European Commission

Synopsis of RFCS Projects 2015 – 2017

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

Version 1.0
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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

754205 (2017)	**ROCD** *Reducing risks from Occupational exposure to Coal Dust*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 3,400,906	Start Date	01/07/2017
	EU Contribution	€ 2,040,544	End date	30/06/2020

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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Partners		
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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)	36
	Total Budget	€ 2,634,755	Start Date	01/07/2017
	EU Contribution	€ 1,550,726	End date	30/06/2020

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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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	€ 2,734,328	Start Date	01/07/2017
	EU Contribution	€ 1,640,597	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.

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752504 (2017)

PRASS III

PRODUCTIVITY AND SAFETY OF SHIELD SUPPORT

Info				
	Type of Project	Research	Duration (months)	36
	Total Budget	€ 3,105,890	Start Date	01/07/2017
	EU Contribution	€ 1,863,534	End date	30/06/2020

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*
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JASTRZEBSKA SPOLKA WEGLOWA SA	PL	Mr. Kamil DEBOWSKI

748632 (2017)	**INDIRES** *INformation Driven Incident RESponse*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 3,139,999	Start Date	01/07/2017
	EU Contribution	€ 1,883,998	End date	30/06/2020

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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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	€ 3,335,839	Start Date	01/07/2016
	EU Contribution	€ 2,001,503	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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TGC1 : Coal mining operation, mine infrastructure and management, unconventional use of coal deposits

RFCR-CT-2015-00005	**MAPROC** *Monitoring, Assessment, Prevention and Mitigation of Rock Burst and Gas Outburst Hazards in Coal Mines*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 4,122,079	Start Date	01/07/2015
	EU Contribution	€ 2,473,246	End date	31/12/2018

Abstract

The main objectives of MapROC are to:

• Develop and field test rock burst and gas outburst prevention techniques based on the use of large diameter boreholes with alternative stress and gas pressure relief techniques such as blasting, slotting and/or high pressure water injection;

• Formulate a methodology to couple the near-real time processing of field monitored microseismic data with Artificial Neural Networks and Fractal Dimension analysis to develop a short-term prediction method for rock bursts and gas outbursts;

• Demonstrate the use of this prediction method as a tool for early risk assessment, prevention, and mitigation of rock bursts and gas outbursts;

• Numerically model the field application of the borehole stress/gas pressure relief methods as well as modelling stress control and protective mining options;

• Develop and validate a generic risk assessment methodology for the prevention and mitigation of rock bursts and gas outbursts; and

• Widely disseminate the research findings within the industrial and academic communities.

Coordinator	*Country*	*Scientific person in charge*
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RFCR-CT-2015-00004	MERIDA *Management of Environmental RIsks During and After mine closure*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 3,793,767	Start Date	15/12/2015
	EU Contribution	€ 2,276,259	End date	14/12/2019

Abstract

The management of environmental risks during and after mine closure is a multi-hazard and multi-risk process that requires integration of interrelated environmental processes and combining their effects when considering hazard identification and risk characterisation. Failure to manage environmental impacts and risks in an acceptable manner throughout the mine closure and post-closure will result in the mining industry finding it increasingly difficult to obtain community and government support for existing and future projects. The objective of the current proposal (MERIDA) is to design and provide technical guidance on the implementation of necessary investigations that should be undertaken in order to develop a mine closure plan. The aim is to minimise the environmental impacts and risks during the mine closure and post-closure periods in accordance with the general principle that the mine must take responsibility and minimise all risks that can be foreseen. In practical terms, MERIDA will provide a planning tool that allows the design of a logical, step-wise approach to mine closure that can be progressively refined during the post-closure period and allows to address all relevant environmental risks.

The objectives of MERIDA are:

• To provide specific guidance on the issues that need to be considered when assessing the environmental impacts from coal mines at closure and post-closure stages;

• To identify the physical and chemical processes that affect environmental risks during mine closure and post-closure and establish monitoring and modelling methods that should be implemented in order to make reliable environmental impact predictions;

• To establish an integrated risk assessment methodology;

• To provide a practical methodology (written up as a technical guidance) that can be used for the evaluation of risk remediation measures in terms of their performance in risk reduction, practical implementation and cost.

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RFCR-CT-2015-00003	BEWEXMIN *Bucket wheel excavators operating under difficult mining conditions including unmineable inclusions and geological structures with excessive mining resistance.*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 2,817,117	Start Date	01/09/2015
	EU Contribution	€ 1,690,271	End date	31/08/2018

Abstract

In newly-opened as well as in existing lignite mines are increasingly difficult mining conditions. Mainly due to the presence of growing number of undiggable inclusions and partings of excessive mining resistance in overburden. During exploitiation of such centers there are large dynamic and impulse loads. Already working excavators and often newly designed are not fully adapted to such conditions. This results in frequent breakdowns, resulting in the exclusion of the machine from normal operation. The aim of the project is to develop solutions to reduce failure rates of bucket wheel excavators working in those conditions. This will be achieved either by reducing the sensitivity of excavators on pulse load or by efforts to reduce the size of dynamic loads.

The project includes three packages. The first package WP1 includes:

• The experimental determination of the dynamic surplus from mass forces and the linkage of these surpluses with physico-mechanical characteristics of exploited soils;

• Method for determining of alternative computational strength of pulse loads;

• Determination of the requirements for flawless excavator work in specific conditions.

In the second - WP2 will be developed way to create a system to monitor stress excavator's structures leading to continuous assessment of the degree of construction effort, signaling of the damage possibility, and information on the residual fatigue strength.

The activities included in the third - WP3 is to strive to eliminate or just reduce the size of pulsed loads caused by encountering on undiggable obstacle (stone) by early detection of stones in the slope and adequate control of the excavator. Information collected by the system will also facilitate the correct interpretation of the signals sent by the stress monitoring system.

All three WPs are interrelated and create a complete set of activities aiming at the same goal, which is to reduce failure rates of bucket wheel excavators in difficult mining conditions.

Coordinator	*Country*	*Scientific person in charge*
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RFCR-CT-2015-00002	STAMS *Long-term STability Assessment and Monitoring of flooded Shafts*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 3,153,076	Start Date	01/07/2015
	EU Contribution	€ 1,891,845	End date	30/06/2018

Abstract

The main objective is to implement solutions to monitor and assess the stability of flooded shafts, for long periods of time. The objective will be achieved by subjecting a shaft (a) to periodic measurements, and (b) to continuous monitoring. This requires developing new technologies and achieving the following goals:

• Develop and test a Multi-functional Monitoring Module for periodic measurements;

• Develop and test an Ultrasonic Inspection Module, featuring the novel combination of ultrasonic profiling and ultrasonic imaging, to inspect shafts visually and measure possible deformations;

• Develop and test water dynamics and gas devices to continuously measure, analyse and ases the stability with provision to deploy sensors post-closure, that will withstand shaft filling operations;

• Develop and test a software conol and analysis system to measure, in-situ and in real-time, significant differences that may indicate instability or significant changes in a flooded shaft;

• Develop a modelling approach to assess the long term stability of shafts during and after flooding by coupling the hydro-mechanical behaviour with the chemical reactions which occur between the aqueous solution and the shaft lining components.

For periodic measurements, inspection tools will be implemented with multiple instruments to perform measurements of water aggressiveness, gas production and to carry out macroscopic inspection. A software control system will be developed to analyse, in-situ, if there are significant changes in the conditions of the shafts acquiring information from the inspection modules and from the continuous measurement devices. For continuous measurements the objective is to install newly developed devices to monitor the water level recovery dynamics. Additionally this device could also be used as reference points to make comparisons between periodic images. The numerical simulation will be used to help the design and the interpretation of the in-situ measurement.

Coordinator	*Country*	*Scientific person in charge*
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RFCR-CT-2015-00001	SLOPES *Smarter Lignite Open Pit Engineering Solutions*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 3,309,995	Start Date	01/07/2015
	EU Contribution	€ 1,985,998	End date	30/06/2018

Abstract

The SLOPES project brings together experts from across Europe to advance the current technology and methodologies applied to monitoring and risk analysis of slopes within open pit lignite mines. Modern techniques which aim to overcome the challenges of monitoring within open pit mines will be deployed and tested within real mines and results will be compared against physical model tests as well as rigorous numerical modelling. A reliability-based method for the evaluation of risks will be developed based on monitoring and modelling results which will provide significant benefits to design optimisation and decision support within real open-pit lignite mines.

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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

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	€ 1,724,561	Start Date	01/07/2017
	EU Contribution	€ 1,034,736	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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INSTYTUT CHEMICZNEJ PRZEROBKI WEGLA	PL	Dr. Bartosz MERTAS

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	€ 2,166,729	Start Date	01/07/2016
	EU Contribution	€ 1,300,037	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*
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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	Start Date	01/10/2016
	EU Contribution	€ 1,325,164	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*
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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	€ 3,435,164	Start Date	01/07/2016
	EU Contribution	€ 2,061,098	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; and

• 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*
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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

RFCR-CT-2015-00007	BINGO *Bulk density and INternal Gas pressure in coke Ovens*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,897,471	Start Date	01/07/2015
	EU Contribution	€ 1,138,483	End date	31/12/2018

Abstract

Wall Pressure is one of the major causes of coke oven degradation but it is impossible to measure it directly. Internal Gas Pressure is easier accessible; so the present project aims at increasing coke plant service life by controlling Internal Gas Pressure in industrial ovens. This project proposes to investigate parameters influencing Internal Gas Pressure measurements in stamp and gravity charging and to find correlations between Internal Gas Pressure measured at pilot and industrial scales. This study will allow to define guidelines for European coke plants to better monitor Internal Gas Pressure and to define limit values for safe operation.

Coordinator	*Country*	*Scientific person in charge*
ARCELORMITTAL MAIZIERES RESEARCH S.A.	FR	Mr Matthieu LANDREAU

Partners		
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ARCELORMITTAL ATLANTIQUE ET LORRAINE SAS*AAL	FR	Mrs. Juliette DELINCHANT
DMT GMBH & CO KG	DE	Dr. Drazen GAJIC
THYSSENKRUPP STEEL EUROPE AG	DE	Mr. Viktor STISKALA
VOESTALPINE STAHL GMBH	AT	Dipl.-Ing. Karl PILZ

RFCR-CT-2015-00006	SUPERCOAL *Coal-liquid based upgraded carbon materials for energy storage*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 2,075,609	Start Date	01/07/2015
	EU Contribution	€ 1,245,365	End date	30/06/2018

Abstract

This project is aimed at the development of coal liquid-based carbon materials with superior properties for their use as active electrode materials in electrochemical energy storage systems as supercapacitors (SCs) and hybrid systems (battery-capacitor), a topic that is given top priority in the RFCS programme (upgrading of coal-derived liquids). In the present proposal, coal-derived liquids, such as coal tars and anthracene oil, are proposed as starting materials for the production of polymerized-isotropic/mesophase pitches, cokes and graphites to be used in the preparation of carbon materials with a tailored structure and, consequently, specifically targeted properties. Moreover, some of these materials will be subjected to different activation methods to develop the porous structure required for some of the proposed applications (electrodes in supercapacitors). The as such obtained activated carbons (ACs) will be studied alone or combined with graphene (G), a high-tech material also produced and investigated as electrode material by itself. The development of this project will address the growing need of the electrical energy industry to have more efficient storage devices. One special feature is to choose proper treatment methods of transforming the irregular structure of the starting carbonaceous matter into the organised structure of carbon materials. The possibility of synthesizing carbon materials maximizing their porosity, tailoring their morphology, controlling their surface chemistry and retaining high electrical conductivity will allow the production of electrodes with improved performance and, subsequently, energy storage systems with higher power and energy densities. Thus, and from feedstocks with a low added-value, a new generation of supercapacitors and hybrid systems will be developed, which will help to a better and cleaner utilization of the energy resources.

Coordinator	*Country*	*Scientific person in charge*
AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	ES	Prof. Rosa MENENDEZ LOPEZ

Partners

CLAUDIU TOPROM SRL	RO	Dr. Sorin AXINTE
INDUSTRIAL QUIMICA DEL NALON S.A.	ES	Dr. Juan José FERNANDEZ-RODRIGUEZ
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POLITECHNIKA WROCLAWSKA - WROCLAW UNIVERSITY OF TECHNOLOGY	PL	Prof. Grazyna GRYGLEWICZ
UNIVERSITATEA POLITEHNICA DIN BUCURESTI	RO	Dr. Georgeta PREDEANU

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 w ith solid waste or biomass
- Zero emissions and high efficient power generation
- CHP from coal
- Coal contribution to global energy security

754060 (2017)	COALBYPRO *Innovative management of COAL BY-PROducts leading also to CO2 emissions reduction*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,789,859	Start Date	01/07/2017
	EU Contribution	€ 1,073,915	End date	30/06/2020

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
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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	Start Date	01/07/2017
	EU Contribution	€ 1,718,215	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.

The project consortium includes one well established EU CFB manufacturer, one full and one associate European utility and multi-disciplinary research center . Finally, the proposal addresses Coal RFCS priority 1.5 for 2016.

Coordinator	*Country*	*Scientific person in charge*
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ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	EL	Dr. Nikos NIKOLOPOULOS
TECHNISCHE UNIVERSITAT DARMSTADT	DE	Dr. Jochen STRÖHLE
TEKNOLOGIAN 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)	48
	Total Budget	€ 2,893,589	Start Date	01/09/2016
	EU Contribution	€ 1,736,153	End date	31/08/2020

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*
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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)	18
	Total Budget	€ 2,269,930	Start Date	01/07/2016
	EU Contribution	€ 1,361,958	End date	31/12/2017

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*
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Partners		
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TECHNISCHE UNIVERSITAT DARMSTADT	DE	Dr. Alfred SCHOLZ
TECHNISCHE UNIVERSITAET CHEMNITZ	DE	Prof. Peter MAYR
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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	€ 2,452,366	Start Date	01/07/2016
	EU Contribution	€ 1,471,420	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

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	Start Date	TBC after GAP is completed
	EU Contribution	€ 1,072,781	End date	TBC after GAP is completed

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.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Mr. Roland PIETRUCK
Partners		
THYSSENKRUPP STEEL EUROPE AG	DE	Dr. Alexandra Hirsch
SODERN SA	FR	Mr. Vincent Flahaut
PANALYTICAL B.V	NL	Mr. Jeffrey Kemmerer

754055 (2017)	**DUMICO** *Dust minimisation and control at the blast furnace*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 4,411,210	Start Date	01/07/2017
	EU Contribution	€ 2,646,726	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.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
CENTRE DE RECHERCHES METALLURGIQUES ASBL	BE	Mr. Frederic VANLOO
RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN	DE	Dr. AlexanderBABICH
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TATA STEEL NEDERLAND TECHNOLOGY BV	NL	Mr. Stefan BORN
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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	€ 2,880,451	Start Date	01/07/2017
	EU Contribution	€ 1,721,070	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.

Coordinator	*Country*	*Scientific person in charge*
ARCELORMITTAL MAIZIERES RESEARCH SA	FR	Dr. Judit KAKNICS
Partners		
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CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	FR	Dr. Valérie MONTOUILLOUT
UNIVERSITE PAUL SABATIER TOULOUSE III	FR	Prof. Martin CYR
ECOCEM MATERIALS LIMITED	IE	Mr. Garry GROGAN

709816 (2016)	**STACKMONITOR** *Online Blast Furnace Stack Status Monitoring*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,813,217	Start Date	01/07/2016
	EU Contribution	€ 1,087,930	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.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr. Hauke BARTUSCH
Partners		
AKTIEN-GESELLSCHAFT DER DILLINGER HÜTTENWERKE	DE	Dr. Rongshan LIN
SALZGITTER FLACHSTAHL GMBH	DE	Dr. Tatjana MIRKOVIC
ABO AKADEMI	FI	Prof. Henrik SAXEN
OULUN YLIOPISTO	FI	Prof. Timo FABRITIUS

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	€ 2,080,691	Start Date	01/07/2016
	EU Contribution	€ 1,248,414	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

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr. Jörg ADAM
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FUROL TANACSADO ES SZOLGALTATO KORLATOLT FELELOSSEGU TARSASAG	HU	Dr. Oszkar GREGA

RFSR-CT-2015-00002	ALCIRC *Assessing and control of alkaline circulation in BF operation*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,302,713	Start Date	01/07/2015
	EU Contribution	€ 1,381,628	End date	31/12/2018

Abstract

The overall research project objective is improved blast furnace (BF) process stability and energy efficiency with increasing flexibility in raw material selection, taking into account deteriorating raw material qualities in terms of alkali content. This is achieved by developing and establishing new methods for online alkali control in the BF, based on a novel online top gas evaluation tool for determination of the alkali accumulation in the operational blast furnace. This tool consists of the top gas measurement equipment (FTIR or MS) and the evaluation routine for determination of the alkali accumulation / cycle. The new online tool will be applied for monitoring of the alkali cycle amount at selected representative BF's with elevated alkali input and with differences in the source of alkali components. The selected BF's differ in operational modes. Monitoring of the alkali cycle amount enables the premature detection of operational states with elevated alkali load. In this way, countermeasures for alkali control may be triggered at an early stage in order to prevent operational disturbances at the BF. For BF alkali control some promising novel measures are developed within the research project, like coke pre-treatment/coating with alkali absorbing minerals as well as a more optimised adjustment of BF slag composition. Finally, concepts will be worked out for improved BF alkali control by combined application of the online top gas evaluation tool with selected methods for inhibition of the alkali circulation. The concepts will consider the special restraints at the different operational BF's. Finally the concepts will be validated by operational trials at the different BF's in comparison with normal operational data.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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LULEÅ UNIVERSITY OF TECHNOLOGY	SE	Prof. Bo BJÖRKMAN
SWEREA MEFOS AB	SE	Dr. Lena SUNDQVIST ÖQVIST
SSAB EMEA AB	SE	Mr. David LINDSTRÖM
VOESTALPINE STAHL DONAWITZ GMBH & CO KG	AT	Dipl.-Ing. Roland MAYERHOFER

RFSR-CT-2015-00001	**OPTIBLAFINS** *Optimizing Blast Furnace Hearth Inner State*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 3,599,376	Start Date	01/07/2015
	EU Contribution	€ 2,159,625	End date	31/12/2018

Abstract

This proposal reflects to different dead man states in a blast furnace hearth in relation to coke particles forming the dead man, hearth liquid flow and respective heat loads. Describing the dead man as a conglomeration of individual particles and correlating global process parameters with local wear factors will form highly innovative activities of the project. State of the art computer modelling technique combining DEM-CFD approaches will be used to understand the actual liquid and solid flow within the hearth. Such modelling approach will be used for the first time in a project realised within the RFCS framework. In addition, advanced monitoring techniques wil be tested with the aim to gain an improved understanding of localised wear events. This will provide a better ground for decsion-making concerning stabilizing the hearth condition, improving hearth drainage and prolonging hearth life.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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ARCELORMITTAL EISENHÜTTENSTADT GMBH	DE	Dr. Jörg MERNITZ
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UNIVERSITÄT LINZ*JOHANNES KEPLER UNIVERSITÄT, LINZ	AT	Dr. Gijsbert WIERINK
LUOSSAVAARA-KIIRUNAVAARA AB	SE	Mr. Nicklas EKLUND
SWEREA MEFOS AB	SE	Dr. Lena SUNDQVIST ÖQVIST
RUHR-UNIVERSITÄT BOCHUM	DE	Dr. Siegmar WIRTZ
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr.-Ing. Yalcin KAYMAK
VOESTALPINE STAHL GMBH	AT	Dipl.-Ing. Christoph FEILMAYR

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	Start Date	01/07/2017
	EU Contribution	€ 974,994	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.

Coordinator	*Country*	*Scientific person in charge*
RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN	DE	Prof. Herbert PFEIFER
Partners		
STAHL- UND WALZWERK MARIENHÜTTE GESMBH	AT	Mr. Helmut SOMMERAUER
MONTANUNIVERSITAT LEOBEN	AT	Prof. Jürgen ANTREKOWITSCH
MAX AICHER UMWELT GMBH	DE	Dr. Dirk MUDERSBACH
MFG METALL- UND FERROLEGIERUNGSGESELLSCHAFT MBH HAFNER, BLONDIN & TIDOU	DE	Mr. Stefan PREIß
SIDENOR INVESTIGACION Y DESARROLLO SA	ES	Dr. Inigo UNAMUNO
OULUN YLIOPISTO	FI	Prof. Timo FABRITIUS
POLITECNICO DI MILANO	IT	Prof. Carlo MAPELLI

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	Start Date	01/07/2017
	EU Contribution	€ 769,100	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.

Coordinator	*Country*	*Scientific person in charge*
SWEREA MEFOS AB	SE	Dr. Erik SANDBERG
Partners		
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr. Ralf PIERRE
SIDENOR INVESTIGACION Y DESARROLLO SA	ES	Dr. Inigo UNAMUNO
OUTOKUMPU STAINLESS AB	SE	Mr. Patrik STRANDBERG

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	€ 1,788,480	Start Date	01/07/2017
	EU Contribution	€ 1,073,088	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.

Coordinator	*Country*	*Scientific person in charge*
MINKON SP ZOO	PL	Mr. Mark POTTER
Partners		
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr. Tobias KORDEL
FERRIERE NORD SPA	IT	Dr. Loris BIANCO
KUNGLIGA TEKNISKA HOEGSKOLAN	SE	Prof. Du SICHEN

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	Start Date	01/07/2016
	EU Contribution	€ 721,142	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.

Coordinator	*Country*	*Scientific person in charge*
RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN	DE	Prof. Herbert PFEIFER

Partners		
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LUXMET OY	FI	Mr. Mikko JOKINEN
OULUN YLIOPISTO	FI	Prof. Timo FABRITIUS
KUNGLIGA TEKNISKA HOEGSKOLAN	SE	Prof. Pär JÖNSSON

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	€ 365,684	Start Date	01/07/2016
	EU Contribution	€ 219,410	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.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr. Bernd KLEIMT
Partners		
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CENTRO SVILUPPO MATERIALI SPA	IT	Dr. Piero FRITTELLA
SWEREA MEFOS AB	SE	Dr. Jonas ALEXIS
MATERIALS PROCESSING INSTITUTE	UK	Dr. Stuart MILLMAN

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	Start Date	01/07/2016
	EU Contribution	€ 1,013,022	End date	30/06/2019

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.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr. Martin SCHLAUTMANN
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PEINER TRAGER GMBH	DE	Mr. Vasilij ZAGREBIN
CENTRO SVILUPPO MATERIALI SPA	IT	Dr. Piero FRITTELLA
FERALPI SIDERURGICA S.P.A.	IT	Mr. Stefano FILIPPINI

RFSR-CT-2015-00031	SIMULEAF *Improvement of electrical arc furnace operations with support of advanced multiphysics modeling SIMULations of the EAF process*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,534,605	Start Date	01/09/2015
	EU Contribution	€ 920,763	End date	31/08/2018

Abstract

The proposal, supported by two research centres (CSM and BFI), three industrial partners (GERDAU, GMH and ORI Martin) and a supplier of electromagnetic stirring devices (ABB AB) are aimed at:

• developing a numerical simulation tool for the EAF process, coupling fluid flow, magneto-hydrodynamics, energy and mass transfer as well as selected thermodynamic calculations;
• using this tool for elaboration of process measures with respect to energy savings, reduction of CO2 emissions, and improved metallic yield.

Validating and integrating sub-models (micro-models) into a macro-model used as advanced simulation tool will allow to:

• Improve EAF process knowledge, as some data can only be obtained using mathematical modelling techniques due to practical limitations of taking measurements on the plant;
• Reduce risks, as modelling can enable decisions on production plant modifications without carrying out on-site experiments, which are expensive and leading to a loss of production;
• Reduce development costs, as modelling offers a wider range of design options to be evaluated before testing on the plant.

The project is composed by the following working topics:

• Selection of available micro-models (detailed description of local phenomena, e.g., stirring, decarburisation by lance, postcombustion);
• Development of missing micro-models (e.g. thermodynamics, ..);
• Integration into a macro-model (able to describe unsteady transport phenomena by coupled multi-physics approach);
• Performance of complete EAF furnace simulations with the tool;
• Validation of the modelling results with process data collected at several EAF plants;
• Performance of parameter studies to optimise the process layout and the operational practices;
• Dissemination of the results.

The techniques used will be based on:

• Modelling: Computational Fluid Dynamics numerical models and physical modelling tools will be used;
• Design of stirring sources - plant tests.

Coordinator	*Country*	*Scientific person in charge*
CENTRO SVILUPPO MATERIALI SPA	IT	Dr. Valerio BATTAGLIA
Partners		
ABB AB	SE	Mr. Jan Erik ERIKSSON
SIDENOR INVESTIGACION Y DESARROLLO EUROPA S.A.	ES	Mr. José Manuel LLANOS RUIZ
GEORGSMARIENHÜTTE GMBH	DE	Mr Bernd DETTMER
O.R.I. MARTIN - ACCIAIERIA E FERRIERA DI BRESCIA SPA	IT	Ing. Uggero DE MIRANDA
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dipl.-Ing. Kersten MARX

RFSR-CT-2015-00005	LEANSTORY *Improvement of steel cleanness by reducing refractory contamination in secondary steelmaking*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,735,185	Start Date	01/07/2015
	EU Contribution	€ 1,041,112	End date	31/12/2018

Abstract

MgO based refractory of new generation is developed by the joint competence of steelmaker, refractory producer and university scientists. Both new carbon free binder system and modification of the current binder systems are studied. The new refractory (either bricks or castable) is characterized and tested firstly in laboratory and then in full scale ladles. The development is directly towards the need of steelmaking. The new refractory is expected to result in great improvement of steel cleanness and prolonged lifetime of ladle lining. The sustainability and recyclability of the refractory should be another important factor in the development.

Coordinator	*Country*	*Scientific person in charge*
KUNGLIGA TEKNISKA HÖGSKOLAN - THE ROYAL INSTITUTE OF TECHNOLOGY	SE	Prof. Du SICHEN

Partners

SIDENOR INVESTIGACION Y DESARROLLO EUROPA S.A.	ES	Mr. Asier ARTEAGA
REFRACTORY SOLUTIONS INSERTEC SL	ES	Mr. Roberto CABALLERO
OVAKO SWEDEN AB	SE	MSc Jan-Erik ANDERSSON
POLITECNICO DI BARI	IT	Prof. Giovanni MUMMOLO
UNIVERSIDAD POLITECNICA DE MADRID	ES	Prof. Joaquín ORDIERES MERE

RFSR-CT-2015-00004	DYNSTIR *Dynamic stirring for improvement of energy efficiency in secondary steelmaking*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,927,815	Start Date	01/07/2015
	EU Contribution	€ 1,156,689	End date	30/06/2018

Abstract

The project objective is to improve ladle stirring by developing dynamic stirring policies in secondary steelmaking at different treatment stations (CASOB treatment, vacuum treatment and final treatment (rinsing)). In heat-individual dynamic stirring, the stirring process will be tailored to the individual need of each treated steel melt, based on metallurgical fundamentals, with the aim to improve the energy efficiency of the ladle stirring processes while maintaining the cleanness of the final product. Imaging and vibration measurement systems will be used to monitor the actual stirring, compare it to the ideal treatment according to the stirring policies and advise correct stirring accordingly. Extensive sampling and analysis will verify the improvements. Energy efficiency will be improved by shorter treatment time, reduced amount of stirring gas used and diminished temperature loss of the steel melt.

Coordinator	*Country*	*Scientific person in charge*
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Dr.-Ing. Birgit PALM
Partners		
CENTRO SVILUPPO MATERIALI SPA	IT	Dr.ssa Patrizia MICELI
GEORGSMARIENHÜTTE GMBH	DE	Mr. Bernd DETTMER
KUNGLIGA TEKNISKA HÖGSKOLAN - THE ROYAL INSTITUTE OF TECHNOLOGY	SE	Prof. Du SICHEN
UDDEHOLMS AB	SE	Dr. Mselly NZOTTA

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

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	€ 1,506,988	Start Date	01/07/2017
	EU Contribution	€ 904,193	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.

Coordinator	*Country*	*Scientific person in charge*
MATERIALS PROCESSING INSTITUTE	UK	Dr. Bridget STEWART
Partners		
IMERYS METALCASTING GERMANY GMBH	DE	Mr. Klaus SCHULZ
SIDENOR INVESTIGACION Y DESARROLLO SA	ES	Mr. Victor SANTISTEBAN
ARCELORMITTAL MAIZIERES RESEARCH SA	FR	Ms Maite CORNILLE
SWEREA MEFOS AB	SE	Dr. Pavel ERNESTO RAMIREZ LOPEZ

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	Start Date	01/07/2017
	EU Contribution	€ 1,361,649	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.

Coordinator	*Country*	*Scientific person in charge*
SWEREA MEFOS AB	SE	Dr. Pavel Ernesto RAMIREZ LOPEZ
Partners		
VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Mr. Bernd FELDMEYER
SIDENOR INVESTIGACION Y DESARROLLO SA	ES	Mrs. Izaskun ALONSO
SAPOTECH OY	FI	Mr. Juha ROININEN
ACCIAIERIE DI CALVISANO SPA	IT	Dr. Piero FRITTELLA
OUTOKUMPU STAINLESS AB	SE	Mr. Marko PETÄJÄJÄRVI

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	€ 1,453,483	Start Date	01/07/2016
	EU Contribution	€ 872,090	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.

Coordinator	*Country*	*Scientific person in charge*
FUNDACION TECNALIA RESEARCH & INNOVATION	ES	Mr. Jose Ignacio BARBERO
Partners		
ERGOLINES LAB SRL	IT	Dr. Isabella MAZZA
FERRIERE NORD SPA	IT	Dr. Loris BIANCO
UNIVERSITY OF BATH	UK	Dr. Manuchehr SOLEIMANI

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

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	€ 2,936,880	Start Date	01/07/2017
	EU Contribution	€ 1,762,128	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.

Coordinator	*Country*	*Scientific person in charge*
SWEREA MEFOS AB	SE	Mr. Patrik SIDESTAM
Partners		
CENTRE DE RECHERCHES METALLURGIQUES ASBL	BE	Mrs. Diana ESPINOSA
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TATA STEEL NEDERLAND TECHNOLOGY BV	NL	Dr. Wanda MELFO
SSAB EMEA AB	SE	Mrs. Marit PERSON

709920 (2016)	**REDUWEARGUID** *Reduction of wear on guiding components in hot strip mill*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,086,788	Start Date	01/07/2016
	EU Contribution	€ 1,252,073	End date	31/12/2019

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.

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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	€ 2,479,534	Start Date	01/07/2016
	EU Contribution	€ 1,487,720	End date	31/12/2019

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*
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RFSR-CT-2015-00009	LASER4ROLLS *Development of compound work rolls for hot mill finishing stands by Laser-cladding*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 1,920,389	Start Date	01/07/2015
	EU Contribution	€ 1,152,233	End date	30/06/2019

Abstract

The objective is developing a new compound work roll system for the HSM finishing stands by exploiting the advantages of the laser-cladding to overlay a reusable steel arbour with a thick layer (20 mm) of enhanced tool steel materials. Key points will be defining the system requirements, lasercladding trials, modelling and materials evaluation. Modelling of the laser-cladding process, of abrasive wear and of thermal treatment combined with NDT measurements for a sound layer and bonding zone will lead to recommendations for this new processing route and a demonstrator (diameter 600mm, length 1m , layer 20 mm) will assess the feasibility.

Coordinator	*Country*	*Scientific person in charge*
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TATA STEEL NEDERLAND TECHNOLOGY B.V.	NL	Dr. Petrus Henk BOLT
UNIVERSITEIT TWENTE	NL	Dr. Gert-Willem ROMER

RFSR-CT-2015-00008	**INFOMAP** *Integration of complex measurement information of thick products to optimise the through process geometry of hot rolled material for direct application*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,385,416	Start Date	01/07/2015
	EU Contribution	€ 1,431,250	End date	31/12/2018

Abstract

Measurement systems covering flatness and dimensional accuracy on plate/strip products are widely available. Output is usually in the form of contour plots or 'maps', providing visual feedback to mill operators who must interpret the information subjectively, and also to technical staff for investigative purposes. Objective interpretation of these maps is not straightforward, and comparison of output from devices of different type or manufacturer often presents further difficulties. The proposed project seeks to address this, developing a tool for objective interpretation of maps from different devices along the process route, generating concise data suitable for use within automatic control/advisory systems.

Coordinator	*Country*	*Scientific person in charge*
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VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE	Mr. Roger LATHE

RFSR-CT-2015-00007	MICROCONTROL-PLUS *Combined Online Microstructure Sensor and Model for a Better Control of Hot Rolling Conditions and Final Products Properties (phase 2)*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 1,817,557	Start Date	01/08/2015
	EU Contribution	€ 1,090,535	End date	31/07/2019

Abstract

Improving of the hot rolling process and achieving better consistency of end-user properties is a big challenge. The online real-time evaluation of microstructure changes becomes key element to address this challenge, particularly for the new generation of steels. For example, to comply with the everlasting need for CO2 emission reduction, advanced high strength steels for automotive applications are lighter and stronger. At the same time, their microstructures show higher sensitivity to process variations, especially of hot rolling conditions. In continuation with the MicroControl (RFS-CR- 2009-10010) project, a new tool combining a microstructural hot rolling model and a Laser Ultrasonic Sensor (LUS) is proposed to predict/control steel properties all along the coil, while maximizing mill productivity. To reach this goal, the all-fibered LUS (prototype successfully tested in previous project) will be improved to a robust, portable, full-industrial version for multi-points measurements at several locations in the hot rolling mill. In parallel, laboratory tests will help develop new signal processing techniques to monitor microstructural changes i.e.:

• Austenite or ferrite average grain size;

• Grain size gradients along thickness;

• Multiple phase transformation during cooling;

• Final ferrite grain size before coiling.

Finally, a new analysis and control tool will be developed combining a microstructural model using a multi-objectives optimization and calibrated with signals obtained from the LUS sensor. This tool will be tested in two industrial situations: 1. predict hot rolling process parameters to achieve final mechanical properties and evaluate microstructure evolution. 2. measure and control austenite microstructure during finishing to improve toughness of line-pipes grades. This online tool will significantly improve the hot rolling process and move a step closer to a fully automatic feed-back control of microstructure and product properties.

Coordinator	*Country*	*Scientific person in charge*
ARCELORMITTAL MAIZIERES RESEARCH S.A.	FR	Dr. Louis SATYANARAYAN
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SWEREA MEFOS AB	SE	Mr. Bijish BABU

RFSR-CT-2015-00006	MANCOOL *Effective Management of Coolant in Cold Rolling*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,129,209	Start Date	01/07/2015
	EU Contribution	€ 677,526	End date	31/12/2018

Abstract

The objective of this research project is to increase the process and product window in cold rolling mills by enhancing the coolant functionality. In a previous RFCS-project "INCOOL" enormous steps have been made already. Based on the findings in it is expected that a further optimisation is possible and more benefits can be obtained. New innovative ideas that will be investigated in this project should further increase the cold mill capabilities. Expected benefits are increased reduction per stand, increased rolling speed and less temperature related material rejections. Specific objectives of this project are:

• Development of a strip cool unit with width control and testing of this unit in an industrial Cold Rolling Mill;

• Development of a method to re-use the thermal energy that is stored in the emulsion bath. A small scale test installation will be built to verify the concept. If successful, the option that saves most energy will be tested in a packaging cold mill in Tata Steel Ijmuiden;

• Thorough experimental work in order to improve the currently used roll coolant settings (flow, nozzle type, distance/angle of header with respect to the roll). In contrast to previous experimental work, emphasis will be on testing with (various types of) emulsions and particular interest will be given to the influence of oil layer on cooling efficiency;

• Investigation and implementation of innovative approaches with respect to cooling, such as adding additives to the bath and optimising the lubricant to enable efficient cooling;

• Increasing the fundamental knowledge with respect to the formation of heat scratches. More specific a model will be developed that predicts the maximum reduction per stand without creating heat scratches (depending on roll/strip/emulsion temperature and material grade).

Coordinator	*Country*	*Scientific person in charge*
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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

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	Start Date	01/07/2017
	EU Contribution	€ 1,135,679	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*
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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	€ 1,483,674	Start Date	01/09/2017
	EU Contribution	€ 890,204	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*
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VEOLIA ENVIRONNEMENT-VE	FR	Mr. Benoit EMO
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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	Start Date	01/07/2016
	EU Contribution	€ 960,182	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*
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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	€ 974,853	Start Date	01/07/2016
	EU Contribution	€ 487,426	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*
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DEUTSCHE EDELSTAHLWERKE GMBH	DE	Mr. Sebastian BANGE

RFSR-CT-2015-00012	ORSC *Optimal Residual Stress Control*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,702,556	Start Date	01/07/2015
	EU Contribution	€ 1,621,533	End date	31/12/2018

Abstract

Client demands for European steel sheet producers are facing a trend in product development where higher quality standards in terms of tighter material property tolerances are demanded. Producers today encounter great problems coupled to residual stresses where an increased number of customer complaints are experienced. Traditional control approaches are not sufficient anymore whereas this project will develop a new “residual-stressbased” control concept, validated at participating industrial partner plants, applicable by combining inline measurements and accurate modelling approaches. Thereby, material property-related homogenization will be facilitated resulting in noticeable increased product quality for European steel producers to successfully meet the market expectations.

Coordinator	*Country*	*Scientific person in charge*
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Partners

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RFSR-CT-2015-00011	**MICROCORR** *Improving steel product durability through alloy coating microstructure*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,789,066	Start Date	01/09/2015
	EU Contribution	€ 1,073,439	End date	28/02/2019

Abstract

The project is devoted to the relationship between the metallic coating microstructure and corrosion resistance. Interactions between alloys coating components will be investigated in series of experiments using a number of innovative, mostly in-situ, electrochemical, corrosion and surface analytical techniques. A numerical model describing the effect of coating microstructure on the evolution of coated steel structures with time emphasizing Zn-Al and Zn-Al-Mg systems will be developed and validated by accelerated and field corrosion tests. It will allow coating developers to reduce the time to market for new generations of metallic coatings with superior long-term corrosion stability and lower coating thickness. The new products will be more cost-effective due to reduced use of raw materials providing thus competitive advantage to European steel industry and end-users.

Coordinator	*Country*	*Scientific person in charge*
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RFSR-CT-2015-00010	IMMARS *Integrated Material Modelling for Abrasion Resistant Steels*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,556,191	Start Date	01/07/2015
	EU Contribution	€ 933,714	End date	30/06/2018

Abstract

The abrasion resistance of a material is not solely determined by the ratio of its hardness as compared to the hardness of the abrasive medium. It is also affected by other factors like:

• The surface state (topography, composition and microstructure);

• The level of residual stresses at the surface.

At the same time, systematic screening have indicated that the material's microstructure as well as its mechanical response to impact (strain hardening and damage accumulation) have a pronounced effect on the abrasion resistance. This effect is not captured in the conventional design criteria, where only the material hardness is taken into account. The IMMARS project objective is to develop an enhanced numerical model to link the surface state (i.e. topography, composition and structure), the level of residual stresses at the surface and the microstructure to the abrasion resistance, by:

• Lab-scale (open three body impact abrasion) and full-scale (cultivator tine rig) testing to measure abrasion resistance for different microstructural and operational conditions;

• Develop a micromechanically sound microscopic model that allows taking into account the microstructural features;

• Develop a mechanism informed macroscopic model specifically accounting for the deformation and damage/failure mechanism of the abrasion process;

• Develop a scaling method to link microstructural features with macroscopic abrasion damage;

• Validate the predictive capability of the micro- and macroscale models by simulation of the lab-scale coupon tests and full-scale cultivator tine tests;

• Applying the multiscale modelling approach to perform design optimization of microstructures with tailored property profiles.

Coordinator	*Country*	*Scientific person in charge*
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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

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	Start Date	01/10/2017
	EU Contribution	€ 930,106	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*
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Partners

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

751360 (2017)	HPDCSTEEL *Development of a new STEEL grade to increase High Pressure Die Casting dies life*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,413,308	Start Date	01/07/2017
	EU Contribution	€ 847,985	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		
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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	Start Date	01/07/2017
	EU Contribution	€ 1,340,198	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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PANEPISTIMIO THESSALIAS	EL	Prof. Gregory HAIDEMENOPOULOS
CENTRO RICERCHE FIAT SCPA	IT	Dr. Daniele PULLINI
INSTITUTO DE SOLDADURA E QUALIDADE	PT	Mrs. Margarida PINTO
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	Start Date	01/07/2016
	EU Contribution	€ 1,078,636	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*
FUNDACION TECNALIA RESEARCH & INNOVATION	ES	Dr. Maribel ARRIBAS
Partners		
ARCELORMITTAL MAIZIERES RESEARCH SA	FR	Dr. Artem ARLAZAROV
CENTRO RICERCHE FIAT SCPA	IT	Dr. Giuseppe DANGELO
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	Start Date	01/07/2016
	EU Contribution	€ 1,048,711	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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TECHNISCHE UNIVERSITAET BERGAKADEMIE FREIBERG	DE	Prof. Rudolf KAWALLA
ASOCIACION CENTRO TECNOLOGICO CEIT-IK4	ES	Dr. Javier ALDAZABAL
GERDAU INVESTIGACION Y DESARROLLO EUROPA SA	ES	Ms Zurine IDOYAGA
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	Start Date	01/07/2016
	EU Contribution	€ 1,174,153	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*
FUNDACIO CTM CENTRE TECNOLOGIC	ES	Ms Silvia MOLAS

Partners

SALZGITTER MANNESMANN FORSCHUNG GMBH	DE	Dr. Marion BECHTOLD
AGENCIA ESTATAL CONSEJO SUPERIOR DEINVESTIGACIONES CIENTIFICAS	ES	Dr. Carlos CAPDEVILA
INSTITUT NATIONAL DES SCIENCES APPLIQUEES DE LYON	FR	Dr. Sophie CAZOTTES
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	FR	Frédéric DANOIX
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	€ 2,699,139	Start Date	01/07/2016
	EU Contribution	€ 1,619,483	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*
FUNDACION IMDEA MATERIALES	ES	Dr. Ilchat SABIROV
Partners		
UNIVERSITEIT GENT	BE	Prof. Roumen PETROV
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TATA STEEL NEDERLAND TECHNOLOGY BV	NL	Dr. Piet KOK
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	Start Date	01/07/2016
	EU Contribution	€ 952,148	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*
RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN	DE	Dr.-Ing. Sebastian MÜNSTERMANN
Partners		
ONDERZOEKSCENTRUM VOOR AANWENDING VAN STAAL NV	BE	Dr. Filip VAN DEN ABEELE
THYSSENKRUPP STEEL EUROPE AG	DE	Mr. Georg PAUL
PANEPISTIMIO THESSALIAS	EL	Prof. Nikolaos ARAVAS
UNIVERSITEIT GENT	BE	Prof. Patricia VERLEYSEN
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	Start Date	01/10/2016
	EU Contribution	€ 946,302	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

Partners

ONDERZOEKSCENTRUM VOOR AANWENDING VAN STAAL NV	BE	Dr. Lode DUPREZ
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	Start Date	01/07/2016
	EU Contribution	€ 1,324,102	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*
TATA STEEL NEDERLAND TECHNOLOGY BV	NL	Dr. Piet KOK
Partners		
KATHOLIEKE UNIVERSITEIT LEUVEN	BE	Prof. Albert VANBAEL
MAX PLANCK INSTITUT FUR EISENFORSCHUNG GMBH	DE	Dr. Franz ROTERS
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TECHNISCHE UNIVERSITEIT DELFT	NL	Prof. Jilt SIETSMA

RFSR-CT-2015-00015	LIGHTOUGH *Screening of tough lightweight Fe-Mn-Al-C steels using high throughput methodologies*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,086,144	Start Date	01/07/2015
	EU Contribution	€ 651,686	End date	31/12/2018

Abstract

Fe-Mn-Al-C steels show superior tensile properties at low density, which triggered further studies on other engineering properties but also on fundamental aspects. Stabilised by Mn and C, the dominant microstructure most compositions is austenitic, although formation of brittle phases needs to be avoided by a proper balance of Mn and C. Adding Al reduces the density and leads to the precipitation of nano-sized kappa carbides, which, if properly controlled by the right tempering conditions, effectively strengthen the material. Further, Al readily promotes the formation of ferrite, opening possibilities for application tailored microstructure variations, but also greatly increasing the alloy complexity. The ongoing steel design and development process is therefore often time consuming and of limited efficiency. This proposal deals therefore with the screening of toughness, density and strength of Fe-Mn-Al-C alloys, in quenched and quenched and tempered condition. Alloy compositions with interesting properties and their respective thermo-mechanical processing parameters will be systematically identified and refined following an iterative combinatorial approach. In parallel innovative methodologies will be fine-tuned and applied for thermodynamic modelling as well as for efficient high throughput sample generation, processing and testing. The targeted outcome is twofold:

• Property and microstructure “maps” as a function of chemical composition and processing parameters provide the basis for future product development;

• Innovative high-throughput methodologies enable to accelerate future steel alloy design.

Coordinator	*Country*	*Scientific person in charge*
MAX-PLANCK-INSTITUT FÜR EISENFORSCHUNG GMBH	DE	Dr. Hauke SPRINGER
Partners		
KUNGLIGA TEKNISKA HÖGSKOLAN - THE ROYAL INSTITUTE OF TECHNOLOGY	SE	Prof Malin SELLEBY
ONDERZOEKSCENTRUM VOOR AANWENDING VAN STAAL N.V.	BE	Dr. Nele VAN STEENBERGE
STRATEGISCH INITIATIEF MATERIALEN VZW*SIM SIM-FLANDERS	BE	Dr. Guido HUYBERECHTS

RFSR-CT-2015-00014	INCROHSS *Impact of two-phase region rolling on the microstructure and properties distribution in heavy gauge structural steel plate*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,529,323	Start Date	01/07/2015
	EU Contribution	€ 917,594	End date	31/12/2018

Abstract

Heavy gauge line pipe and structural steel plate materials are often rolled in the two-phase region for strength reasons. However, strength and toughness show opposite trends and the exact effect of each rolling process parameter remains unclear. A stable process window can only be achieved by a more profound understanding of the microstructure development during the intercritical rolling and its relations with the final microstructure and properties. By means of recently developed microstructure investigation techniques and modelling, the relation between the temperature gradient, bcc-fcc balance at high temperature, strain partitioning between phases and subsequent transformation will be studied in detail to allow for wider process windows. Especially as there is a current trend in increasing the product thickness it is important to zoom in on the microstructure evolution and how it influences the processing window and the distribution of the final mechanical properties in these products. This project for first time will use a clear strategy to assess the potential opportunities and risks for the implementation or the consequences of intercritical rolling in an actual industrial product. By combining a systematic approach to map the behavior of each phase separately and looking at the global mechanical properties on the other hand a correlation will be developed to allow improved processing conditions for this type of products. In addition the current know-how and capabilities for microstructure investigation will allow developing an actual micro-mechanical model based on actual observations.

Coordinator	*Country*	*Scientific person in charge*
CENTRE DE RECHERCHES METALLURGIQUES ASBL	BE	Mr. Matteo CARUSO
Partners		
ASOCIACION CENTRO DE ESTUDIOS E INVESTIGACIONES TECNICAS	ES	Dr. Pello URANGA
ONDERZOEKSCENTRUM VOOR AANWENDING VAN STAAL N.V.	BE	Mrs. Ulrike LORENZ
TECHNISCHE UNIVERSITEIT DELFT	NL	Dr. Ir. Jilt SIETSMA

RFSR-CT-2015-00013	PRETICONTROL *Control of precipitation sequences during hot rolling to improve product uniformity of titanium containing high strength steels*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,113,428	Start Date	01/07/2015
	EU Contribution	€ 1,268,057	End date	31/12/2018

Abstract

The project aims to understand how precipitation of Ti, in conjunction with Nb and V, influences microstructure and property development during processing of high titanium (max. 0.15wt%) containing high strength steels (>700MPa) and hence make recommendations for compositions which are relatively insensitive to varying processing conditions. It will be achieved by characterization of precipitation sequences during the main stages of the hot rolling process. Influence of microalloying elements on austenite recrystallization behaviour and bainite phase transformation will be investigated by thermo-mechanical techniques coupled to high resolution characterization methods. Models will be developed and applied to optimise hot strip rolling strategy.

Coordinator	*Country*	*Scientific person in charge*
CENTRE DE RECHERCHES METALLURGIQUES ASBL	BE	Mr. Benjamin POHU
Partners		
ASOCIACION CENTRO DE ESTUDIOS E INVESTIGACIONES TECNICAS	ES	Dra Beatriz LOPEZ SORIA
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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

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	€ 1,578,022	Start Date	01/07/2017
	EU Contribution	€ 940,813	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*
ASOCIACION DE INVESTIGACION METALURGICA DEL NOROESTE	ES	Mrs. Gala PEREZ
Partners		
SIDENOR INVESTIGACION Y DESARROLLO SA	ES	Mr. Rafael PIZARRO
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	Start Date	01/07/2017
	EU Contribution	€ 911,886	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*
SIDENOR INVESTIGACION Y DESARROLLO SA	ES	Mr. Roberto ELVIRA EGUIZABAL

Partners		
KARLSRUHER INSTITUT FUER TECHNOLOGIE	DE	Dr. Stefan DIETRICH
STRESSTECH GMBH	DE	Mr. Dominik DAPPRICH
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	Start Date	01/07/2017
	EU Contribution	€ 1,071,187	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*
SIDENOR INVESTIGACION Y DESARROLLO SA	ES	Dr. Diego HERRERO VILLALIBRE
Partners		
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CENTRO RICERCHE FIAT SCPA	IT	Dr. Eva BUTANO
SWEREA KIMAB AB	SE	Dr. Thomas BJÖRK
USTAV FYZIKY MATERIALU, AKADEMIE VED CESKE REPUBLIKY, V.V.I	CZ	Mr. Pavel HUTAR

709601 (2016)	ULTRASLIM *ULTRA-fine austenitic stainless Steel as a LIghtweight automotive Material*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,258,243	Start Date	01/07/2016
	EU Contribution	€ 754,946	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*
CENTRO RICERCHE FIAT SCPA	IT	Dr. Giuseppe DANGELO
Partners		
ACERINOX EUROPA SA	ES	Mrs. Julia CONTRERAS FORTES
FUNDACION TECNALIA RESEARCH & INNOVATION	ES	Ms Teresa GUTIERREZ
TWI LIMITED	UK	Mr. Sullivan SMITH

RFSR-CT-2015-00019	EFFIPRESS *Development of energy-efficient press hardening processes based on innovative sheet and tool steel alloys and thermo-mechanical process routes*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 2,210,210	Start Date	01/07/2015
	EU Contribution	€ 1,326,127	End date	30/06/2018

Abstract

Increased emphasis on the lifecycle resource efficiency of automobiles is pushing the boundaries of contemporary steel grades. The implementation of the new SSAB steel grade enables the production of lightweight components with improved resource efficiency during the manufacturing and service cycles. The know-how on steel hot forming process necessary to exploit its potential market competitiveness edge, however, does not exist today. The objective of this project is to characterise and develop press hardening processes for this new DOCOL® 2000Bor steel alloy and featuring a tensile strength of 2000 MPa. In addition, investigations of the assisting heating and cooling processes and sheet forming are aimed at ensuring the comprehensive industrial applicability of the project. The cost-to-benefit advantages of this new steel grade can be demonstrated by the development and evaluation of automotive component prototypes. As reference for this evaluation, the commercially established DOCOL® 1800Bor steel alloy will be considered. For the development of the die tools, the new grade HTCS® 230 tool steel alloy will be optimized in order to be used for production dies considering the potential advantages that can be achieved with help of its enhanced thermal and mechanical properties along with reduced die construction cost. The project encompasses sheet and tube-based component processing workflows that finalise in dedicated prototypes of passive safety-critical parts. Material property and forming limit characterization of this steel sheets and tubes is followed by the experimental study of sheetforming and tube hydroforming processes with an emphasis on formability, tool loads and spring-back behaviour. Within the tube workflow the welding and heat treatment for improved properties and precision are assessed. The sheet and tube workflows are supported by forming FE simulations, and experimental tribological characterisation for the selection of appropriate coatings.

Coordinator	*Country*	*Scientific person in charge*
TECHNISCHE UNIVERSITÄT CHEMNITZ	DE	Mr. Enrique MEZA GARCIA
Partners		
GRUPO ANTOLIN-INGENIERIA S.A.	ES	Mr. Diego VAL
FUNDACIO CTM CENTRE TECNOLOGIC- CTM	ES	Prof. José Maria CABRERA MARRERO
FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	DE	Ms Anja RAUTENSTRAUCH
ROVALMA SA	ES	Dr. Anwar HAMASAIID
SALZGITTER HYDROFORMING GMBH & CO KG	DE	Dipl.-Ing. Peter FREYTAG
SSAB EMEA AB	SE	Mr. Thomas MÜLLER
ZAPADOCESKA UNIVERZITA V PLZNI-UNIVERSITY OF WEST BOHEMIA	CZ	Prof. Dr.-Ing. Bohuslav MASEK

TGS7 : Steel products and applications for automobiles, packaging and home appliances

RFSR-CT-2015-00018	ICUT *Integrative cutting solutions to produce high performance automotive components with high-Mn steel sheet*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,170,945	Start Date	01/07/2015
	EU Contribution	€ 1,302,568	End date	31/12/2018

Abstract

The high mechanical strength of AHSS makes them especially susceptible to premature failure if defects are introduced in structural parts as a result of non-optimised cutting processes.The exceptional combination of strength and ductility of high Mn steeel (HMnS) poses them as exceptional candidates for parts that needs high fatigue resistance and may contain defects from processing steps. Currently, there is a major lack of knowledge about the effects of the cutting processes on the mechanical properties and formability of HMnS. It hampers their extensive industrial application because nonoptimized cutting could lead to dramatic reduction of part performance. A detailed investigation regarding the quality of the cut edge, which determines fatigue and delayed fracture resistance, is required to face the industrial implementation of HMnS in structural vehicle parts. Moreover, the costs associated with cutting high strength sheets, as well as the environmental impact of the use of HMnS steels, have to be considered before industrial implementation. Press cutting is the most efficient cutting process but tool durability has a big impact on process efficiency and has to be assessed to develop competitive industrial process. A rational evaluation will be performed based on LCA of the of the substitution of currently used steels in the car body by TWIP steels. Thus, the objective of iCut is to provide the clues to overcome the detrimental effects of the imperfections introduced in cut edge during cutting processes on the fatigue, H-embrittlement sensitivity and formability of sheared areas of HMnS sheets aimed at obtaining the cutting parameters and cutting technology that allow producing high performance HMnS parts. Different cutting technologies will be studied, looking at process competitiveness and LCA evaluation. For press cutting, which is currently considered the most competitive cutting technology, tool durability and to the effect of tool wear on the evolution.

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TGS7 : Steel products and applications for automobiles, packaging and home appliances

RFSR-CT-2015-00017	**HOTFORM** *New multiphase AHSS steel grades for hot forming, with improved formability and reduced springback*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,756,120	Start Date	01/07/2015
	EU Contribution	€ 1,053,672	End date	31/12/2018

Abstract

In automotive lightweight design, AHSS components are one of the preferred alternatives, since they allow downsizing vehicle structures in a cost effective manner. Different AHSS grades are used according to the component required functionality, structural, stiffness, crash behaviour,... Cold forming of AHSS grades, in the range of 1.000MPa, implies high resulting springback and press force, limited formability, reduced post-forming ductility and low stretch flangeability, several operations needed for manufacturing complex geometry parts and large scrap is produced after trimming the addendum and blank-holder areas. HOTFORM proposes a new route for manufacturing multiphase AHSS grades (DP type and CP type), where the annealing stage, from the steel processing, is performed at the press shop, heating the blank sheet in a furnace and then hot forming the part, with cooled dies. This will be achieved by optimized steel alloying design and dilatometry testing and characterization, aiming at ensuring the stability of the required phase transformation kinetics over the combined thermal and deformation gradients, produced during hot forming. The benefits of hot forming will be: improved formability, no springback, reduced press forming forces, reduced raw material usage and produced scrap, only one forming operation for complex geometries,... The total energy usage will be optimized, as the energy used for annealing stage, from the steel processing, will be converted in the heating before the hot stamping. Reduced press forces and number of operations will account for production energy savings. Zn coated materials will be used, and the hot forming process will be designed to ensure the quality of the hot stamped parts (neither liquid metal embrittlement nor micr-cracks). Experimental tests will validate the new steels. An additional pursued benefit will be the possibility of integrating flanging operations during the hot stamping. This will be evaluated with CAE simulations.

Coordinator	*Country*	*Scientific person in charge*
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VOLKSWAGEN AG	DE	Dr. Christina SUNDERKOETTER

RFSR-CT-2015-00016	JOININGTWIP *JoiningTWIP - TWIP-Steels for multi material design in automotive industry using low-heat joining technologies*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 2,134,379	Start Date	01/07/2015
	EU Contribution	€ 1,280,628	End date	30/06/2018

Abstract

JoiningTWIP will support the introduction of TWIP-steels in applications of vehicle manufacturers by providing reliable joining technologies for multimaterial design of TWIP-steels with conventional steels and lightweight materials. The results of JoiningTWIP will shift the state of art concerning lightweight-related joining technologies significantly. Already established mechanical and low-heat joining technologies will be enhanced regarding their applicability in joining similar and dissimilar joints of TWIP-steels with conventional ultra high strength steels and traditional lightweight materials. The joining technologies examined in this project will be clinching, tack-setting, flow-drill screwing, rivet-element welding and friction element welding. The joints made with these specially adapted joining technologies will be tested comprehensively. The testing programme consists of metallographic analysis, determination of mechanical properties (static and crash loads, fatigue) and corrosion tests and even prototype tests under realistic conditions. This will allow end-users to consider TWIP-steels in further designs and constructions by providing them the needed mechanical and technological properties in joining this new steel-grade in multi-material design. Always in focus of the project is the applicability of the results for end-users. Therefore, the results will be directly comparable to already existing results of solutions made from conventional steels and will show the superior properties of multi-material designs made with TWIP-steels.

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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

754198 (2017)	**TRAFIR** *Characterization of TRAvelling FIRes in large compartments*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,199,975	Start Date	01/07/2017
	EU Contribution	€ 719,985	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.

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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	€ 1,341,566	Start Date	01/07/2017
	EU Contribution	€ 804,939	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.

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OXFORD BROOKES UNIVERSITY	UK	Prof. Raymond OGDEN
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754102 (2017)	**STEELWAR** *Advanced structural solutions for automated STEELrack supported WARehouses*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 2,455,460	Start Date	01/07/2017
	EU Contribution	€ 1,473,276	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.

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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	Start Date	01/07/2017
	EU Contribution	€ 491,262	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

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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	€ 813,702	Start Date	01/07/2017
	EU Contribution	€ 813,701	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 and (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.

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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	€ 1,218,712	Start Date	01/07/2017
	EU Contribution	€ 1,218,712	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.

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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	€ 1,220,393	Start Date	01/07/2017
	EU Contribution	€ 732,236	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.

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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	€ 1,438,021	Start Date	01/07/2017
	EU Contribution	€ 862,813	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.

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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	€ 1,483,736	Start Date	01/07/2017
	EU Contribution	€ 890,241	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	€ 1,664,996	Start Date	01/06/2017
	EU Contribution	€ 998,997	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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THE STEEL CONSTRUCTION INSTITUTE LBG	UK	Dr. Michael SANSOM

745982 (2017)	**FASTCOLD** *FAtigue STrength of COLD-formed structural steel details*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,873,936	Start Date	01/07/2017
	EU Contribution	€ 1,724,361	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	€ 1,519,694	Start Date	01/07/2017
	EU Contribution	€ 911,816	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	€ 1,125,080	Start Date	01/07/2016
	EU Contribution	€ 651,810	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.

Coordinator	*Country*	*Scientific person in charge*
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710040 (2016)	REDUCE *Reuse and demountability using steel structures and the circular economy*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,143,810	Start Date	01/07/2016
	EU Contribution	€ 1,286,286	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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UNIVERSITY OF BRADFORD	UK	Prof. Dennis LAM

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	Start Date	01/09/2016
	EU Contribution	€ 1,015,911	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	Start Date	01/07/2016
	EU Contribution	€ 933,940	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	Start Date	01/07/2016
	EU Contribution	€ 944,211	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	Start Date	01/07/2016
	EU Contribution	€ 1,156,602	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	€ 1,608,411	Start Date	01/07/2016
	EU Contribution	€ 965,046	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.

Coordinator	*Country*	*Scientific person in charge*
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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	€ 613,619	Start Date	01/07/2016
	EU Contribution	€ 368,171	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	€ 1,826,177	Start Date	01/07/2016
	EU Contribution	€ 1,095,706	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	Start Date	01/07/2016
	EU Contribution	€ 597,392	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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RFSR-CT-2015-00025	PROLIFE *Prolonging life time of old steel and steel-concrete bridges*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,514,602	Start Date	01/07/2015
	EU Contribution	€ 908,761	End date	30/06/2018

Abstract

European bridges need refurbishment and strengthening to meet new demands of higher loads and new codes. Three distinctive ideas with potential of saving costs for the European community, reducing the environmental impact for the same result and minimizing the traffic disturbance:

• New composite action or strengthening of existing shear connectors by post installed shear dowels;

• Box action by horizontal trusses between the bottom flanges of I-girder bridges, transferring the very fatigue-sensitive I-girders into box girders;

• Effective strengthening of old truss bridges.

The multi-criteria decision scheme will be delivered reviewed by the expert group proposed by transport authorities.

Coordinator	*Country*	*Scientific person in charge*
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RFSR-CT-2015-00024	**JABACO** *Development of Modular Steel Jacket for Offshore Windfarms*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,381,993	Start Date	01/07/2015
	EU Contribution	€ 1,429,196	End date	31/12/2018

Abstract

Aim of JABACO is to develop a Modular Jacket concept composed by components of pre-qualified quality, for cost reduction of offshore wind farms. The concept is based on an integrated design considering water depths 30-80m, turbine sizes 5-10 MW, in the North Sea and the Mediterranean. Design of basic six cases, tests and numerical simulations of structural components conducted together with a sensitivity analysis. Deliverable is the "JABACO manual", containing procedure /recommendations for modular jacket design and the six case studies optimized, which will define apathway to lowering cost of energy for upcoming offshore wind farms in European waters.

Coordinator	*Country*	*Scientific person in charge*
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Partners

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RAMBOLL MANAGEMENT CONSULTING GMBH	DE	Dr. Tim FISCHER
PANEPISTIMIO THESSALIAS*UNIVERSITY OF THESSALY	EL	Dr. Spyros A. KARAMANOS

RFSR-CT-2015-00023	NEWREBAR *NEW dual-phase steel REinforcing BARs for enhancing capacity and durability of antiseismic moment resisting frames*			
Info	Type of Project	Research	Duration (months)	48
	Total Budget	€ 1,911,052	Start Date	01/07/2015
	EU Contribution	€ 1,146,631	End date	30/06/2019

Abstract

One of the main requirements of the seismic-resistant reinforced concrete structures is a high global ductility, i.e. the ability to absorb energy during earthquakes. Another fundamental requirements of modern buildings is durability, in order to maintain an adequate safety level over time, minimizing the maintenance costs. This project aims to develop a new class of reinforcing bars using DP steels, which should guarantee better mechanical properties and improved corrosion resistance. DP steels have not yet used as reinforcing steel and they can represent a breakthrough for the European construction sector, allowing the realization of safer and more durable structures.

Coordinator	*Country*	*Scientific person in charge*
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UNIVERSITY OF PATRAS* PANEPISTIMIO PATRON	EL	Prof Charis APOSTOLOPOULOS

RFSR-CT-2015-00022	FREEDAM *FREE from DAMage Steel Connections*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,449,860	Start Date	01/07/2015
	EU Contribution	€ 869,915	End date	30/06/2018

Abstract

The proposed research is aimed at the development of a new design strategy whose goal is the design of connections able to withstand without any damage the rotation demands due to seismic events, namely “Free From Damage Connections”. Such innovative beam-to-column connections are equipped with friction dampers which are located at the bottom flange level of the connected beam to dissipate the earthquake input energy. The friction resistance is calibrated by acting on the number and diameter of bolts and their tightening torque governing the preloading. The flexural resistance results from the product between the damper friction resistance and the lever arm. The connections are conceived to exhibit wide and stable hysteresis loops without any damage to the connection steel plate elements. Therefore, the basic idea of the work is inspired to the strategy of supplementary energy dissipation, but it is based on the use of damping devices under a new perspective. In fact, while passive control strategies have been commonly based on the integration of the energy dissipation capacity of the primary structure by means of a supplementary dissipation coming from damping devices, conversely, the FREEDAM design strategy is based on the use of friction dampers conceived in such a way to substitute the traditional dissipative zones of MRFs, i.e. the beam ends. The development of FREEDAM connections has to be considered, on one hand, a first important goal because of the benefits coming from the cancellation of the connection repair costs in the aftermath of a seismic event and, on the other hand, a step towards the ambitious goal of free from damage buildings which will require, additionally, the identification of connection details, between non-structural components and primary structure, able to prevent also the damage to non-structural components (cladding panels, ceilings, plantfacilities, etc.) and systems to allow the structural recentering after severe seismic events.

Coordinator	*Country*	*Scientific person in charge*
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O FELIZ - METALOMECÂNICA, S.A.	PT	Dr. José Manuel SILVA
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UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II	IT	Prof. Dr. Raffaele LANDOLFO
UNIVERSIDADE DE COIMBRA	PT	Prof. Dr. Luis SIMOES DA SILVA

RFSR-CT-2015-00021	SHOWTIME *Steel Hybrid Onshore Wind Towers Installed with Minimal Effort*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,849,586	Start Date	01/07/2015
	EU Contribution	€ 1,109,751	End date	30/06/2018

Abstract

More powerful wind turbines need higher towers (over 120 m) and therefore require new solutions which are economically justified and environmentally friendly. The project goal is to find an economical solution based on a hybrid tower, comprising a steel lattice lower part and a steel tubular upper part. The solution is targeted at tall onshore applications which are more effective in energy generation in situations where wind shear profile is clearly benefiting higher turbines, for example near forests. The work will focus on:

• The erection process, in which the lattice portion of the tower is used as support for the installation of the upper tubular part of the tower and the turbine;

• The use of new type of steel for maintenance-free bolts and high strength steel grades for critical parts of the tower (the transition between the lattice and tubular parts);

• The optimization of design and construction of a low maintenance truss structure for the design life.

The work packages and the partnership are formed in order to address following issues:

• Optimal proportions and geometry of lattice and tubular parts of the hybrid structure, considering transport and crane size constraints; Conceptual design of several case studies will be performed;

• Competitiveness of solution in terms of structural performance and life cycle assessment; fabrication, construction and inservice maintenance must be minimized; alternative steel-intensive piled foundations will be considered;

• Practicality of erection process (using lower lattice part as support for sliding procedure); numerical simulations will be carried out and a small scale prototype will be constructed;

• Use of high strength steel grades for the lattice part and transition segment; several experimental tests are proposed in order to assess compressive strength of truss bars, stiffness of joints, feasibility of erection, resistance of transition segment and metallurgical characterization of bolts' steel.

Coordinator	*Country*	*Scientific person in charge*
UNIVERSIDADE DE COIMBRA	PT	Prof. Carlos REBELO

Partners

FRIEDBERG PRODUKTIONSGESELLSCHAFT MBH	DE	Mrs. Beatrix BRAND
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THE UNIVERSITY OF BIRMINGHAM	UK	Prof. Dr.-Ing. Charalampos BANIOTOPOULOS

RFSR-CT-2015-00020	SLIMAPP *Slim-Floor Beams - Preparation of Application rules in view of improved safety, functionality and LCA*			
Info	Type of Project	Research	Duration (months)	36
	Total Budget	€ 1,269,763	Start Date	01/07/2015
	EU Contribution	€ 761,858	End date	30/06/2018

Abstract

The aim is to increase the competitiveness of steel in buildings by developing the application of slim floor beams through improved rules for safety, functionality and LCA. Within a holistic approach considering all aspects of optimal technical and sustainable design, special focus is given to the composite action by reinforcing bars as efficient shear connectors. For normal design, new rules will fill the gap where slim floor solutions are currently not covered in Eurocode 4. Based on this new ULS and SLS design methodology, “pilot” projects will allow optimization of different composite slim floor solutions taking account of lifecycle assessment.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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LINDAB SA	LU	Mr. Ernest HENDRICKX
THE STEEL CONSTRUCTION INSTITUTE LBG	UK	Dr. R. Mark LAWSON
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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

753592 (2017)	**TRACKOPT** *Consistent ladle tracking for optimisation of steel plant logistics and product quality*			
Info	Type of Project	Pilot&Demonstration	Duration (months)	42
	Total Budget	€ 898,258	Start Date	TBC after GAP is completed
	EU Contribution	€ 449,129	End date	TBC after GAP is completed

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*
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Partners		
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STAHLWERK BOUS GMBH	DE	Dr. Arne Treppschuh
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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	€ 407,221	Start Date	01/07/2017
	EU Contribution	€ 407,221	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*
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SCUOLA SUPERIORE DI STUDI UNIVERSITARI E DI PERFEZIONAMENTO SANT'ANNA	IT	Dr. Valentina COLLA

710066 (2016)	**DROMOSPLAN** *Drones for autonomous monitoring of steel plants*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,857,589	Start Date	01/07/2016
	EU Contribution	€ 1,114,553	End date	31/12/2019

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		
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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	Start Date	01/07/2016
	EU Contribution	€ 1,070,163	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*
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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	€ 1,924,678	Start Date	01/07/2016
	EU Contribution	€ 962,339	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		
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PSC AUTOMATIZARI SI INSTALATII SRL	RO	Mr. Raul PAL

RFSR-CT-2015-00030	AUTOADAPT *Novel automatic model identification and online parameter adaption for supporting the industrial deployment of model-based material property process control*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,976,527	Start Date	01/07/2015
	EU Contribution	€ 1,185,916	End date	31/12/2018

Abstract

In the process route from hot-rolling to hot-dip galvanization, the homogeneity of the material properties often fails to meet increasing customer demands and there is an urgent need to improve processing systems here. Model-based automation is capable to solve this problem, but its value for the EU steel community is currently not fully exploited. Due to a cumbersome process of model generation, this technology is not widely deployed yet. The proposed expandable system aims to apply self-learning methods for adapting such automations to new products and plants. It will be implemented and tested in industrial scope. Easier commissioning will stimulate the industrial acceptance and distribution of model-based control, resulting in increased product quality for the EU steel industry.

Coordinator	*Country*	*Scientific person in charge*
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THYSSENKRUPP STEEL EUROPE AG	DE	Dr. Thomas KEBE

RFSR-CT-2015-00029	GASNET *Optimization of the management of the process gases network within the integrated steelworks*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 1,849,502	Start Date	01/07/2015
	EU Contribution	€ 1,109,701	End date	31/12/2018

Abstract

The project aims at improving the off-gases management within steelworks by minimizing gas amount that is burned in torch, air emissions, environmental impact and costs related to the waste of a resource and of CO2 allowances. A decision support tool for process operators and process support team is also developed simulating gas networks and optimizing gases distribution, by considering all the operating constraints. System dynamics and correlations between energy demands and gases production are fundamental for this analysis, as considerable savings can be achieved through transients proper management. Multi-period and multi-objective optimization techniques are applied to face this challenging objective.

Coordinator	*Country*	*Scientific person in charge*
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RFSR-CT-2015-00028	**POWGETEG** *Power generation from hot waste gases using thermoelectrics*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,381,665	Start Date	01/07/2015
	EU Contribution	€ 1,428,999	End date	31/12/2018

Abstract

The possibilities of thermoelectric (TE) power generation using industrial gaseous waste heat at temperatures well above 550 °C will be determined in the PowGETEG project. Since the TE generators will be installed in the waste gas of an iron and steel manufacturing process, advanced components, materials and solutions need to be integrated in the TE generators and the electrical power subsystem. These requirements are determined by the high temperature level at which TE power generation will now be applied and the nature of such waste gases, that are produced when combusting iron and steel process gases like blast furnace gas or coke oven gas. Not only are such waste gases often fluctuating in temperature, composition and flow, they also contain particle matter that could lead to accretions on the surface of the heat exchanger of the TE generator, thus decreasing heat transfer, electrical power production and efficiency. Several waste heat sources of a German integrated steel mill will be studied, supported by both tests and data evaluation, in order to be able to detailly describe these waste gases. By testing both a bench scale unit and a demonstrator, which will able to produce about 1000 W, conclusions can be drawn about the requirements to process control, power conversion, heat exchanger design and the construction that supports the TE generator in the waste heat stream. These will then be used to study the techno-economic feasibility of implementing TE generators in high temperature waste gases and the effect it will have on energy efficiency of the integrated steel plant. This includes a comparison with other steam based power producing technologies and an extrapolation of the research results to other industries.

Coordinator	*Country*	*Scientific person in charge*
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Partners		
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GENTHERM EUROPE GMBH	DE	Mr. Rüdiger SPILLNER
THYSSENKRUPP STEEL EUROPE AG	DE	Mr. Hans-Peter DOMELS
THE UNIVERSITY OF GLASGOW	UK	Prof. Andrew KNOX

RFSR-CT-2015-00027	PREVENTSECDUST *Prevention of secondary dust emissions in ironmaking plants using dust suppressants*			
Info	Type of Project	Research	Duration (months)	42
	Total Budget	€ 2,002,593	Start Date	01/07/2015
	EU Contribution	€ 1,201,556	End date	31/12/2018

Abstract

The awareness of the importance of fine dust for human health increased strongly within the last years and with it the legislative regulations with regard to both emissions and occupational health. The project Prevention of secondary dust emissions in iron making plants using dust suppressants (PreventSecDust) will provide a major step to decrease the secondary dust emissions in iron making plants. It will cover all sources of secondary dust upstream to the blast furnace: Transport, storage and mechanical processing of raw materials and products. Tests with locally atomized aqueous dust suppressants showed good results with respect to dust suppression. However, almost no basic knowledge exists about the mechanisms of dust generation, the limits of the techniques or the influences on the processes involved. Finally, no technical devices exist, suitable for continuous, reliable operation in the hostile environment. Monitoring and control concepts are missing. The project starts with the investigation of the mechanisms of dust generation and propagation to derive the governing conditions. Local dust concentrations and relevant conditions will be measured at different locations and plants. This provides the knowledge necessary to develop tailor-made techniques and measures. Pilot spraying devices will be installed and extensive trials will be performed to derive guidelines for selection, concentration and dosing of dust suppressants. The design of the spraying devices will be optimised for continuous operational use with regard to effectiveness, maintenance and costs. Measuring and monitoring concepts will be developed. As well, new concepts for conventional dust suppression methods will be developed by DEM/CFD calculations. The new techniques will be completely assessed and will be integrated in existing dust prevention concepts to provide a new basis for the Best-Available-Techniques.

Coordinator	*Country*	*Scientific person in charge*
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RFSP-CT-2015-00026	**PLANTTEMP** *Plant wide control of steel bath temperature*			
Info	Type of Project	Pilot&Demonstration	Duration (months)	36
	Total Budget	€ 804,981	Start Date	01/07/2015
	EU Contribution	€ 402,491	End date	30/06/2018

Abstract

The objective of the Pilot & Demonstration project is to develop an operator advisory system for through-process monitoring and control of the liquid steel temperature in order to improve the accuracy in meeting the target casting temperature with minimisation of energy and material consumptions.

The through-process control system covers the complete process chain of electric steelmaking from the superheating phase in the EAF up to the end of the casting process in the tundish. The operator advisory system will evaluate the reliability of the information and give operational advice regarding appropriate measurement procedures and optimised set-points for the practices of the remaining treatment steps. For that purpose optimised measurement guidelines, model and sensor based monitoring systems and predictive control strategies are combined and applied. Thus the advisory system will help the operator to react in the optimal way on unscheduled variations in the temperature evolution. The following benefits shall be achieved by the application of the advisory system:

• Support of the operator in judging the accuracy and reliability of the temperature information and recommendations for optimized operational practice;

• Improved accuracy in meeting the target casting temperature;

• Optimised resource efficiency with reduced electrical energy consumption;

• Less interference with the casting speed, thus improved steel quality with higher reproducibility and productivity.

The operator advisory system will be implemented, tested and validated at a well-equipped and instrumented electric steelmaking plant with a 140 t DC electric arc furnace, 2 ladle furnaces, a vacuum degasser, a final stirring station and a six strand continuous billet caster.

Coordinator	*Country*	*Scientific person in charge*
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