

Overview on RFCS research on EAF energy and resource efficiency

Dr.-Ing. Thomas Echterhof

RFCS VALEAF seminar „EAF Energy and Resource Efficiency“
Aachen, 23.04.2015

VALEAF is a dissemination project on Electric Arc Furnace technology

What is a dissemination project ?

A dissemination project is a way to **valorise** and **diffuse** the most important results obtained in RFCS research with direct benefits for European steel industry. It intends to be also a basis for establishing a roadmap for future research work.



What is VALEAF ?



Objectives

1. to promote the knowledge and various outputs derived from the European projects in this sector
2. to supply guidelines for the next developments of EAF technologies, to give indications on priorities for research subjects and suggest a clear road map for the technological development in this field

Ways and means

Collection and organisation of ECSC/RFCS projects of the last ten years
Seminars and workshop across Europe
Construction of a web site

In the project a number of public events are planned

Seminars

To present most relevant results of European research

The seminars are communication events to diffuse results and information on specific subjects

Workshops

To share and discuss EAF technological issues with stakeholders

The aims of the workshops are:

- to better define the really available results, their weak and strong points, potentiality, criticalities, trends
- to define a road map for the future EAF technology
- to individuate barriers and needs for research

From 1991 up to now, in the context of the research programmes of the **European Coal and Steel Community** and **Research Fund for Coal and Steel** about 70 projects have been dedicated to EAF, 33 in the period 2001-2015.

In the various projects all the most important players of European industry were involved (steel industry, engineering companies, suppliers, research centers)

All the relevant technical issues of EAF process have been faced.

Project topics

1) Process control

- New models (deterministic, analytical, statistic, based on innovative neural network and fuzzy logic techniques) for improved energy efficiency, productivity (end point control) and quality (target composition and temperature)
- New sensors and mathematical techniques for continuous offgas composition and temperature measurements and related use of the derived information to guide process operations
- Sensors for monitoring the status of the charge during melting and the status of the electrodes

2) EAF Efficiency and optimisation

- Relationships between energy consumption and productivity
- Control and exploitation of chemical energy
- Techniques (models and sensors) and guidelines for running the EAF in airtight conditions

3) Slag control

- Measurements and model calculations of slag status and use of additives for foam control
- Additives for slag reduction to recover alloy elements from the slag

4) Scrap treatment and control

- Pre-treatment of scrap to improve quality and to reduce energy consumption
- Innovative (ultrasonic, optical, laser based) measurements of physical and chemical properties of scrap to control quality
- Determination of scrap properties based on statistical evaluations
- Cost optimal charge mix calculation
- Mathematical tools to manage flexible scrap charging

5) Environmental Impact

- Measurements and operating practices to reduce NOx emissions
- Pre-treatment of scrap to improve environmental impact

6) Alternative charge

- Techniques and guidelines to use alternative iron sources
- Use of char from biomass replacing coal
- Recycling of by-products

7) Production of new steel grades

- High Mn steel (ultra high strength steel grades)

Project	Consortium	Duration
Characteristics of a hot-air/oxygen fuel burner for increasing the input of fossil energy into the EAF and comparison with conventional burners	ATZ-EVUS, BSW, CRM	1996-1998
Modelling and optimising of oxygen lances, tuyères, and of the injection technique of various materials into electric arc furnaces	Profilarbed, CRM, Sidenor I+D, BFI	1996-1999
Control of the decarburization and the stirring efficiency in the EAF	Arcelor, Corus UK, CRM, Sidenor	1997-2000
Improved utilisation of fossil fuel by injection through hollow electrodes in the EAF	CSM, MEFOS, RWTH-MCH, Techint, A. Rubiera	1998-2001
Improving the productivity of EAFs	BFI, Profilarbed, CRM, FERALPI	1999-2002
Evaluation of airtight furnace technology (reduction of air ingress in EAF)	IRSID (Arcelor), CRM	2000-2003
New cooling panels for reduction of heat losses in EAF steelmaking	CRM, CSM, Dalmine, Profilarbed	2001-2004
Development of operating conditions to improve chemical energy yield and performance of dedusting in airtight EAF	CSM, BFI, RWTH-IOB, ORI, GMH, TKN	2002-2005
Improved EAF process control using on-line offgas analysis - OFFGAS	RWTH-IOB, CRM, CSM, DEW, Marienhütte, ORI, TENOVA, THYSSEN, BFI	2006-2009

EAF Efficiency and optimisation

Project	Consortium	Duration
Economic advantages of integrated processing of steelworks EAF wastes, mainly containing Zn, Pb, Cd, FeOx, Zn ferrite and others, with total recovery	Ferriere Nord	1995-1998
The in-plant by-product melting (IPBM) process	MEFOS, CRM, CSM, FEhS	1996-1998
Briquetting of self-reducing blendings of waste iron oxide mixtures	Profilarbed, CRM, BFI	1997-2000
High purity zinc and ferroalloys recovery from EAF dusts through a combined pyro-hydrometallurgical treatment	CSM, TK AST, TKN, ASO, TECHINT	1998-2001
Foaming of the slag and recycling of stainless steel dusts by injection into the electric arc furnace for stainless steels	UGINE, KEP, IRSID, FEhS	1999-2002
Efficient utilisation of raw materials used in secondary steelmaking as flux in steelmaking furnaces	FEhS, DEW, HORN, RIVA, CENIM-CSIC, FQZ Brandenburg	2000-2003
Pre-processing of metallurgical wastes by direct reduction for recovery of iron, zinc and lead	CRM, IRSID, TKS	2000-2003
Upgrading and utilisation of residual iron oxide materials for hot metal production – URIOM	BFI, Böhler, CSM, Tribovent	2007-2010
Sustainable EAF steel production – GREENEAF	FERRIERE, CSM, DEW, IMPERIAL COLLEGE, Marienhütte, RWTH-IOB, Tecnocentro	2009-2012

Alternative charge

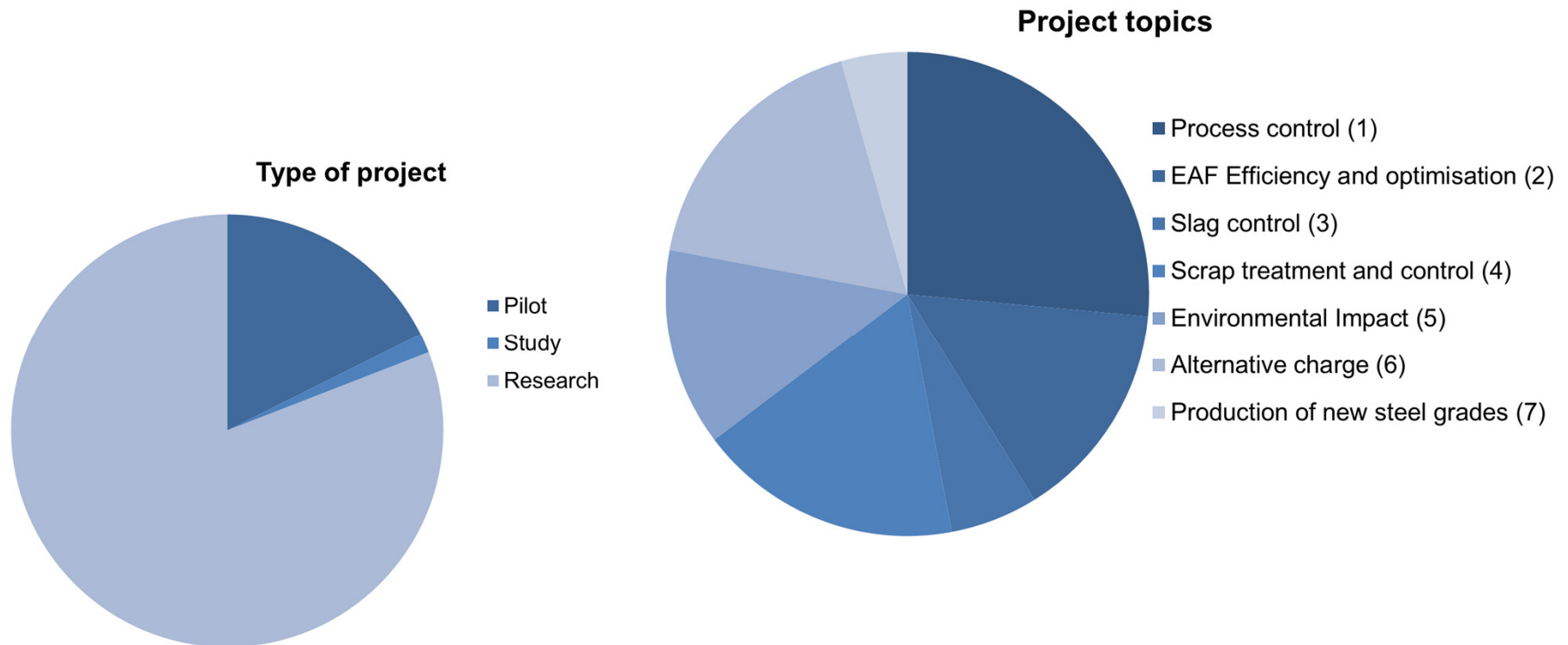
Running projects

Project	Consortium	Duration
Control of slag quality for utilisation in the construction industry – SLACON	FEhs, CSM, GERDAU, RIVA, BFI	2012-2015
Biochar for a sustainable EAF steel production – GREENEAF2	CSM, FERRIERE, GMH, Imperial College, Marienhütte, RWTH-IOB	2014-2016
Recycling of industrial and municipal waste as slag foaming agent in EAF – RIMFOAM	MEFOS, ARCELOR (2x), CSM, FERALPI, HÖGANÄS	2014-2017

Statistics

Period	Nr of EAF Projects	EAF Energy and Resource Efficiency	
1991 - 2014	68	22	32 %

Types and topics



RFCS VALEAF seminar „EAF Energy and Resource Efficiency“

Agenda

- 9:00** Overview on RFCS research on EAF energy and resource efficiency
- 9:15** Improvement of energy and resource efficiency during stainless steelmaking in the EAF
- 9:45** Use of biomass and biogenic carbonisates in EAF steelmaking
- 10:15** Coffee break
- 10:45** Increased energy and resource efficiency of EAF process by dynamic control of oxygen input
- 11:15** Energy output through EAF off-gas – Modelling the EAF off-gas system
- 11:45** Alternative materials in EAF charge to increase resource efficiency
- 12:15** Lunch

Upcoming seminars and workshops

Event	When	Where	Subject
Seminar 4	Jun 3-4, 2015	Stockholm (Sweden)	Scrap control
Seminar 5	Jun 19th 2015	Düsseldorf (Germany), ESTAD-METEC	Sensors technology
Seminar 6	Sep 23-25, 2015	Bardolino (Italy), SteelSIM	Modelling-based process control
Workshop 2	Nov 11th, 2015	Düsseldorf (Germany)	Road map for future EAF technology

Contact:

RWTH Aachen University
Department for Industrial Furnaces and Heat Engineering
Dr.-Ing. Thomas Echterhof
Kopernikusstraße 10
52074 Aachen
Germany

echterhof@iob.rwth-aachen.de
www.iob.rwth-aachen.de