed-acid online analysis was successfully developed. First tests at two stainless steel strip pickling lines showed very promising results. However, further measuring technique optimisations are necessary to reach TRL 7. This pilot project addresses the optimisation of the innovative online concentration measuring technique concerning set-up, long-term reliability and operative range. Besides laboratory investigations and pickling process operation model developments, pilot scale tests shall be carried out at a stainless steel strip pickling line including acid regeneration, and for the first time at a wire rod plant. Finally, modernisation concepts for existing mixed acid pickling plants are to be developed. The overall goal of this pilot research project is the further optimisation of the mixed acid concentration monitoring and control in order to improve the pickling plant process operation and working conditions.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr Matthias WERNER
Partners		
OUTOKUMPU NIROSTA GMBH	DE	Mr Karl-Heinz KIRCHHOFF
DEUTSCHE EDELSTAHLWERKE GMBH	DE	Mr Sebastian BANGE
UNIVERSIDAD DE OVIEDO	ES	Dr Iván MACHÓN GONZÁLES
ACERINOX EUROPA SA	ES	Mrs Esther QUIRÓS PINO
SWEREA KIMAB AB	SE	Dr Karin JACOBSON

709435 (2016)	HIJETROD PILOT *Resource-efficient hydromechanical descaling system for wire coils*			
Info	Type of Project	Pilot&Demonstration	Duration (months)	42
	Total Budget	€ 974,852.80	Start Date	01/07/2016
	EU Contribution	€ 487,426.40	End date	31/12/2019

Abstract

During rolling and annealing of steel, metal oxides (scale) are formed on the steel surface. The demand for further processing of steel is a scale-free surface. The achievement of a completely scale-free surface is expensive, especially for wire rod. In the forerunner project RFSR-CT-2010-00014 (HiJetRod) the great advantages of environmentally friendly high pressure water jet treatment were shown. Manually operated onsite tests have been performed with wire coils of three industrial partners. The descaling results are very good and the downstream pickling treatment of the treated coils can be reduced – the tests have shown a potential of 10% to 15% productivity increase of the pickling line.

For widespread application of the new descaling process, energy and water consumption of high pressure water jet treatment have to be reduced. For this purpose, new concepts for descaling (self-induced pulsating nozzles, acid resistant equipment, innovative shape of the coil rotation equipment) as well as spent water treatment and recycling will be investigated on a laboratory and pilot scale. For detailed evaluation of the reduction of pickling effort with the new descaling process in terms of consumables (energy, pickling acid and water), a life cycle assessment is included in the project.

The industrial integration of the developed process in a pickling line by this pilot and demonstration project is completely new and innovative. It is a logical and important step to reduce the high effort required for wire coil pickling and to replace resource-intensive pre-treatment. Besides the application for so-called swab-removable scale – scale loosened in a previous pickling step – other applications for the removal of organic/inorganic deposits will be tested. Authoritative data regarding the operational and investment costs for the installation of the high pressure water jet treatment will be determined to give a basis for investment decisions of potential users.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr Barbara WENDLER
Partners		
VYSOKE UCENI TECHNICKE V BRNE	CZ	Prof. Miroslav RAUDENSKY
DEUTSCHE EDELSTAHLWERKE GMBH	DE	Mr Sebastian BANGE

Technical Group Steel 6

Physical metallurgy and design of new generic steel grades

The scope TGS6 includes:

- Precipitation, re-crystallisation, microstructure & texture and ageing
- Predictive simulation models on microstructures & mechanical properties
- Development of steel with improved properties at low and high temperatures such as strength and toughness, fatigue, wear, creep and resistance against fracture
- Magnetic properties
- New steel grades for demanding applications
- Standardisation of testing and evaluation methods

847195 (2019)	QPINOX *Development of New Martensitic Stainless Steels for Automotive Lightweight Structural Applications*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,506,097.45	Start Date	01/06/2019
	EU Contribution	€ 903,658.47	End date	30/11/2022

Abstract

This project aims to generate a new class of affordable martensitic stainless steels for the automotive sector. In detail, there are two main objectives. First, to develop new martensitic stainless steel grades containing retained austenite, using a combination of novel heat treatments (quenching and partitioning -QP) and steel chemistry optimisation, to give unique combinations of strength (>1200 MPa UTS) and ductility (total elongation more than 15%), suitable for lightweight automotive applications.

The second main objective is to facilitate the industrial implementation (manufacture and use) of these new grades.

The first objective will be achieved by alloy and heat treatment design, first using models, and second via experiments, gradually scaling up from small heats with dilatometer heat treatment on small samples, to large heats followed by Gleeble heat treatment on larger hot rolled strips, and finally to lab pilot scale fully processed sheet production. At each iteration, the microstructure and mechanical properties will be assessed, in order to assist in optimization of properties in the final fully processed sheets.

The second objective will be met by detailed experimental studies on critical automotive properties i.e. weldability, formability, fatigue, and corrosion. In addition, life cycle cost studies, component forming simulations, assessment of industrial processing windows, will be carried out with appropriate benchmarking to other steels, in order to assist in the industrial implementation of the developed steels. The project results are expected to benefit European stainless steel producers through the realisation of new and affordable martensitic stainless steel grades suitable for breakthrough into the lightweight automotive sector. In addition, the new grades are expected to offer attractive properties for other typical martensitic stainless steel applications such as those requiring improved corrosion and strength combinations.

Coordinator	*Country*	*Scientific person in charge*
RINA CONSULTING - CENTRO SVILUPPO MATERIALI SPA	IT	Ali SMITH
Partners		
CION IMDEA MATERIALES	ES	Ilchat SABIROV
TECHNISCHE UNIVERSITEIT DELFT	NL	Maria SANTOFIMIA
ACERINOX EUROPA SA	ES	Rafael SANCHEZ

847165 (2019)	**iNiTiAl** *Advanced implementation of novel corrosion resistant maraging steels with improved process robustness via tuned intermetallic nano-precipitation*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,969,999.00	Start Date	01/07/2019
	EU Contribution	€ 1,181,999.40	End date	31/12/2022

Abstract

This project targets an implementation and development of corrosion resistant high strength maraging steels for two applications, i.e. a closed-die forged 1900MPa grade for aircraft landing gears for which process robustness is the bottleneck currently, and a breakthrough lean stress corrosion resistant 1400MPa steel for sour service.

These objectives will be realised via a combination of two industrial trials to evaluate improved processability and 3 waves of generic laboratory materials aiming at understanding the isolated effect of single elements and intermetallic phases (mainly Ni3Ti and NiAl). Extended dilatometry and advanced high resolution characterisation techniques are key differentiators to obtain an in-depth insight in the precipitation of nano-sized intermetallics.

Coordinator	*Country*	*Scientific person in charge*
ONDERZOEKSCENTRUM VOOR AANWENDING VAN STAAL NV	BE	Nele VAN STEENBERGE

Partners

AUBERT & DUVAL SAS	FR	Denis Béchet
LIEBHERR-AEROSPACE LINDENBERG GMBH	DE	Sebastian ZIEHM
MONTANUNIVERSITAET LEOBEN	AT	Francisca MENENDEZ-MARTIN
RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN	DE	Prof. Wolfgang BLECK

800693 (2018)	CRASHTOUGH *Towards high crashworthiness parts through the investigation of microstructural effects on fracture toughness of 3rd generation AHSS*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,896,937.25	Start Date	01/07/2018
	EU Contribution	€ 1,138,162.35	End date	31/12/2021

Abstract

3rd Gen AHSS containing transformable retained austenite are excellent candidates for lightweight construction of high crashworthiness automotive parts. This is due to their complex microstructures with moderated retained austenite contents. Stress induced transformation of this retained austenite and the matrix characteristics affect both crack initiation and propagation. Crash&Tough aims to investigate and better understand such microstructural effects to optimize crash resistance in 3rd Gen TRIP-aided steels. It will be assessed through fracture mechanics based tests, advanced characterization techniques and FE modelling to phenomenologically understand crack initiation and propagation in 3rd Gen AHSS and optimize their microstructure for high crashworthiness.

Coordinator	*Country*	*Scientific person in charge*
FUNDACIO CTM CENTRE TECNOLOGIC	ES	Mr David FRÓMETA
Partners		
VOESTALPINE STAHL GMBH	AT	Mr Clemens SUPPAN
ARCELORMITTAL MAIZIERES RESEARCH SA	FR	Dr Thomas DIEUDONNÉ
CENTRO RICERCHE FIAT SCPA	IT	Dr Daniele PULLINI
LULEA TEKNISKA UNIVERSITET	SE	Dr Jörgen Kajberg

754070 (2017)	**STEELSECO** *Design of new economic secondary precipitating steels for fatigue resistance at elevated service temperatures*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,550,177.20	Start Date	01/10/2017
	EU Contribution	€ 930,106.32	End date	30/09/2020

Abstract

The aim of this project is to investigate the microstructure evolution due to tempering of nanobainitic steels and their properties. Furthermore this project will be the first attempt to evaluate the potential of a new class of steel combining nanostructured bainitic steels with secondary precipitation.

Potential applications are subjected to elevated temperatures and require high fatigue performances at these temperatures (e.g. gas injection components, bearings, gears). Indeed, it is hoped that this yet untested combination will lead to an economical yet very high performance material for use at elevated temperatures.

Coordinator	*Country*	*Scientific person in charge*
ROBERT BOSCH GMBH	DE	Dr Matthias KUNTZ

Partners

AGENCIA ESTATAL CONSEJO SUPERIOR DEINVESTIGACIONES CIENTIFICAS	ES	Dr Carlos GARCIA-MATEO
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	FR	Dr Julien TEIXEIRA
ASCO INDUSTRIES	FR	Dr Thomas SOURMAIL
OVAKO SWEDEN AB	SE	Dr Patrik OLUND

751360 (2017)	**HPDCSTEEL** *Development of a new steem grade to increase high pressure die casting dies life*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,413,308.15	Start Date	01/07/2017
	EU Contribution	€ 847,984.89	End date	31/12/2020

Abstract

European automotive industry, focused on the lightweight and reliability, requires sound and complex components of aluminum and magnesium produced by HPDC (High Pressure Die Casting). Steel dies are used to shape components in liquid state, but extremely high pressures (up to 1.200 bars), chemical attack of molten metal and high thermal-mechanical stresses produce premature die defects and failures. This proposal proposes to develop a new steel with a new composition that will improve the mechanical, thermal and chemical properties of the dies, enhancing the competitiveness of HPDC products and steel and European automotive industry.

Coordinator	*Country*	*Scientific person in charge*
FUNDACION TECNALIA RESEARCH & INNOVATION	ES	Dr Iban VICARIO
Partners		
LEBARIO RO SRL	RO	Mrs Marian DUMITRASCU
SCHMIEDEWERKE GROEDITZ GMBH	DE	Mr Alexander HENGST
2A SPA	IT	Claudio D'AMICO GIUSEPPE

749918 (2017)	**LIGHTCHASSIS** *Development of affordable integrated lightweight chassis components from flexible 3G medium-Mn steels*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,233,662.15	Start Date	01/07/2017
	EU Contribution	€ 1,340,198,10	End date	31/12/2020

Abstract

The current trend in automotive industry that has been derived from regulations, fuel efficiency, safety etc. is to produce light weight car body part and chassis components. In that context the goal of this project is to design a novel medium manganese material that will be a candidate to substitute the Complex phase steels currently used in chassis component and lead to further weight reduction. The material will be designed utilizing thermodynamic and kinetic modelling to 'handpick' the compositions that are potential candidates, taking into account mechanical properties and industrial feasibility. Materials with these compositions will be belt casted and characterized with respect to microstructure and mechanical properties. The material with the optimum properties will be supplied for forming of a newly designed component. The component and forming design will be performed using industrial standards of forming and welding and advanced mechanical models that will take into account the composite microstructure. After the component is formed it will be transferred to an automotive car producer where it will be tested based on company standards providing a proof of concept.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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AUTOTECH ENGINEERING DEUTSCHLAND GMBH	DE	Mr Mehdi ASADI

709855 (2016)	HIGHQP *Controlling austenite stability by substitutional alloying elements in QP route*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,797,726.35	Start Date	01/07/2016
	EU Contribution	€ 1,078,635.81	End date	31/12/2019

Abstract

This proposal presents a new high temperature Quenching & Partitioning (Q&P) treatment where the stabilization of austenite is achieved not only by C diffusion but also by the diffusion of substitutional alloying elements. This innovative idea opens an unprecedented approach to produce martensite – austenite microstructures, which is expected to lead to a new 3rd generation advanced high strength steel family with enhanced formability. Investigations will combine advanced experimental techniques and the formulation of new models. It will lead to understand the partitioning behavior of substitutional elements in Q&P route and to determine the TRIP effect that an austenite stabilized by substitutionals can originate.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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TECHNISCHE UNIVERSITEIT DELFT	NL	Dr Maria SANTOFIMIA
SWEREA KIMAB AB	SE	Mr David MARTIN

709828 (2016)	MILDROLLING *Ultrafine grained steel long products by multi-pass warm caliber rolling technology*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,747,851.00	Start Date	01/07/2016
	EU Contribution	€ 1,048,710.60	End date	31/12/2019

Abstract

The aim of this project is to produce submicron ultrafine grain (UFG) long steel products (ferrite-cementite microstructure) with high strength and adequate ductility for automotive and mechanical applications that can be further processed by cold forming or direct machining. The idea consists in producing UFG bars by multi-pass warm caliber rolling in the temperature range 500-700°C, exploiting as refining mechanism the dynamic recrystallization or recovery of ferrite induced by accumulation of strain during multipass deformation. The focus will be on medium and high carbon steels. The medium carbon steels are currently used in the manufacturing of automotive component and in this case the development of ultrafine microstructure can lead to improvement in strength and toughness and, accordingly, to a subsequent improvement of dynamic properties, as fatigue resistance and a higher reliability of safety components with direct impact on vehicle safety. About high carbon steels, a problem of using them for engineering applications is the fact that toughness deteriorates due to the high carbon content. Grain refinement is a method of improving toughness and strength simultaneously and could allow the use of high carbon steels for mechanical applications where high toughness levels are required. While previous research, both at European and worldwide levels, has been focused on validation of UFG technologies at laboratory scale, MILDROLLING project approach is extending validation to semi industrial scale in order to determine its industrial feasibility, to state mechanical properties of UFG steels for further processing and to establish the influence of those processes on grain size stability, aiming for a practical application and quick transferability to European car – making industry of UFG long steel products.

Coordinator	*Country*	*Scientific person in charge*
CENTRO SVILUPPO MATERIALI SPA	IT	Mrs Ilaria SALVATORI
Partners		
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ACCIAIERIE E FERRIERE DI PIOMBINO SPA	IT	Dr Alessandra MERIGO

709803 (2016)	NANOFORM *Improved formability in 3rd generation AHS steels by nanosize precipitation and microstructure control during and after hot rolling*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,956,922.45	Start Date	01/07/2016
	EU Contribution	€ 1,174,153.47	End date	31/12/2019

Abstract

The goal of this project is to develop new Complex Phase Low Carbon Microalloyed Steels, by optimization of chemistry and thermomechanical processing, i.e. hot rolling and cooling, to simultaneously obtain refined microstructures and arrays of precipitate nanoparticles. The previously unexplored synergies between the elements Nb, Mo, V and Ti on precipitation before, during and after phase transformation from austenite during hot rolling and cooling will be also addressed. The project will result in new product concepts optimized with respect to processing parameter windows to give robust mechanical properties, i.e. static and fatigue strength, bendability, hole expandability and toughness.

Coordinator	*Country*	*Scientific person in charge*
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INSTITUT NATIONAL DES SCIENCES APPLIQUEES DE LYON	FR	Dr Sophie CAZOTTES
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THYSSENKRUPP STEEL EUROPE AG	DE	Dr Kirill KHLOPKOV

709755 (2016)	**OPTIQPAP** *Optimization of QP steels designed for industrial applications*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,699,138.55	Start Date	01/07/2016
	EU Contribution	€ 1,619,483.13	End date	31/12/2019

Abstract

Despite significant research on microstructure, strength, ductility and strain hardening of advanced high strength steels (AHSS) processed via quenching and partitioning (Q&P) in the current literature, their application related performance has not yet been studied. The present OptiQPAP proposal focuses on intelligent microstructural design in the high strength Q&P steels for simultaneous improvement of various performance and mechanical properties, which are required for their commercialization. Special attention is paid to fatigue and fracture behaviour, wear resistance, weldability, ductile-brittle transition temperature, high strain rate behavior and energy absorption, along with the formability and bendability of Q&P steels.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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TECHNISCHE UNIVERSITEIT DELFT	NL	Prof. Jilt SIETSMA

709711 (2016)	TOOLKIT *Toolkit for the design of damage tolerant microstructures*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,586,913.20	Start Date	01/07/2016
	EU Contribution	€ 952,147.92	End date	30/06/2019

Abstract

Two measures can be applied to improve the sustainability of components subjected to mechanical loads. On the one hand, materials should be used that offer the optimum balance of mechanical properties. On the other hand, a full exploitation of the offered mechanical properties should be made possible. This project addresses the first measure. It aims to provide a simulation toolkit for the computer-assisted design of damage tolerant microstructures. In detail, the project presents an approach that is made up by three steps:

• Identification of mechanical property requirements through numerical simulations of full component behaviour. Therefore, parametric studies shall reveal the required hardening and fracture parameters that will help achieving a significantly improved structural performance;

• Finding microstructural configurations providing the required properties. This task is based on parametric studies on statistically representative artificial microstructure models;

• Identification of suitable processing parameters to adjust these tailored microstructures.

The project is based on the understanding that the conventional measures for mechanical property optimization have been widely exploited for many steel grades, so that tailoring the microstructure morphology is the most promising measure for future steel developments. The focus of the project lies in the development of the general method. Its applicability will only be demonstrated for two different examples. The project will bring added value in:

• Fostering sustainable component design options;

• Providing the method of tailoring steels for specific applications;

• Finding new mechanisms of material performance improvement;

• Improving the ICME approaches;

• Strengthening the position of steel products.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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THYSSENKRUPP STEEL EUROPE AG	DE	Mr Georg PAUL
PANEPISTIMIO THESSALIAS	EL	Prof. Nikolaos ARAVAS
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SOLINOURGEIA KORINTHOU ANONYMI ETAIREIA VIOMICHANIAS SOLINON KAI EKMETALLEFSIS AKINITON	EL	Dr Athanasios TAZEDAKIS

709607 (2016)	TIANOBAIN *Towards industrial applicability of (medium C) nanostructured bainitic steels*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,577,170.15	Start Date	01/10/2016
	EU Contribution	€ 946,302.09	End date	31/03/2020

Abstract

Excellent combinations of strength and toughness can be obtained from high-carbon nanobainite, but this requires high levels of alloying and long heat treatments. This project will develop very fine bainitic – austenitic steels more cost effectively from leaner medium carbon alloys using shorter processing times via thermomechanical ausforming. Tensile strengths above 1600MPa are aimed at to give hot rolled steels with enhanced wear resistance combined with good toughness. Suitable compositions and processing parameters will be developed using modelling and physical simulation. Trial products will be produced and tested using laboratory rolled materials, and recommendations for full-scale production parameters will be made.

Coordinator	*Country*	*Scientific person in charge*
AGENCIA ESTATAL CONSEJO SUPERIOR DEINVESTIGACIONES CIENTIFICAS	ES	Dr Carlos GARCIA-MATEO

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THYSSENKRUPP STEEL EUROPE AG	DE	Mr Georg PAUL
OULUN YLIOPISTO	FI	Dr Mahesh SOMANI

709418 (2016)	MUSTMEF *Multi Scale Simulation Techniques for Metal Forming*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 2,206,836.40	Start Date	01/07/2016
	EU Contribution	€ 1,324,101.84	End date	30/06/2020

Abstract

This project aims at a breakthrough in modeling of AHSS. These steels are increasingly being used within the automotive industry but have a challenging forming behavior. This project aims at a breakthrough in modeling of AHSS. These steels are increasingly being used within the automotive industry but have a challenging forming behavior.

An extremely fast crystal plasticity code will be used to derive macroscopically observable anisotropic plastic properties from complex 3D artificial multi-phase microstructures. This will be directly coupled to efficient Multi-Scale code, leading to numerically very efficient state-of-the-art models for forming processes of dual-phase steels. The resultant multi-scale material model will be demonstrated for realistic microstructures in an industrial FE-Code to predict product properties after forming of a large automotive part.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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MAX PLANCK INSTITUT FUR EISENFORSCHUNG GMBH	DE	Dr Franz ROTERS
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Technical Group Steel 7

Steel products and applications for automobiles, packaging and home appliances

The scope TGS7 includes:

- Technologies relating to the forming, cutting, welding and joining of steel and other materials
- Design of assembled structures to facilitate the easy recovery of steel scrap and its re-conversion into usable steels and techniques for recycling
- Steel-containing composites and sandwich structures
- Prolonging service life of steel products
- Standardisation of testing and evaluation methods

847284 (2019)	FATECO *Improvement of the fatigue performance of automotive components through innovative ecofriendly finishing operations*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,191,963.15	Start Date	01/06/2019
	EU Contribution	€ 1,315,177.89	End date	30/11/2022

Abstract

The improvement of vehicles safety is a EU priority. The enhancement of the components performance reduces the likelihood of accidents caused by failures of these components. The FATECO project aims the fatigue and tribological performance improvement of automotive transmission parts by means of an optimized surface integrity reached through innovative finishing techniques. Additionally, some of these techniques will allow the lubricant removal, leading to a 100% ecofriendly process.

Complementary, an automatic learning approach, capable of predicting the surface integrity and the fatigue and tribological behavior, depending on input variables (material properties, process parameters…), will be developed.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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CENTRO RICERCHE FIAT SCPA	IT	Eva BUTANO
SAMPUTENSILI MACHINE TOOLS S.R.L.	IT	Enrico LANDI
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ECOLE NATIONALE D'INGENIEURS DE SAINT-ETIENNE	FR	Joel REICH

847213 (2019)	**CuttingEdge4.0** *Facing edge-cracking in AHSS: towards zero-defect manufacturing through novel material characterization and data driven analytics for process monitoring*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,510,346.40	Start Date	01/06/2019
	EU Contribution	€ 1,506,207.84	End date	30/11/2022

Abstract

Cutting operations are widely used in sheet forming. They influence post-forming operations in AHSS that are sensitive to edge damage.

CuttingEdge4.0 addresses edge-cracking in AHSS by developing experimental tools and digital twins for the cutting process and incorporating Industry 4.0 data driven analytics for process monitoring.

The final aim is to improve automotive industry tools to predict edge-cracking in the early part design stages. Machine learning solutions based on real-time process data will detect edge-cracking defects and assure part quality. It will permit to boost the applicability of AHSS in safety related automotive parts as a cost-efficient lightweight solution.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
PWO CZECH REPUBLIC A.S.	CZ	Martin SLÁMA
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LULEA TEKNISKA UNIVERSITET	SE	Pär JONSÉN
VOESTALPINE STAHL GMBH	AT	Christian WALCH
FAURECIA AUTOSITZE GMBH	DE	Hosen SULAIMAN
TATA STEEL NEDERLAND TECHNOLOGY BV	NL	Eisso ATZEMA

800763 (2018)	HSSF *Hybrid Semi-Solid Forming*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,966,907.70	Start Date	03/06/2020
	EU Contribution	€ 1,180,144.62	End date	03/06/2020

Abstract

A majority of transport sector components are manufactured by forging and casting. Forging annihilates the defects and casting is more suitable for manufacturing complex geometries. The proposed novel Hybrid Semi-Solid Forming (HFFS) process utilizes the benefits of achieving a forged-like microstructure and yet provides net-shape production possibilities. It relies on hot processing in a temperature regime between forging and conventional semi-solid forming. Unlike in conventional semis-solid forming, a wide range for steels can be processed by HSSF and posited advantages include higher energy, material and cost efficiency over traditional techniques. Proposed project explores industrial viability of HSSF and investigates micromechanics.

Coordinator	*Country*	*Scientific person in charge*
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Partners

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UNIVERSITY COLLEGE LONDON	UK	Prof. Peter LEE
FUNDACION CIE I+D+I	ES	Mr Iñigo Loizaga

800726 (2018) STEEL S4 EV

STEEL Solutions for Safe and Smart Structures of Electric Vehicles

Info				
	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,936,648.10	Start Date	03/06/2020
	EU Contribution	€ 1,161,988.86	End date	03/06/2020

Abstract

STEEL S4 EV aims at putting high strength steel at the forefront of a new trend in electric vehicles: light vehicles with three or four wheels that comply with crash regulation and with more restrictive Euro NCAP demands. Weld joint design and welding methodologies research to keep material properties along the joints assuring robustness and long term durability. To do this cost competitively low investment manufacturing will be achieved by a modular and flexible structural design: a complex 3D skeleton frame of welded tubes, bent with high accuracy using programmed laser cuts will enable different vehicles sharing the same tooling.

Coordinator	*Country*	*Scientific person in charge*
FUNDACION CIDAUT	ES	Mr Javier ROMO

Partners		
INTERACTIVE FULLY ELECTRICAL VEHICLES SRL	IT	Dr Pietro PERLO
BELGISCH INSTITUUT VOOR LASTECHNIEK VZW	BE	Dr Koen FAES
LULEA TEKNISKA UNIVERSITET	SE	Dr Esa VUORINEN
MA SPA	IT	Dr Jean LAMONTANARA
THINKSTEP AG	DE	Mr Alexander FORELL

800649 (2018)	WARMLIGHT *Development of a methodology for lightweight design of warm formed components with complex geometries in heavy vehicle applications*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,922,626.80	Start Date	03/06/2020
	EU Contribution	€ 1,153,576.08	End date	03/06/2020

Abstract

The aim of the project is to develop a methodology for simulation based design of thick-walled components for trucks and other heavy machinery in the transport sector. The objective of the project is to enable weight-optimized components with complex geometries, meeting advanced requirements regarding the fatigue properties by avoiding assemblies and welded joints. The methodology of warm forming and a FE-simulation based forming process design is applied with new ultra-high strength (UHSS) steel grades for warm forming evaluated within the project. A process chain is defined in which the developed steel grade is combined with down-stream thermo-mechanical processes. The process chain will involve a sequence of processes steps performed at the steel manufacturer, in the hot forming process and operations at the OEM. The methodology will be fully supported by modelling and simulation, including microstructural predictions, forming simulations and final property assessments. The objectives are to: • Develop a predictive simulation methodology that supports an optimal design of a warm forming process in order to meet the performance and lightweight demands of the HDV sector. • Optimize a thermo-mechanical forming process (warm forming) for manufacturing of components that meets the demands with respect to strength, elongation and fatigue limit • Screening, evaluation and selection of new steel grades for warm forming of thick-walled components for forming of thick-walled components with complex geometries, based on alloying concepts for steel grades that are currently used for applications in industry. The ultimate target is a yield limit over 1150 MPa and elongation of more than 15% after warm forming. • Develop a demonstrator component fulfilling strength and fatigue resistance requirements and with 25 % weight reduction compared with traditional technologies. • Perform a complete and detailed LCA to validate the sustainability of the proposed solutions.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
FUNDACIO CTM CENTRE TECNOLOGIC	ES	Prof Daniel CASELLAS
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SCANIA CV AB	SE	Dr Henrik SIEURIN
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TBC	A	tbc

799787 (2018)	**LIGHTTECH** *Innovative approaches of stress shot peening and fatigue assessment for the development of lightweight, durability-enhanced automotive steel leaf springs.*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,738,363.65	Start Date	03/06/2020
	EU Contribution	€ 1,043,018.19	End date	03/06/2020

Abstract

The project aims at creating a novel R&D platform for accurate durability enhancement and assessment of automotive components made of high-strength steels, focusing here on leaf springs. The main technological project objectives are:

1. Development of a sophisticated elastoplastic FEM-based Stress Shot Peening (SSP) simulation model for systematic and reproducible elaboration of optimized SSP process parameters for enhanced product durability.

2. Development of a modularly structured, analytical fatigue life calculation model, applicable in any stage of development depending on the input data level (material data / leaf specimen data / full-scale component prototype data), independent or in conjunction with the SSP simulation model.

3. Creation of a experimental database that will be used for the input and comprehensive validation of the above theoretical models.

4. Development of two lightweight, high-performance full-scale leaf springs, with exceptional strength and fatigue performance, not attainable with the current technologies, both of high industrial interest, demonstrating the remarkable industrial exploitation potential of the above mentioned models. A huge impact of the project outcomes is expected: Development times, currently counted in years, will be shortened down to few months. Reproducibility, high quality and effectiveness will give credence and big added-value to the final products, crossing the current thresholds in the development of springs with highest requirements of lightweight, safety and durability. The competitiveness of the (currently balky) position of the European leaf spring industry and the associated European steel producers will be significantly strengthened against their non-European competitors. Starting from the leaf spring branch, the developed models will be applicable to further high-strength steel components, especially the ones with graded surface properties due to their surface treatment.

Coordinator	*Country*	*Scientific person in charge*
ARISTOTELIO PANEPISTIMIO THESSALONIKIS	EL	Prof. Georgios SAVAIDIS
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MUELLES Y BALLESTAS HISPANO ALEMANAS PROJECTS SL	ES	Mr Javier ISACH
MAN TRUCK & BUS AG	DE	Mr Jose CAMPOS-HERNANDEZ
DEMOCRITUS UNIVERSITY OF THRACE	EL	Prof. Georgios MALLIARIS
HOCHSCHULE BOCHUM	DE	Prof. Eckehard MÛLLER

754155 (2017)	STIFFCRANK *Advanced laser surface hardening of microalloyed steels for fatigue enhancement of automotive engine components*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,723,041.35	Start Date	01/07/2017
	EU Contribution	€ 940.813,41	End date	31/12/2020

Abstract

Fatigue strength of crankshafts needs to be improved to meet today's demands of higher performance automotive engines. In some cases, fatigue improvement can be difficult to reach due to poor residual stress distributions in relation to non-uniform/heterogeneous surface strengthened layers produced by standard techniques (induction surface hardening -IH- and deep rolling –DR-). In addition, the limited flexibility and complexity of equipment used for IH and DR may also hamper building next generation of high-performance engine crankshafts. STIFFCRANK will propose a novel laser-based processing strategy for surface hardening of microalloyed steel components, aimed at imparting an optimum distribution of residual stresses under the surface by generating uniform and homogenous hardened layers for improving fatigue resistance of the final steel component. The new strategy will involve using Advanced Laser Surface Hardening (ALSH) techniques for tailoring the energy distributed over the surface area and overcoming the limitations of conventional laser-surface hardening methods due to tempering of overlapped tracks during multi-pass laser beam hardening. Different options of laser processing technology will be employed, such as Laser Linear Oscillation Scanning (LLOS) and Beam shaping, for distribute the laser energy and induced optimum residual stress profiles. In STIFFCRANK, experimental and simulation tests will be combined with extensive measurements of the residual stress profile, detailed microstructural analysis and bending fatigue tests of advanced laser surface hardened steels and crankshafts. At the end of the project, the most promising conditions will be demonstrated by bench testing of full-size crankshafts.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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UNIVERSITAET KASSEL	DE	Prof. Thomas NIENDORF
LULEA TEKNISKA UNIVERSITET	SE	Prof. Alexander KAPLAN

747346 (2017)	LEAFSLIM *Lightweight steel Leaf Springs with improved durability and reliability*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,519,811.20	Start Date	01/07/2017
	EU Contribution	€ 911,886.02	End date	30/06/2020

Abstract

EURO-VI directive for emission reduction forces to cut weight of trucks, vans and other LCV and HCV. In particular, this means to reduce weight of suspension leaf springs. Despite the effort made up to date, further weight reductions must be achieved. Leaf springs currently are made with CrV steel grades, that are hot rolled, quenched and tempered and stresspeened.

To make feasible a leaf spring downweighting and cope with higher bending stresses, two approaches are possible: the optimization of residual stresses due to complex stresspeening process and the development of ultra high strength steels. The interactions and synergies between innovative complex stress peening processes and novel ultra high strength leaf spring steels will be studied at experimental and industrial scale, with the aim of lightening these components, guaranteeing an outstanding fatigue performance.

The aim of LEAFSLIM project is the weight reduction of the leaf springs for suspensions of light and heavy duty commercial vehicles through:

• Development of novel steel grades for lightweight leaf spring applications;

• Optimization of the Residual Stress profile through innovative stresspeening processes to achieve an enhanced profile of residual stresses, smoother surface roughness and relaxation resistance;

• Improvement of fatigue performance of the final components through a decrease in crack propagation rate within the residual stress field;

• Development of a Woodvine-analysis including the transient physical mechanisms of the peening processes derived from the residual stress profile and the microstructure of the new steel in order to predict fatigue lifetime and fatigue damage.

Coordinator	*Country*	*Scientific person in charge*
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ARISTOTELIO PANEPISTIMIO THESSALONIKIS	EL	Prof. Georgios SAVAIDIS
MUELLES Y BALLESTAS HISPANO ALEMANAS PROJECTS SL	ES	Mr Javier ISACH

747266 (2017)	INNOFAT *Innovative approach to improve fatigue performance of automotive components aiming at CO2 emissions reduction*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,785,311.20	Start Date	01/07/2017
	EU Contribution	€ 1,071,186.72	End date	31/12/2020

Abstract

Cars are responsible of 25% of CO2 emissions in the EU. To reduce these emissions, EU established a mandatory target, to be reached in 2020, of 95 g CO2/km (30% lower than the average CO2 emissions in 2012).

Vehicle lightweight is the main alternative to reduce CO2 emissions. Crankshaft is the heaviest special steel component in a vehicle. So, its weight reduction potential is high. The crankshaft downsizing must be performed taking into account that engine torque can not be reduced. So, if crankshaft is downsized, the steel fatigue limit must be increased to guarantee the required crankshaft in-service performance.

This INNOFAT project is focused on crankshafts manufactured with microalloyed steels, but the obtained results may be extrapolated to other automotive components (camshafts, gears, common-rails...).

Two different approaches are considered to improve the component fatigue performance: 1) steels with improved isotropy and 2) steels with higher strength. In the first case, different isotropy levels will be evaluated to determine which of them leads to the best fatigue performance. The second approach is based on a new high strength microalloyed steel (UTS>1.050 MPa) up to now only manufactured at laboratory scale.

Along the INNOFAT project, the crankshafts manufacturing process (from hot forging to different machining operations) will be studied at laboratory scale. Finally, the most suitable steel from each approach will be chosen to manufacture and test real crankshafts in order to estimate the weight reduction that could be achieved.

At the end of the project, some guidelines will be elaborated in order to facilitate the industrial implementation of the developed steels.

Coordinator	*Country*	*Scientific person in charge*
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709601 (2016)	**ULTRASLIM** *Ultrafine austenitic stainless steel as a lightweight automotive material*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,258,243.45	Start Date	01/07/2016
	EU Contribution	€ 754,946.07	End date	31/12/2019

Abstract

The 300-series austenitic stainless steels (ASS) are an excellent choice for the automotive sector, but its use is limited by the price fluctuation due to the nickel content. Current low Ni grades of 200-series do not fully match the outstanding balanced properties 300-series steels, thus they are not considered a sound option for this sector. ULTRASLIM aims at developing ultrafine ASS – with low Ni content, high strength/ductility and good formability/weldability for the automotive industry. The new steels will be based on modifications of actual 201 ASS with an appropriate martensite thermomechanical treatment for ultrafine (< 1µm) austenitic microstructure production.

Coordinator	*Country*	*Scientific person in charge*
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Technical Group Steel 8

Steel products and applications for building, construction and industry

The scope TGS8 includes:

- Structural safety and design methods, in particular with regard to resistance to fire and earthquakes
- Technologies relating to the forming, cutting, welding and joining of steel and other materials
- Design of assembled structures to facilitate the easy recovery of steel scrap and its re-conversion into usable steels and techniques for recycling
- Prolonging service life of steel products
- Standardisation of testing and evaluation methods

800732 (2018)

SCHEDULE

Steel concrete high efficiency demonstration - European collaborative experience

Info				
	Type of Project	Pilot&Demonstration	Duration (months)	48
	Total Budget	€ 4,486,470.30	Start Date	01/06/2018
	EU Contribution	€ 2,243,235.16	End date	31/05/2022

Abstract

SC is an innovative form of steel-concrete composite construction comprising two steel plates connected by a grid of tie bars and infilled with structural concrete. The plates act as load bearing formwork during the placement of concrete and as reinforcement to the concrete once it hardens. Composite action between the plates and the concrete is achieved through shear studs welded to the plates. SC construction is a direct competitor to reinforced concrete (RC) for wall and floor elements with the added benefit of reduced construction time due to the elimination of reinforcement and formwork fixing, elimination of formwork removal and the ability to maximise parallel activities through offsite construction. In industrial applications, where large numbers of electrical and mechanical items are supported from the structure, SC construction eliminates the complex and time consuming installation of embedded plates in RC leading to further time and cost saving.

A recent RFCS project (SCIENCE, 2017) produced comprehensive European design rules for SC structures. It also showed that structure volume can be reduced using SC compared to RC, leading to CO2 emissions reduction. What is now needed to promote the industrial exploitation of SC construction is a demonstration of the time and cost savings at a realistic scale.

The aim of this pilot project is to document the efficiency of SC by constructing a replica of a building forming part of a nuclear power plant. This has been chosen as the nuclear sector (where buildings and containment structures are currently built from reinforced or post-tensioned concrete) offers significant potential for SC. The project will address the challenges of SC module fabrication, erection, joining and concreting. All civil and structural works will be monitored and both time and cost will be recorded. The lessons learnt will be readily transferable to other applications such as core walls in tall buildings, retaining walls, bridges, etc.

Coordinator	*Country*	*Scientific person in charge*
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COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	FR	Mr Pierre SAUNIER
EGIS INDUSTRIES SA	FR	Mr Jean Luc TUSCHER
BOUYGUES TRAVAUX PUBLICS SA	FR	Mr Denis ETIENNE
UAB PEIKKO LIETUVA	LT	Mr Saulius GRIGAS
ONDERZOEKSCENTRUM VOOR AANWENDING VAN STAAL NV	BE	Dr Martin Liebeherr

800699 (2018)	DISSIPABLE *Fully dissipative and easily repairable devices for resiliern buildings with composite steel-concrete structures*			
Info	Type of Project	Pilot&Demonstration	Duration (months)	36
	Total Budget	€ 1,814,811.65	Start Date	01/06/2018
	EU Contribution	€ 907,405.82	End date	31/05/2021

Abstract

Anti-seismic devices previously designed and characterized within RFCS Projects by the proposal's authors will be further developed taking into account the experience collected so far. Optimized structural systems will be proposed, with improved dissipation, reliability and reparability features. Single storey buildings with seismic resistance provided by the improved devices will be built and subjected to strong earthquakes. Systematic post-earthquake repair and reassembly procedures for these buildings applied and provided as "instructions for use". Ability of repaired systems to resist strong earthquakes will be examined. Economic and environmental benefits and improved resiliency properties of the proposed systems will be quantified.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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RINA CONSULTING - CENTRO SVILUPPO MATERIALI SPA	IT	Dr Giuliana Zilli
UNIVERSITA DI PISA	IT	Prof. Walter SALVATORE

800687 (2018)	DESDEMONA *Detection of steel defects by enhanced monitoring and automated procedure for self-inspection and maintenance*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 2,200,885.75	Start Date	01/06/2018
	EU Contribution	€ 1,320,531.45	End date	31/05/2021

Abstract

DESDEMONA objective is the development of novel design methods, systems, procedure and technical solution, to integrate sensing and automation technologies for the purpose of self-inspection and self-monitoring of steel structures. The approach will lead to an increment of the service life of existing and new steel civil and industrial infrastructure and to a decrease in the cost associated to inspections, improving human activities performed in difficult conditions, safety and workers' potential by the use of advanced tools.

The research aims to expand beyond the current state-of-the-art new high-quality standard and practices for steel structure inspection and maintenance through the interrelated development of the following actions: i) steel structure geometry and condition virtualization through data fusion of image processing, thermography and vibration measurements; ii) developing of procedure for steel defect detection by robotic and automatic systems such as Unmanned Aerial Vehicles (UAV) and ground mobile robots iii) embedding sensor systems to revalorize and transform steel elements and structures into self-diagnostic (smart) elements and materials even through nanotechnologies, iv) realizing an experimental lab-based apparatus and a series of case studies inspected by intelligent and robotic systems.

The project outcome will have an impact on the reduction of the cost of steel structures inspection and maintenance and on the increase of user safety and comfort in industrial and civil environment. The proposal with a multidisciplinary approach fulfils the objectives of the Strategic Research Agenda of the European Steel Technology Platform.

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754198 (2017)	TRAFIR *Characterization of travelling fires in large compartments*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,199,975.10	Start Date	01/07/2017
	EU Contribution	€ 719,985.06	End date	31/12/2020

Abstract

Many studies of fires in large compartments reveal that they do not burn uniformly throughout the enclosure. They tend to travel and lead to highly non-uniform temperatures which implies a transient heating of the structure. Travelling fires are not considered in the Eurocodes : the main limit in developping models is the lack of large scale, realistic test results. This project aims to realize such tests and performing numerical simulations to define the conditions in which travelling fires develop, to build an analytical model which evaluate the thermal effect and to create design guidance which improves structural safety.

Coordinator	*Country*	*Scientific person in charge*
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THE UNIVERSITY OF EDINBURGH	UK	Dr Stephen WELCH
UNIVERSITY OF ULSTER	UK	Prof. Ali NADJAI

754185 (2017)	HAIR *Improved durability of steel sandwich panel constructions regarding hygrothermal and airtightness Performance*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,341,565.70	Start Date	01/07/2017
	EU Contribution	€ 804,939.42	End date	30/06/2020

Abstract

HAIR is concerned with safeguarding the durability of steel intensive building envelopes against thermal and moisture related hygrothermal failures of the type that are increasing common, in part as a consequence of the more widespread use of well insulated construction. The project concentrates on investigations and solutions to prevent condensation and corrosion effects at steel sandwich construction, which have been increasing in recent years throughout Europe. Improved solutions in relation to both new build and refurbishment will be developed to produce reliable design methods and practical guidance for avoidance of failures in the future. As a consequence, the work will reduce the levels of risk associated with hygrothermally induced premature corrosion of steel sandwich panel constructions, and moisture related degradation of non-steel elements such as insulation materials and internal linings. The project also focusses on renovating and repowering of existing buildings by over-cladding with steel sandwich panel constructions. Especially, the impact on the building physics performance due to changing the envelope properties and interactions between heat, air and moisture on element level are regarded. The conducted investigations are raised from element to building level in order to extend applications of steel sandwich panel constructions to a wider use for several building types, climatic conditions and user profiles. In this way, the whole building performance of the systems will be investigated and assessed with regard to their influence on the durability, energy efficiency and life cycle performance of hall-like buildings. In addition to the development of explicit solutions, the principles of durable steel sandwich panel constructions will be summarised in guidelines.

Coordinator	*Country*	*Scientific person in charge*
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OXFORD BROOKES UNIVERSITY	UK	Prof. Raymond OGDEN
IFBS EV	DE	Dipl. Ing. Kai KAHLES

754102 (2017)	STEELWAR *Advanced structural solutions for automated steeelrack supported warehouses*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 2,455,459.80	Start Date	01/07/2017
	EU Contribution	€ 1,473,275.88	End date	30/06/2021

Abstract

Automated Rack Supported Warehouses (ARSW) represent the future of storage technology, providing substantial savings in terms of cost, space and energy with respect to traditional warehouses. Currently, designers refer to building codes, without any control of their correct applicability to the specific typologies of these peculiar steel structures. This creates important safety and efficiency problems because ARSWs' structural characteristics are considerably different from those of normal steel structures for buildings. Basing on an accurate evaluation of safety level of the design concepts actually adopted in current practice (in the total absence of specific design codes), the main objective of the proposal is the definition of dedicated innovative design approaches for ARSWs in not seismic and seismic conditions. In particular, attention will be focused on loading conditions that characterize the ARSWs during its installation and service life and on ductile design under seismic loading. Based on such analysis specific design rules and recommendations will be carried out for erection and design of ARSWs.

Coordinator	*Country*	*Scientific person in charge*
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754092 (2017)	GRISPE PLUS *Valorisation of knowledge for specific profiled steel sheets,*			
Info	Type of Project	Accompanying Measures	Duration (months)	18
	Total Budget	€ 818,775.25	Start Date	01/07/2017
	EU Contribution	€ 491,261.87	End date	31/12/2018

Abstract

The core objective of GRISPE+ is the promotion, dissemination, valorization and use in practice of the knowledge, technical guidelines, calculation methods, background information obtained on, and codification proposals made for, 7 families of economic, environmentally friendly and safe steel profiles in the RFCS funded project No RFSR-CT-2013-00018 “Guidelines and Recommendations for integrating specific profiled steel sheets in the Eurocodes (GRISPE)" by means of high-impact, innovative dissemination tools including e-tools (structured online database, eLectures, e-networks, input to web-based media) and valorization activities such as strategically located dissemination workshops.

It also gives the opportunity to promote the use of cold-formed thin-gauge elements in the construction market.

In addition, in the context of the on-going process of evolution of the Eurocodes, GRISPE+ will seek to pursue the dialogue with CEN TC250/SC3/WG3 in order to further contribute to the technical issues raised and to help with the ongoing process of incorporating GRISPE and GRISPE+ outputs into the Eurocode EN 1993-1-3

Coordinator	*Country*	*Scientific person in charge*
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SOKOL PALISSON CONSULTANTS SARL	FR	Mrs Anna PALISSON
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UNIVERSITA DI PISA	IT	Prof. Walter SALVATORE

754072 (2017)	**LOCAFIPLUS** *Temperature assessment of a vertical steel member subjected to localised fire - Valorisation*			
Info	Type of Project	Accompanying Measures	Duration (months)	18
	Total Budget	€ 813,701.55	Start Date	01/07/2017
	EU Contribution	€ 813,700.65	End date	31/12/2018

Abstract

LOCAFI+ represents the valorisation project of LOCAFI whose main objective was to provide designers calculation methods with scientific evidence that will allow them to design steel columns subjected to localised fires such as those that may arise, for example, in car parks. In fact, at the time being, such evidence, models and regulations exist for beams located under the ceiling, but nothing is available for columns, and this situation may lead to unnecessary and excessive thermal insulation that jeopardizes the competitiveness of whole steel projects.

Within LOCAFI, number of tests and numerical investigations enabled to gain comprehensive understanding of the involved phenomena that led to the quantification of convective and radiative heat fluxes received by a column subjected to a localised fire. This combination of experimental and numerical investigation also led to the definition of two calculation methods: (i) a quite complex method implemented into FE software; (ii) a simplified method implemented into the existing user-friendly free software OZone and aimed at being introduced into the Eurocodes.

The technical objective of LOCAFI+ is to disseminate the methodology for the fire design of columns under localised fire to practicing engineers in various countries by exploiting the results obtained in LOCAFI. The transfer of the developed calculation methods into practice will be achieved by national seminars and clearly structured design manuals.

Coordinator	*Country*	*Scientific person in charge*
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754048 (2017) EQUALJOINTS-PLUS

Valorisation of knowledge for European pre-qualified steel joints

Info				
	Type of Project	Accompanying Measures	Duration (months)	24
	Total Budget	€ 1,218,711.55	Start Date	01/07/2017
	EU Contribution	€ 1,218,711.55	End date	30/06/2019

Abstract

Within the previous RFCS project EQUALJOINTS (RFSR-CT-2013-00021), seismic prequalification criteria of steel joints have been developed. This proposal aims at the valorisation, the dissemination and the extension of the developed prequalification criteria for practical applications to a wide audience (i.e. academic institutions, Engineers and architects, construction companies, steel producers).

The main objectives of the proposal are the following:

• To collect and organize informative material concerning the prequalified joint typologies: informative documents will be prepared in 12 languages (English, Spanish, French, German, Italian, Dutch, Portuguese, Czech, Bulgarian, Romanian, Greek, and Slovenian);

• To develop pre-normative design recommendations of seismically qualified joints on the basis of results from Equaljoints project;

• To develop design guidelines in order to design steel structures accounting for the type of joints and their relevant non-linear response;

• To develop a software and an app for mobile to predict the inelastic response of joints;

• To organize seminars (2) and workshops (14) for disseminating the gained knowledge over EU and internationally. Workshops and seminars will be organized in the own-countries of partners involved in the project as well as in United States of America (USA). With this regard, since in EQUALJOINTS dog-bone joints with heavy sections have been qualified using US shapes produced in Europe, the organization of seminars in USA will be an important opportunity to get to the US Market, consolidating the gain of European economy and having beneficial impact on exportation of European products in USA;

• To create a web site with free access to the users in order to promote the obtained results;

• To create a You-Tube channel to make available the videos of the experimental tests and simulations to show the evolution of damage pattern.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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753993 (2017)	ANGELHY *Innovative solutions for design and strengthening of telecommunications and transmission lattice towers using large angles from high strength steel and hybrid techniques of angles with FRP strips.*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,220,392.50	Start Date	01/07/2017
	EU Contribution	€ 732,235.50	End date	31/12/2020

Abstract

Angle sections are extensively used in lattice towers and masts for telecommunication or electricity transmission. In addition, single or built-up sections made of angles are used in a wide field of civil engineering applications including buildings, bridges or for strengthening existing structures. However, there is a lack of consistent European rules for design for members made of angle profiles. Recent developments have led to a wider application of large angle sections made of high strength steel, for which European design rules are missing. Due to increasing loads, strengthening of existing towers, especially for communication, is an issue faced in everyday practice. However, design codes cover only one specific configuration.

The objective of this proposal is the development of design rules that exploit the carrying potential of angle sections, including large angles from high strength steel, the improvement of existing rules for built-up sections and the incorporation of innovative types of built-up sections composed of two angles with unequal sections. In addition, hybrid profiles composed of angle sections and FRP plates will be investigated and relevant design rules developed. Such hybrid members provide innovative and cost effective solutions for strengthening existing lattice towers. Experimental and numerical investigations will be performed at the level of cross sections, members, as well as of structural tower sub-assemblies to incorporate the influence of realistic connection conditions, existing eccentricities and load shedding between tower walls. Case studies will be examined and a performance-based assessment of the actual system safety will be conducted incorporating uncertainties in loads, material and geometry. A comprehensive evaluation of the reliability infused by the new design rules will be made. The proposed rules will be integrated in design software for towers.

Coordinator	*Country*	*Scientific person in charge*
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751583 (2017)	STABFI *Steel cladding systems for stabilization of steel buildings in fire*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,438,020.85	Start Date	01/07/2017
	EU Contribution	€ 862,812.51	End date	30/06/2020

Abstract

It has been shown in a recent project that considerable savings can be achieved for structural members, columns, beams and trusses, if sandwich panels and trapezoidal sheeting are used for stabilizing the whole structure, compared to the case when stability is ensured by other means. The question addressed here is: can we achieve similar savings in fire due to this stabilizing effect? Until now stabilization with these cladding structures has been used only without fire. The project offers innovation of using it also during fire, which is expected to lead to considerable savings in costs and carbon emissions for steel structures in competition against other materials in buildings.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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749959 (2017)	INNO3DJOINTS *Innovative 3D joints for robust and economic hybrid tubular construction*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,483,735.50	Start Date	01/07/2017
	EU Contribution	€ 890,241.30	End date	30/06/2020

Abstract

The main goal of INNO3DJOINTS is to develop innovative plug-and-play joints for hybrid tubular construction, whereby tubular columns are combined with cold-formed lightweight steel profiles to provide a highly efficient structural system. For this, the following objectives will be fulfilled:

• Development of a design procedure in the framework of the component method for innovative plug-and-play joints. This is currently not addressed in the structural eurocode and consistency with the component method will always be kept. This is accomplished by carrying out extensive experimental and numerical studies. These are carried out both at the joint level and at the component level;

• Codifying the design procedures for cold-formed connections (EC3-1-3) in a completely consistent format with the component method and EC3-1-8 – which is also currently not achieved;

• Characterization of particular aspects of joints involving cold-formed tubular sections. Influences of manufacturing procedures in the behavior of the profile. Influences of the corner welded region on the welding of the plug-and-play connection;

• Implementation of a general procedure for tackling the 3D behaviour of these particular steel joints, essential to deal with robustness issues. A generalized finite element that includes all studied components of the design model for joints with 3D behaviour is developed and further implemented in a software tool – firstly for analysis of the connection itself and secondly for the overall structural building analysis. Although this aspect may be further extendable to other types of cross sections and fabrication procedures, in this project focus is only given to the hybrid connections.

Finally, the project demonstrates the suitability of the hybrid system including the innovative joints for low to medium-rise buildings under normal and accidental actions (fire and seismic) through representative case studies, using the developed methodologies.

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747847 (2017)	PROGRESS *Provisions for Greater Reuse of Steel Structures*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,664,995.75	Start Date	01/06/2017
	EU Contribution	€ 998,997.45	End date	31/05/2020

Abstract

The PROGRESS project will provide methodologies, tools and recommendations on reusing steel-based components from existing and planned buildings. The project particularly targets the design for deconstruction and reuse of envelopes, load-bearing frames, trusses and secondary elements of single-storey buildings framed in steel. This building type has broad applicability as industrial, commercial, sports, exhibition, warehouse facilities, and shows most potential in suitability for reuse and viability for circular-economy business models. The whole life benefits of reusable single-storey steel buildings will be quantified from environmental and economic viewpoints. The outcomes will be extensively disseminated in particular among manufacturers, designers, contractors and researchers.

Implementation of a circular economy involving essentially closed material loops is only starting to take the first steps. The strong industrial motivation in the project is based on the need to establish novel profitable business ecosystems and to increase competitiveness of steel products. Our consortium proposes to develop technologies and business models in the steel construction sector to address the most significant needs in the business and society.

The project offers a completely new point of view on the design and execution of buildings and manufacture of construction products. They will be no longer considered as end products, but instead in the scope of circular economy as a part of continuous chain of the products ecosystem. The construction and demolition waste will became a new resource to be considered in the future buildings design.

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745982 (2017)	FASTCOLD *Fatigue strength of cold-formed structural steel details*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,873,935.80	Start Date	01/07/2017
	EU Contribution	€ 1,724,361.48	End date	31/12/2020

Abstract

Fatigue design rules for cold-formed steel sections and details are completely missing on a European level. EN 1993-1-3, deals only with the static design of cold-formed thin-walled sections. Its commentaries, and related design manuals, do not even mention fatigue design. EN1993-1-9, the relevant part of Eurocode-3 for fatigue design, is not covering design and classification of cold-formed thin-walled details.

Cold-formed steel members are increasingly adopted in racking systems installed in logistic warehouses where "storage and retrieval" (S/R) machines run faster and faster, while carrying heavier and heavier loads in a "7 days - 24 hours" economy. For this reason, loading conditions on these type of racks and their auxiliary structures are not anymore quasi-static but dynamic, and cold-formed steel structural details may be subjected to load cycles in the order of 0.5 million/year. Despite many (high-cycle) fatigue failures recently occurred, the total lack of fatigue assessment rules for cold-formed steel structural details at European level represents a relevant problem for the whole European logistic industry, causing losses estimated in the order of 25-30 millions/year.

Answering to this industrial need, FASTCOLD aims at generating essential knowledge in the field of fatigue assessment of cold-formed steel structural details, with the intrinsic wider perspective of a “pre-normative” research, as the results will be presented in a way compatible for immediate implementation in Eurocodes. The project aims at developing fatigue design rules of general validity for cold-formed steel structural details and at generating a classification of such details according to their fatigue strength (like those given for thick-walled, hot-rolled steel details in EN 1993-1-9). Specific focus will be given to applications for the logistic industry (which represent a typical case of fatigue prone cold-formed structural steel details).

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UNIVERSITA DI PISA	IT	Prof. Walter SALVATORE
UNIVERSIDADE DO PORTO	PT	Prof. Abilio JESUS
EUROPEAN RACKING FEDERATION	UK	Dr Kees TILBURGS

743504 (2017)	STROBE *Stronger Steels in the Built Environment*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,519,693.75	Start Date	01/07/2017
	EU Contribution	€ 911,816.25	End date	31/12/2020

Abstract

This project seeks to overcome specific obstacles to the wider use of High Strength Steels (HSS) sections (S460 to S700), both homogeneous and hybrid, in building structures through the development of:

• Less conservative ductility and toughness requirements;

• Plastic design rules for HSS continuous beams and frames;

• Design rules to ensure stability of HSS members;

• An analysis tool for determining/optimising the dynamic response of HSS floor systems;

• Comparative designs (HSS versus S355) quantifying weight, carbon and cost savings resulting from the application of the research.

Proposed amendments to Eurocode 3 will be prepared and a seminar will be held with practitioners.

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710068 (2016)	SBRIPLUS *Valorisation of Knowledge for Sustainable Steel-Composite Bridges in Built Environment*			
Info	Type of Project	Accompanying Measures	Duration (months)	24
	Total Budget	€ 1,125,079.80	Start Date	01/07/2016
	EU Contribution	€ 651,810,38	End date	30/06/2018

Abstract

Within the previous RFCS research project SBRI "Sustainable Steel-Composite Bridges in Built Environment€, a holistic approach was applied to steel-composite bridges by combining analyses of environmental, economic and functional qualities along the entire life-cycle of bridges. This proposal aims at the valorisation, the dissemination and the extension of the developed method for Advanced applications. A wide audience including bridge engineers and authorities should be reached, in order to assure the application of the project outcome.

Main tasks:

• Explanation of methodology and background by elaboration of worked examples and improvement of the SBRI-tool;

• Extension of bridge types by advanced application to innovative bridges across Europe demonstrating the flexibility and applicability of the methods developed;

• Dissemination activities (11 European languages, addition of national regulations and practices, organization of 13 workshops);

• Providing of recommendations for advanced applications and guidelines for bridge authorities.

Two design manuals will be prepared, drafted and translated in 11 European languages (CZ, EN, ES, FR, HR, DE, IT, NL, PT, PL, RO, SW) and distributed within the planned dissemination activities. Design Manual I includes background information on the methodology and worked examples for easy application in daily design work with the help of the improved software tool. By analyses of built examples across Europe the SBRI method is applied to innovative bridge solutions, results and conclusions are shown in Design Manual II. Another important task is providing of recommendations summing up and concluding the analyses and being the bases for guidelines to be elaborated for bridge authorities. The seminars around Europe offer the opportunity to present not only the results of the SBRI project, but also the advanced application to innovative solutions in addition to national regulations and practice.

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RAMBOLL SVERIGE AB	SE	Prof. Peter COLLIN
RAMBOLL SVERIGE AB	SE	Prof. Peter COLLIN

710040 (2016)	REDUCE *Reuse and demountability using steel structures and the circular economy*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,143,809.75	Start Date	01/07/2016
	EU Contribution	€ 1,286,285.85	End date	31/12/2019

Abstract

The project will provide methodologies, tools and guidance to assist in design for deconstruction, particularly of composite steel structures for multi-storey buildings. This will lead to new shear connection systems for demountable composite construction, based on push tests and beam tests to verify composite action and to develop design rules.

The whole life benefits of reusable structures will be quantified using LCA and circular economy indicators. Opportunities for greater standardisation and the use of BIM will be explored to facilitate deconstruction. A demonstration of demountability of the developed system is planned. Guidance on design for deconstruction and reuse will be prepared.

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709962 (2016)	DURAMECH *Towards Best Practice for Bolted Connections in High Strength Steels*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,693,185.45	Start Date	01/09/2016
	EU Contribution	€ 1,015,911.27	End date	31/08/2019

Abstract

The main goal of the proposed DURAMECH research project is to understand, predict and ultimately increase the fatigue resistance of bolted connections in moderately thick high strength steel materials, used in applications for heavy machinery. By combining a substantial experimental effort with advanced numerical methods, the fatigue properties of these joints will be assessed and compared with welded solutions that typically have a much lower fatigue resistance. At the same time, design guidelines and best practice modelling techniques for these types of connections will be derived. During the project the results are applied to relevant cases supplied by the end users.

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709936 (2016)	**OPTOSTEEL** *Optimizing the toughness of high strength steel weld metal*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,556,567.35	Start Date	01/07/2016
	EU Contribution	€ 933,940.41	End date	31/12/2019

Abstract

For many steel constructions, high toughness of welds is a critical parameter to meet with current safety standards. For some high strength steel grades, HSS, the required weld metal toughness can be hard to reach due to non-uniform metallurgy achieved by means of standard welding techniques. Heterogeneous distribution of alloy elements of the wire filler metal into the weld seam, together high dilution levels, can lead to poor toughness in conventional welded HSS. For conventional laser arc hybrid welding, LAHW, of thick HSS plates, in addition, the narrow laser welding gaps associated to narrow-and-deep penetration hybrid welds limit the penetration of the elements added by the filler wire and, thus, the attainment of homogenous element distribution along the hybrid weld. As a consequence, scattering of the toughness data is obtained when testing at low temperature, down to -60º C. In the OptoSteel proposal, a novel experimental and simulation-based approach, combined with extensive toughness testing and a detailed metallurgical characterization of welds, will allow defining the new welding strategies and procedures, including filler metal development, aimed at ensuring homogeneous filler material distribution across the weld metal. This will lead to optimized weld metal toughness, enabled by using advanced laser welding techniques and methods, which are non-conventional LAHW and narrow gap multi-layer laser welding with wire addition, NGMLW.

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709892 (2016)	**HOLLOSSTAB** *Overall-Slenderness Based Direct Design for Strength and Stability of Innovative Hollow Sections*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,740,184.20	Start Date	01/07/2016
	EU Contribution	€ 944,210.52	End date	30/06/2019

Abstract

In order to meet the increasing demands for sustainable & economic constructions, the European steel industry sees the increased use of more thin-walled sections and/or higher-strength steel grades as a main industrial goal. However, this leads to a number of scientific and engineering challenges, which stem from greatly increased relevance instability phenomena, as well as from the lack of appropriate design rules for slender, high-strength hollow sections. This project intends to address these points:

• "Direct" design rules for the cross-sectional strength of hollow sections will be developed, on the basis of the "Overall Interaction Concept". The method will lead to a continuous strength function for the class 1 to 4 range and take advantage of beneficial effects (mutual restraint, real stress state, strain hardening, …). For CHS and EHS in particular, the new method will fill the current gap in design rules for class 3 and 4 sections;

• The method will be expanded for the applications in beam-columns and interactive L-G buckling;

• The elastic buckling behaviour of hollow sections will be studied in a systematic, (semi-)analytical way using the Generalized Beam Theory;

• The safety level of the new design rules will be ascertained on the basis of the methodology of EN 1990, making use of the test data provided in the project (physical and numerical tests) as well as production data regarding material properties and geometric tolerances provided by the industrial partners;

• The fields of application and of product improvement will be studied by R&D and engineering representatives of major steel industry stakeholders. Case-studies of structures built using traditional design rules will be re-assessed to determine the economic and technical advantages of the new design rules and developments in steel grades, shapes, and wall thicknesses;

• Specific design guidelines and tools (software) will be developed and made available to the industry.

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709807 (2016)	LASTEICON *Laser technology for innovative connections in steel construction*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,927,669.30	Start Date	01/07/2016
	EU Contribution	€ 1,156,601.58	End date	31/12/2019

Abstract

LASTEICON aims to eliminate the use of excessive amount of stiffener plates and welding in steel joints, using laser cutting technology (LCT). The project will notably enhance the economy and sustainability of the fabrication as well as the aesthetic of any type of steel joints. Major focus is given to I-beam-to-CHS-column connections to promote hollow sections, since their excellent structural properties combined with their aesthetic appeal will lead decision makers (architects, building owners) to use more steel products in the building construction sector. Extendibility of the solution to other construction applications will be investigated with reference to steel truss girders.

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709782 (2016)	OUTBURST *Optimization of steel plated bridges in shape and strength*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,608,410.50	Start Date	01/07/2016
	EU Contribution	€ 965,046.30	End date	30/06/2019

Abstract

Curved steel panels are increasingly used in the design of new bridges due to architectural and/or structural demands. This is a recent trend which has resulted from technological advances that allow the economical use of curved shapes. However, design rules and design recommendations for curved plated members are still scarce and fundamental knowledge needs to be developed at various levels. The main objective of this research project is to develop solid knowledge on the structural behaviour of curved and nonrectangular steel panels (stiffened and unstiffened) made of mild steel and/or high strength steel for an integrated design approach taking into account also the aesthetic impact of bridges in the LCA assessment. The Structural Eurocodes do not cover the design of curved and nonrectangular panel segments. In fact, the scope of EN 1993-1-5 is limited to flat panels and EN 1993-1-6 is also not applicable to this type of elements since its scope is limited to shells of revolution. Design rules for curved and nonrectangular steel panels with and without stiffeners used in box-girder bridges and bridges with I-profile beams will be developed based on laboratory tests and extensive numerical parametric studies, and the following objectives will be targeted:

• Development of integrated design guidelines for the efficient, economic design of curved plated structures taking into account all relevant loading situations and design checks as well as the impact on the environment;

• To establish relevant interactions (dual flange/web role of curved cross-sections);

• To develop design rules for transverse stiffeners taking account of a possible dual flange/web role in curved panels;

• To optimize the number, shape and distribution of longitudinal stiffeners;

• To extend the plate buckling rules to plates with variable width, which are not yet in EN 1993-1-5, though they exist in bridges with curved shapes in transverse as well as in longitudinal direction.

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709600 (2016)	**PUREST** *Promotion of new Eurocode rules for structural stainless steels*			
Info	Type of Project	Accompanying Measures	Duration (months)	18
	Total Budget	€ 613,618.80	Start Date	01/07/2016
	EU Contribution	€ 368,171.28	End date	31/12/2017

Abstract

This project will disseminate new design guidance for structural stainless steel which has been developed over the last 10 years, primarily arising from RFCS-funded research.

Activities are mostly targeted at design practitioners and include:

• Updating and extending the Design Manual for Structural Stainless Steel (Third Edition);

• Translating the Design Manual from English into 9 languages;

• Developing online design software and design apps in accordance with the new stainless Eurocode rules;

• National seminars;

• Recording webinars for distance learning;

• Publishing articles in national engineering journals.

Teaching resources aimed at engineering students will also be prepared.

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709526 (2016)	REFOS *Life-Cycle Assessment of a Renewable Energy Multi-Purpose Floating Offshore System*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,826,176.80	Start Date	01/07/2016
	EU Contribution	€ 1,095,706.08	End date	31/12/2019

Abstract

REFOS is an innovative project, aiming at the development, design and life-cycle assessment of a multi-purpose floating TLP steel platform, suitable for combined offshore wind/wave energy resources exploitation. It involves a multi-discipline partnership, which covers all aspects of REFOS platform analysis and design, through a systematic, integrated and state-of-the-art approach, validated through structural and hydrodynamic testing.

The ultimate target is the final design of REFOS platform and its components, in form of a detailed design report and specific drawings, suitable for two typical locations (one in the Mediterranean and one in the North Sea) and adjustable to the environmental conditions and design requirements of a specific offshore site. The final design is accompanied by a techno-economic analysis, demonstrating the feasibility of the proposed solution. Towards this target, detailed structural analysis is performed, together with hydro-elastic dynamic analysis of the floating system, accounting for the W/T and OWC devices.

The work in REFOS continues and extends the results of a national project, where a multi-purpose floating platform, suitable for the Aegean Sea, has been studied at a preliminary stage, but without structural design considerations.

The project has three phases:

• Definition of design parameters and environmental conditions at selected locations; hydro-aero-elastic analyses; air turbine design for wave energy;

• Structural design of the steel tower, platform, and tendons; mechanical testing and numerical simulations; testing of a scaled-down physical model in the Wave Tank;

• Final design & techno-economic life-cycle analysis; dissemination of results.

The proposed floating solution will constitute a breakthrough in renewable energy technology, allowing for cost-efficient exploitation of combined offshore wind/wave energy in Europe, towards new market opportunities for the steel- and the renewable-energy-industry.

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709434 (2016)	INNOSEIS *Valorization of innovative anti-seismic devices*			
Info	Type of Project	Accompanying Measures	Duration (months)	18
	Total Budget	€ 995,660.35	Start Date	01/07/2016
	EU Contribution	€ 597,392.00	End date	31/12/2017

Abstract

Valorization actions for 12 innovative anti-seismic devices will be undertaken. The devices were recently developed in the frame of RFCS, EU and national research projects by the partners involved in the project. Information documents for all devices will be produced for dissemination to all partners of the construction sector such as Architects, structural Engineers, construction companies, steel producers and all potential decision makers of the construction sector. These documents will be bundled in a volume for dissemination. The volume will be translated in several European languages. Criteria will be set on which it may be decided which of the devices are subject to CE marking in accordance with EN 15129 and which may be considered as innovative systems that require a code approval in EN 1998-1. For the latter pre-normative design recommendations will be drafted that will allow them to receive the status of code-approved systems. A reliability based methodological procedure to define values of behavior factors (q-factors) for building structures will be established. This procedure will be applied in turn to determine q-factors for structural systems with the anticipated devices. Case studies with application examples in which the devices are employed will be worked out. The case studies refer to new single story steel buildings, new multi-story steel-concrete composite buildings and to interventions for seismic upgrading of existing buildings. Seminars and Workshops will be organized in large parts of Europe. In addition, Seminars will ne organized in non-European Mediterranean high seismicity countries to promote technologies and codes developed in Europe. A web site with free access to the users will be created and promoted to practice. Printed and electronic material will be produced and disseminated to all involved in the construction sector.

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UNIVERSITATEA POLITEHNICA TIMISOARA	RO	Prof. Dan DUBINA

Technical Group Steel 9

Factory-wide control, social and environmental issues

The scope TGS9 includes:

- Instrumentation, control and automation including artificial intelligence and information technologies
- Analytical techniques
- Working conditions and quality of life at the work place
- Energy, water and material flow management
- Ergonomic methods
- Occupational health and safety
- Reduction of exposure to occupational emissions
- Standardisation of testing and evaluation methods
- New processes for sustainable steel production
- Recovery and valorisation by-products
- Techniques for classification and preparation of steel scrap
- Control and protection of the environment in and around the workplace
- Restoration of steelwork sites
- Recovery of spent liquors
- Water treatment
- Life cycle assessment and sustainable products

839990 (2019)	**Optimasteel** *Optimum working conditions for ageing workers in Steel industry*			
Info	Type of Project	Accompanying Measures	Duration (months)	21
	Total Budget	€ 637,746.45	Start Date	01/06/2019
	EU Contribution	€ 637,746.45	End date	28/02/2021

Abstract

OptimaSteel addresses the ergonomics problems caused by human computer interaction in a steel industry with an ageing workforce, and its impact in working conditions, health and safety and quality of life in the workplace.

Successful ageing at work and how to support and retain older workers is a critical challenge for organizations. Such issues are particularly accurate in the steel industry. Steel is an ageing industry. The median age of steel industry employees has always been higher than the all-manufacturing average, both in Europe and in the US.

OptimaSteel will address these problems by identifying, assessing, demonstrating and disseminating towards the steel industry state of the art technologies and methods to improve the quality of life of older adults in their working environment. The solution to current health, safety and wellbeing of steel workers does not rely on a single technology or on a new development, and only by combining physical, ergonomic, nutritional and cognitive aspects can a holistic approach to enhance the wellbeing and quality of life at the workplace of older adults be developed. The main goal of our project is therefore to build on state of the art solutions from top-end technology developers and research institutes across EU, to provide well-balanced and holistic systems that are able to meet the steel industry needs and offers benefits and an enhanced quality of life for older adults at the workplace.

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Partners

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839227 (2019)	**REUSteel** *Dissemination of results of the European projects dealing with reuse and recycling of by-products in the steel sector*			
Info	Type of Project	Accompanying Measures	Duration (months)	24
	Total Budget	€ 518,858.05	Start Date	01/06/2019
	EU Contribution	€ 518,858.05	End date	31/05/2021

Abstract

Many research initiatives and projects funded by the RFCS have been undertaken in order to improve reuse and recycling of by-products which are produced in different stages of the integrated or electric steel production cycle (e.g. slags, sludge and scale) and for recovering valuable materials from wastes. Recently, the concept of "circular economy" is receiving increasing attention in the scientific and technical community. The circularity concept pushes researchers and industries to look for synergies with other industrial sectors to analyze and investigate solution for improving by-product re-use and recycling both inside and outside the steelmaking cycle, by thus developing examples of industrial symbiosis.

However, the joint efforts of the EU steel industries on this theme are still not widely known. Moreover, the exploitation of some research results are sometimes hampered by not homogeneous regulations in the different European countries concerning even the definition and classification of some materials as by-products or wastes.

REUSteel aims at extensively disseminating and valorizing important research results on the reuse and recycling of by-products, based on an integrated critical analysis of many list of EU-funded projects, in order to promote the results exploitation and increase the synergies with other sectors. This analysis will also aim at identifying the most urgent needing and ambitions of the EU steel sector, by defining future research topics in this field and highlighting eventual non-technical showstoppers. Common actions will be identified in order to overcome or smooth the existing obstacles and to pave the way to research and implementation of innovative solutions. The target is a wider improvement of by-products reuse and recycling, which can be developed in the future years.The key findings will be implemented in the ESTEP's Strategic Research Agenda. REUSteel will contribute to the low carbon Europe and Big-Scale initiative of EUROFER.

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847296 (2019)	OMA *Online Microstructure Analytics*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 6,296,616.20	Start Date	01/07/2019
	EU Contribution	€ 3,747,804.66	End date	31/12/2022

Abstract

To reduce CO2 emissions and energy consumption in mobility and transport, the steel industry enables weight savings by expansion of the Advanced High Strength Steel (AHSS) product portfolio. AHSS owe their strength to their largely refined and complex microstructures, containing multiple metallurgical phases. Optimal control of the thermo-mechanical processing of AHSS requires inline sensors for real-time monitoring of evolution and consistency of microstructure and material properties. This OMA proposal aims at improving the quality of the information on AHSS's microstructure and mechanical properties extracted from existing inline sensing equipment by combining the strengths of multiscale material models, model inversion techniques and advanced data analytics.

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847260 (2019)	**Slagreus**[4] *Reuse of slags from integrated steelmaking*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,235,085.40	Start Date	01/06/2019
	EU Contribution	€ 741,051.24	End date	30/11/2022

Abstract

The main points of focus of the project will be the internal recycling of a Fe-enriched BOF slag fraction as a substitute for raw material as iron ore fines for the sinter plant and the external use of a Ca- and P enriched BOF fraction as high valuable cement additive and fertilizer. A new processes chain will be developed to increase the reuse.

At the BOF slag special emphasis will be laid on a new process route to concentrate the Fe-content and reduce the P-content in the substitute. The route comprises a primary liquid Fe-enrichment by slag recirculation and secondary solid and dry Fe-enrichment processes. The enrichment processes take benefit from differences of physical and chemical slag properties as density, viscosity, solidification properties, magnetic susceptibility, hardness and thermal expansion.

The secondary Fe-enrichment consists of a microwave assisted comminution of the BOF slag, selective grinding and dry magnetic separation. The secondary Enrichment step will multiply the Fe-concentration in the substitute of the primary step and further reduce the P-content. Simultaneously the quality of the Ca-rich non magnetic fraction will be improved. Due to the dry processing of the BOF slag the produced Ca-rich fractions will keep the hydraulic properties. On this basis the Ca-rich fractions will be evaluated for an external use in the cement industry as a raw meal in clinker production and as alternative reactive cement main constituent. Also the external use of the CaO-rich fraction from magnetic separation as lime fertilizer will be evaluated.

The internal and external reuse concepts of SLAGREUS will be assessed regarding the environmental and economic advantages.

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[4] The Project has been transferred from TGS9 to TGA1 (see Annex I).

847249 (2019)	**E-CO-LadleBrick** *Ecological and Economical waste management of the ladle refractory bricks by implementing circular economy criteria*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,280,225.60	Start Date	01/06/2019
	EU Contribution	€ 768,135.36	End date	31/05/2022

Abstract

Ladle refractory material waste in the European Steelworks is currently mostly being dumped in landfills. This Circular Economy Project answers to this situation based on a 4 R´s model, combining a Reduction of the waste by means of monitoring and optimizing the ladle refractory consumption (via remaining brick thickness) with processes for Reusing/Remanufacturing and Recycling the ladle refractory brick wastes. The final optimized application will come from an expert decision tree and accompanied by the corresponding LCA studies. This innovative approach and knowledge would be totally transferable to other steel companies with both significant environmental and economic benefits.

The main aims of the "E-CO-LadleBrick" project are the following:

• To achieve an innovative ecological and economical waste management for the worn ladle bricks by implementing Circular Economy criteria based in environmental 4R model (Reduce, Reuse, Remanufacture and Recycle).

• To optimize remaining final thickness for the bricks used as ladle refractory (Reduce) by means of developing a 3D laser scanner technique (aiming to high accuracy measures, deviations under 10 mm), together with machine learning models and regression analysis. This approach can be replicated and implemented in any other Steel Plant.

• To optimize the valorisation of the worn bricks after their use as ladle refractory (Reuse, Remanufacture and Recycle) by means of finding suitable applications as well as their benefits and restrictions and implementing a data-based decisión mechanism for best valorisation in either Reuse, Remanufacture or Recycle. This approach can be replicated and implemented in any other Steel Plant.

Coordinator	*Country*	*Scientific person in charge*
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847203 (2019)	**DynReAct** *Refinement of production scheduling through dynamic product routing, considering real-time plant monitoring and optimal reaction strategies*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,275,448.50	Start Date	01/06/2019
	EU Contribution	€ 765,269.10	End date	30/11/2022

Abstract

Aim of this project is to improve flexibility of production scheduling in flat steel production by generation of optimized production plans for each individual coil at each production step considering real-time plant information. This concept enables immediate reactions to critical situations like insufficient plant performances or off-spec coils. The optimal routings will be estimated using real-time capable plant performance models derived from machine learning on large historical data, which will be incorporated in multi-objective, stochastic optimization methods.

The applicability of the system will be demonstrated at tin-plate production providing multiple production steps with free choice of multiple plants.

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847202 (2019) AutoSurveillance

Automatic surveillance of hot rolling area against intentional attacks and faults

Info				
	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,589,524.25	Start Date	01/06/2019
	EU Contribution	€ 953,714.55	End date	30/11/2022

Abstract

Is a hot rolling mill secured against intentional attacks? Could a re-heating furnace or the accelerated cooling be used for sabotaging the quality of a European steel producer? How can attacks be separated from fault behaviour? AutoSurveillance will provide a solution for detecting anomalies in re-heating furnaces, hot-rolling mills and accelerated cooling, a solution that is capable of announcing a threat and in parallel distinguishing between faults and intentional attacks. It focusses on the process-oriented treatment of such occurrences and explicitly not on the IT perspective. The project consortium of AutoSurveillance concluded that there is urgent need to increase the security of control system in European steel plants from an inner process perspective and not to trust in the security an outer IT environment can offer. Therefore any successful novel kind of detection, healing and resilient strategy must be founded on the process knowledge itself. Although the occurrence of such events is actually rather low, the economic stakes of such an event are unbearable high for the European steel industry: the consequences are production out-times, damaged machinery and repair activities, all of which

eat up man-hours and money in an excessive way. It hardens the automation system against it on process level. Many other effects can obfuscate or obscure the view on the process, such as sensor and actuator uncertainties and process anomalies. To detect intentional sabotage, one must prior exclude things like drifts or errors in the measurements and unintentional process anomalies caused by the instability of process situations. Hence there is a need for monitoring control systems online, to detect any kind of abnormal behaviour. Sensorial deficiencies, actuator malfunctioning or process perturbations must be elemental part of a system that secures against intentional damages!

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Partners

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SIDENOR INVESTIGACION Y DESARROLLOSA	ES	Asier ARTEAGA

800762 (2018)	**ECOSLAG**[5] *Eco-friendly steelmaking slag solidification with energy recovery to produce a high quality slag product for a sustainable recycling*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,524,549.35	Start Date	01/06/2018
	EU Contribution	€ 1,514,729.61	End date	30/11/2021

Abstract

The project aim is to find technical solutions for heat recovery from steelmaking slags while producing a high quality slag product for external or process internal utilization. Three main topics will be investigated:

1. Development and testing of an advanced process for heat recovery and material recycling by re-charging of hot LF slag into the EAF process as lime substitute (MAU, FEhS);

2. Development and testing of heat recovery, drying and recycling of BOF slag by further developing the current technology partially developed by SFTec (SFTec, MEFOS);

3. Development and testing of an advanced air/water granulation of EAF slag directly at the furnace (online EAF slag treatment) (Tenova, ACP, CSM);

4. Development of heat utilization concepts for the recovered heat from steelworks slags and investigation / evaluation of technical solutions for:

• the recovery of heat from slag in a heat vector (water, air, steam) to be used directly in the steel process (i.e. solid material drying, scrap pre-heating) or to produce valuable energy to export (i. e. hot water for district heating) (SIDENOR, CICe, Tenova, MEFOS, SFTec);

• direct generation of electrical energy by thermoelectrical technology (CSM, Tenova, ACP);

Different solidification methods will be investigated in order to give options to the steelwork as to the method that will work for them while finding solutions for:

1) transport, storage and distribution of liquid steel slag directly after tapping;

2) alternative solidification methods to avoid/minimise the use of direct water cooling obtaining a proper cooling rate to be maintained during the solidification stage of slag and the handling of hot solidified slag;

3) to provide a suitable slag (high energy content, but transportable) for internal recycling in the steelmaking process or for a conventional system for the recovery of the heat;

4) reducing as much as possible the dust dispersion and gas emission during the slag cooling/handling;

5) producing marketable slag.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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[5] The Project has been transferred from TGS9 to TGA1 (see Annex I).

800677 (2018)	NEWTECH4STEEEL *Enhanced process stability and product quality in steel production by exploitation of break-through technologies for real-time monitoring, control and forecasting inspired by Big Data concepts*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,405,313.75	Start Date	01/06/2018
	EU Contribution	€ 1,443,188.25	End date	30/11/2021

Abstract

The constantly growing requirements to European steel production concerning product quality and process efficiency are accompanied by massive increases of data and information collection at the processes and about the products.

So, there is the possibility, but also the need for new methods to observe and control production processes and to determine and to forecast the properties of intermediate and final products. These new technologies have to exploit comprehensively those huge information sources collected at the steel plants.

This project will focus on dedicated use cases in steel industry, which are related to actual problems and tasks in modern steel production.

The consortium will develop and implement methodologies, which will meet the requirements of examined steel processes on the one hand, but also exploit all technological and scientific possibilities offered by latest technologies concerning data handling and data analysis on the other hand.

To reflect the variety in steel production, the selected industrial use cases cover different processing routes and various final products like flat steel, tube and wire production. Thereby the project findings will be applied and tested under industrial conditions to adjust them to the needs of the European steel industry. The participating non-steel partners like research organisations and suppliers for steel industry guarantee the exploitation of latest available methodologies and technologies.

The final aims of this proposed project are:

- the developed and applied methods for an improved process observation and control as well as extended tools to assess and forecast (intermediate) product quality as examples for the successful application of new technologies,

- to provide evidence of the applicability and efficiency of such methods,

- to make proposals and uncover possibilities of developed new methods outside the investigated use cases to state their benefits for the complete European steel sector.

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DANIELI AUTOMATION SPA	IT	Mr Andrea POLO

800657 (2018)	CYBERMAN4.0 *Cyber Physical System-based approach for intelligent data-driven maintenance operations applied to the rolling area*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,658,641.15	Start Date	01/09/2018
	EU Contribution	€ 1,595,184.69	End date	28/02/2022

Abstract

Cyberman4.0 aims at turning maintenance strategy in steel industry from preventive to optimized predictive maintenance by experimental systems and tools built upon the Industry 4.0 enabling technologies proposing the Integrated Maintenance Model 4.0 (IMM4.0) applied into the rolling area. Investigations on new methods and experimental tools will validate approach and expected benefits like flexibility, machine uptime and costs. Four use cases will be developed considering flat products, an innovative rolling mill for long products the hot and cold rolling roll shop management for flat products connecting product quality and machine status as a valuable indicator of health awareness.

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Partners

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800654 (2018)	WHAM[6] *Water and related energy Hub Advanced Management system in steelworks*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,159,818.20	Start Date	01/09/2018
	EU Contribution	€ 1,295,890.92	End date	28/02/2022

Abstract

The overall objective of the WHAM project is to radically change the current water paradigm, by developing an innovative approach to improve the efficiency of the global water system reducing the water consumption, increasing the reusability by the adoption of innovative technologies. The project aims to set-up a widely deployable methodology based on a customizable supervision system targeted to industrial water networks which are typically found in the steelworks. Moreover innovative water treatment will be tested in several use cases. Such system will implement diagnostic capabilities aiming at highlighting water losses and water systems malfunctioning by jointly achieving an efficient steelworks water circuit management. Moreover WHAM aims at lowering the water intake minimizing the ecological foot print incrementing the recycling of water while assuring sufficient water quality for process conduction. The monitoring and optimization system connected to the innovative water treatment constitute powerful tools to improve the water and related energy utilization by achieving the following targets: • a correct management of the different water sources, including rain water, depending on the requirements and operating conditions of each process; • the minimization of the cooling water losses; • the improvement of the energy efficiency of the water circuit by adjusting the operation mode of its units; • the minimization of the freshwater consumptions, by jointly reducing the related costs in terms of energy and chemical additives and improving the overall environmental impact of the production process • the increase of water reusabilty recycling back into the process current wastewaters such as the cleaning solutions through the adoption of innovative water treatments.

Coordinator	*Country*	*Scientific person in charge*
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[6] The Project has been transferred from TGS9 to TGA1 (see Annex I).

793505 (2018)	**WISEST** *4.0 Lean System integrating workers and processes*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,387,284.40	Start Date	01/09/2018
	EU Contribution	€ 832,370.64	End date	28/02/2022

Abstract

The project idea is to develop advanced tools to automatically collect information from workers and processes, integrate this Information correlating both data sets time wise and event wise and finally produce an assessment of the whole system and offer recommendations for improvement. The recommendations will aim to improve working conditions, safety, knowledge preservation and training (for the workers area) and improve quality and lead to lean operation & maintenance (for the whole system composed of workers and industrial processes). The specific purpose is to integrate I4.0 and people in different Steel processes (like scrap management, steel production, final product preparation and dispatching, coil cutting in automotive industry, etc) in order to promote the application of Lean culture principles in steel industry in combination with IIoT and I4.0. Factors like energy consumption, safety, environmental and workers' health parameters at work place will be considered as KPI's associated to the lean oriented assessment of every process. Working topics are:

●Collection of information about workers position and health parameters (using wearable devices).

●Collection of event oriented information from the processes (using PLCs signals and IIoT).

●Integration of workers' information within processes status to assess the whole process.

●Consideration of all the factors, including safety & health in processes lean performance.

Coordinator	*Country*	*Scientific person in charge*
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788552 (2018)	QUALITY4.0 *Transparent product quality supervision in the age of Industry 4.0*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,577,642.00	Start Date	01/06/2018
	EU Contribution	€ 946,585.20	End date	30/11/2021

Abstract

In a world where steel products can be acquired through platforms like Alibaba.com and the steel market is flooded with cheap steel from Chinese overcapacity, European Steel producers urgently need differentiation as distance or referencing are not a protection anymore.

From steel customers' point of view, one main reason for the decision for a specific supplier is trust in the fact that the delivered product fulfills his individual requirements. Consequently only if the European Steel Industry succeeds to win customer-trust and solidifies client intimacy, it will achieve a durable competitive advantage and thus reduce pressure from world-wide imports

Consequently, this project aims to establish a new level of customer-supplier collaboration by means of the horizontal integration of quality information over the complete supply chain comprising the full exploitation of all available quality information and knowledge from the measurement up to the final product at downstream industries (e.g. car manufacturer).

In this project an adaptive Quality4.0 platform will be developed which allows online analytics of large data streams to realise decisions on product quality and provide tailored information of high reliability that can be individually exchanged with customers to put a common focus on the manufacturing of highest quality goods.

A bidirectional customer/supplier exchange of quality relevant information is foreseen, enabling lower production costs, increased yield and improved identification of quality problems in steel production processes.

In times of challenging global markets with very strong competition from outside Europe it is of strategic importance for the European steel industry to proactively promote such a common platform instead of reacting on specific customer demands.

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753592 (2017)	**TRACKOPT** *Consistent ladle tracking for optimisation of steel plant logistics and product quality*			
Info	Type of Project	Pilot&Demonstration	Duration (months)	48
	Total Budget	€ 898,257.65	Start Date	01/01/2018
	EU Contribution	€ 449,128.82	End date	11/12/2021

Abstract

The project will implement automated ladle tracking systems to ensure consistent factory-wide tracking of the product from steelmaking via casting to delivery. The wireless tracking system in harsh steelworks environment will provide mandatory input data for projects on digitalisation ("Industry 4.0"). Automated, reliable information on actual position of ladles result in increased factory output (avoided hold-ups or downgrading of products due to mix-up of ladles) and in improved safety in steelworks. Furthermore the ladle tracking system will be used to optimise ladle logistics during both smooth production conditions and in case of sudden disturbances in production plan.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr Birgit PALM

Partners		
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748878 (2017)	DISSI2M *Dissemination of results of RFCS-projects in the field of Integrated Intelligent Manufacturing and public discussion of a roadmap in this field*			
Info	Type of Project	Accompanying Measures	Duration (months)	24
	Total Budget	€ 407,220.85	Start Date	01/07/2017
	EU Contribution	€ 407,220.85	End date	30/06/2019

Abstract

In the year 2004 the first Strategic Research Agenda (SRA) of ESTEP (=European Steel Technology Platform) has been written as common action of the European Steel Industry. The topic of "Integrated Intelligent Manufacturing" (I2M) was from the very beginning part of this SRA. A working group has been founded in the year 2007 and has started to create common RFCS proposals. In the meantime this technological field is in Europe better known under the topic of "Industry 4.0". The aim of this proposal is now to disseminate the results of all RFCS projects to this topic, to start a public consultation process about a just finished I2M-roadmap and to create a sequence of future research topics in the field.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Mr Norbert HOLZKNECHT
Partners		
ARCELORMITTAL ESPANA SA	ES	Mr Jose Ramon Laso AYUSO
CENTRO SVILUPPO MATERIALI SPA	IT	Dr Fabio SANFILIPPO
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710066 (2016)	**DROMOSPLAN** *Drones for autonomous monitoring of steel plants*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 1,857,588.90	Start Date	01/07/2016
	EU Contribution	€ 1,114,553.34	End date	30/06/2020

Abstract

Aim of this proposal is to evaluate the benefits arising from the application of Unmanned Aerial Vehicles (UAVs) in steelworks. So far UAVs have been deployed for military applications or used in small but growing number of civil applications, but never systematically in the steel industry. The goal is to substitute men in complex and expensive operations as those related to the monitoring, maintenance and safety of steel plant infrastructures. The implementation of real use cases with autonomous flight in two steel plant (TKSE, ILVA) and the experimental feasibility for indoor applications will prove the benefits deriving from UAV technology.

Coordinator	*Country*	*Scientific person in charge*
CENTRO SVILUPPO MATERIALI SPA	IT	Dr Roberto PIANCALDINI

Partners		
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr Jan POLZER
CLEES CHRISTIAN-ALEXANDER	DE	Mr Christian CLEES
THYSSENKRUPP STEEL EUROPE AG	DE	Mr Tim KÖLSCHEID
MBDA ITALIA SPA	IT	Dr Luca BANCALLARI
CARDIFF UNIVERSITY	UK	Dr Dean STROUD

709669 (2016)	CYBER-POS *Virtual Design of Cyber-Physical Production Optimization Systems for Long Production Factories*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,783,604.40	Start Date	01/07/2016
	EU Contribution	€ 1,070,162.64	End date	31/12/2019

Abstract

Production technology in steel industry has reached a level that significant improvements can only be reached by through-process optimisation strategies instead of improving each process step separately. Therefore the connection of suitable technological models to describe process and product behavior, methods to find solutions for typical multi-criterial decisions and a strong communication between involved plants becomes mandatory.

Cyber-POS will develop a virtual simulation platform for the design of cyber-physical production optimization systems (CPPS) for long production facilities with special emphasis to thermal evolution and related material quality, leading to reduced energy consumption, shortened production time and improved product quality. Simulation and verification tools as well as a new IT framework for establishing the feasibility, safety and benefits of CPPS in the framework of “Steel Industry 4.0 Automation" will be introduced. Process (thermal, rolling, transport) models, material-quality models, logistics/scheduling models and communication (computers, software, networks) models are merged and used for production optimization, enabling fast dynamic and flexible reaction on changes in set-points, production routes, process disturbances or interruptions.

In this project the CPPS will be implemented at two long production facilities with the focus of reducing energy consumption plus reaching shortened production times at Mannstaedt (complex profiles) and at ArcelorMittal (rails) for increasing product quality.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr Jan POLZER
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709553 (2016)	ROBOHARSH *Robotic workstation in harsh environmental conditions to improve safety in the steel industry*			
Info	Type of Project	Pilot&Demonstration	Duration (months)	36
	Total Budget	€ 1,924,677.50	Start Date	01/07/2016
	EU Contribution	€ 962,338.75	End date	30/06/2019

Abstract

This project will disseminate new design guidance for structural stainless steel which has been developed over the last 10 years, primarily arising from RFCS-funded research.

Activities are mostly targeted at design practitioners and include:

• Updating and extending the Design Manual for Structural Stainless Steel (Third Edition);

• Translating the Design Manual from English into 9 languages;

• Developing online design software and design apps in accordance with the new stainless Eurocode rules;

• National seminars;

• Recording webinars for distance learning;

• Publishing articles in national engineering journals.

Teaching resources aimed at engineering students will also be prepared.

Coordinator	*Country*	*Scientific person in charge*
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Partners

POLYTEC SRL	IT	Mr Dario ABBÀ
PSC AUTOMATIZARI SI INSTALATII SRL	RO	Mr Raul PAL

ANNEX I: NEW STRUCTURE TECHNICAL GROUPS (effective since 14/06/2019)

'Following the advices of CAG and SAG and endorsement of COSCO in 2018, the Commission has decided to reduce the number of the Technical Groups from 12 to 7 with 2 for Coal (instead of 3) and 5 for Steel (instead of 9). This contributes to make the management of the RFCS programme more efficient, to update the coal and steel themes, and to give more coherence to the portfolio of RFCS coal and steel projects. The Technical Groups for 2019 are the following: 2 TGK for Coal and 5 TGA for Steel.'[1]

GENERAL OLD-NEW TG CORRESPONDENCE

Old TGs	**New TGs**
TGC1	**TGK1- POST-MINING ISSUES, SAFE AND PRODUCTIVE COAL MINING OPERATIONS**
TGC2 TGC3	**TGK2 - ENVIRONMENTAL, TECHNICAL AND ECONOMIC ISSUES RELATED TO COAL TREATMENT AND USE**
TGS1 TGS2	**TGA1 - IRON AND STEELMAKING**
TGS3 TGS4	**TGA2 - DOWNSTREAM STEEL PROCESSING**
TGS5 TGS6	**TGA3 - CONCEPTION OF STEEL PRODUCTS**
TGS7 TGS8	**TGA4 - STEEL APPLICATIONS AND SOLUTIONS FOR EXISTING AND NEW MARKETS**
TGS9	**TGA5 - STEEL FACTORIES - SMART AND HUMAN**

EXCEPTIONAL TRANSFERT OF PROJECTS

Because of the changes in the scientific scope[2] of each TG, the following projects have been transferred to a different TG.

PROJECT acronym and name	**TG TRANSFERT**
RFCS-2017-800769 - HighSpeedGalvanizing	Transferred from TGA3 to TGA2
RFCS-2018-847318 – CleanEX	Transferred from TGA3 to TGA2
RFCS-2018-847341 – CentriClean	Transferred from TGA3 to TGA2
847260 (2019) – Slagreus	Transferred from TGS9 to TGA1
800762 (2018) – Ecoslag	Transferred from TGS9 to TGA1
800654 (2018) – Wham	Transferred from TGS9 to TGA1

[1] Extract from the *RFCS Information package 2019,* 14 June 2019

[2] See link *supra*.