Dissemination of European project focusing on Connected auxiliary materials

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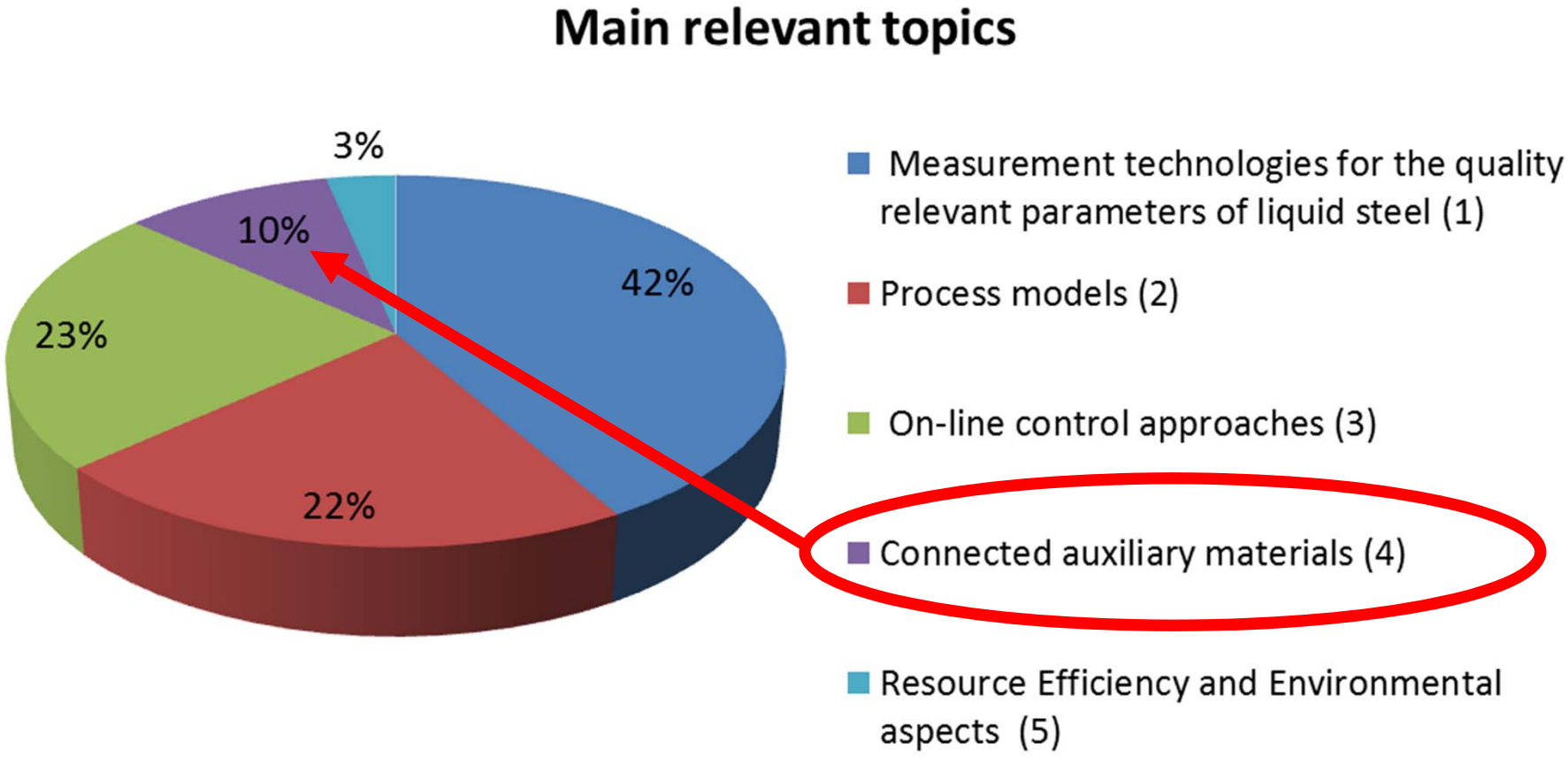
swedish research

Identified topics for the dissemination

- Measurement technologies for the quality relevant parameters of liquid steel
- Process models
- On-line control approaches
- Connected auxiliary materials
- Resources efficiency and environmental aspects

Identified topics for the dissemination



Sub-Topics of Connected auxiliary materials

- Sub-Topic 4.1 Refractories
- Sub-Topic 4.2 Stirring plugs
- Sub-Topic 4.3 Slag formers and slag control

- In total 6 projects were identified to address the topic Connected auxiliary materials as main relevant topic
- Of this projects Sub-Topic 4.1 were addressed in three projects
- Of this projects Sub-Topic 4.2 were addressed in three projects
- Sub-Topic 4.3 Slag formers and slag control were not addressed as main relevant topic
  - However, it was addressed in three projects as a Relevant Sub-Topic

Projects dealing with Sub-Topic 4.1 Refractories

Report number	Title	Participants	End date	Relevant Process
EUR 19485	Development of techniques to minimise ladle/slag interaction and prevent uncontrolled inclusion modification	IRSID, British Steel, SOLLAC	1999-06-30	LF
EUR 21335	Chromium-free alternative refractory for the lining of RH/DH vessels	Arcelor, Corus NL	2002-08-31	RH
EUR 21446	The Determination and elimination of the effect of Anti-Oxidants in Magnesia-Carbon bricks on steel composition and inclusion formation	Corus UK, CSM, DIFK, Saarstahl	2003-12-31	All

Projects dealing with Sub-Topic 4.1 Refractories without being part of Topic 4

Report number	Title	Participants	End date	Relevant Process
EUR 26689	Enhanced steel ladle life by improving the resistance of lining to thermal, thermomechanical and thermochemical alteration **(Ladlife)**	Gerdau I+D, CSM, BFI, Lucchini	2012-06-30	All

Projects dealing with Sub-Topic 4.1 Refractories

- Three projects are all quite old
- Two projects deals mostly with reactions between refractories and steel
- One project deals with replacing chromium containing refractory materials in the RH process and also minimize the environmental effects from landfills of used refractories
- The last project focus on ladle life

Projects dealing with Sub-Topic 4.2 Stirring plugs

Report number	Title	Participants	End date	Relevant Process
EUR 20946	Characterisation and optimisation of ladle stirring systems for the steelmaking industry	voestalpine, TKS, Sidenor, DIFK, BFI	2002-06-30	AS
EUR 24987	Improvement of purging plugs performances by investigations on the materials, process analysis and continuous monitoring **(ImPurgingAr)**	CSM, Terni, Calderys Italia, BFI	2009-06-30	AS
not yet published	Stirring plug monitoring system for improvement of plug availability and stirring performance **(PlugWatch)**	Terni, CSM, DEW, Gerdau, BFI	2015-06-30	LF

Projects dealing with Sub-Topic 4.2
Stirring plugs

- One projects is quite old
- The projects focus on plug performance
- Monitoring of the stirring is an essential part of two projects

Projects dealing with Sub-Topic 4.3
Slag formers and slag control

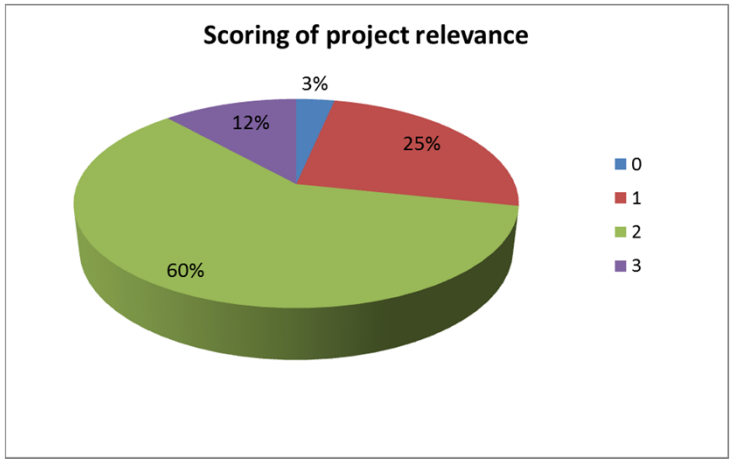
Report number	Title	Participants	End date	Relevant Process
EUR 20474	Desulphurisation of liquid steel with refining top slags	Voest, CSM, DH, BFI	2000-12-31	LF
EUR 23194	De-oxidation practice and slag ability to trap non-metallic inclusions and their influence on the castability and steel cleanliness	ACERALIA, CSM, RWTH, Sidenor Inst. Siderugie Francais	2005-06-30	LF
EUR 25076	Development of steel grade related slag systems with low reoxidation potential in ladle and optimised ladle glaze technique for improving steel cleanness **(STEELCLEAN-CONTROL)**	TU Freiberg, KTH, SSAB, TK Nirosta Uddeholm	2010-06-30	All except RH

Projects dealing with Sub-Topic 4.3
Slag formers and slag control

- Two projects are all quite old
- One project deals with desulphurisation with a refining top slags
- The focus for another project is deoxidation practice, inclusion removal and **steel cleanliness**
- Reoxidation potential of the slag combined with ladle glaze technique for improving **steel cleanness**

Scoring

- The scoring of the projects has been based on the following four criteria:
  - Zero: if “the project idea does not work”
  - One: if “the project idea was in principle good, but industrial implementation was not possible at the time”
  - Two: if “the project idea is applied in at least one industrial plant”
  - Three: if “the project idea is state of the art and is applied in many plants”



# of projects scored zero:

- 2 projects (3%)

Scoring for Connected auxiliary materials projects

The majority of projects were rated to score 2

Important issues addressed

- Sub-Topic 4.1 Refractories
  - Inclusion control
  - Anti-Oxidants
  - Ladle life
- Sub-Topic 4.2 Stirring plugs
  - Purging plugs performance
  - Reliability, efficiency and wear
  - Monitoring system
- Sub-Topic 4.3 Slag formers and slag control
  - Desulphurisation
  - Deoxidation practice, **steel cleanness**
  - Reoxidation, **steel cleanness**
  - Ladle glaze

Possible further field of research

- Refractories
  - Ladle life -> thermal control -> new type of preheating
  - Anti-Oxidants ->Inclusion control
  - Cost vs performance, multi-objectives approach
- Stirring plugs
  - Gas stirring->status of Purging plugs-> measurement of stirring intensity
    - Purging plugs performance
    - Reliability, efficiency and wear
    - Monitoring system
- Slag formers and slag control
  - Steel cleanness
    - Desulphurisation
    - Deoxidation practice
    - Reoxidation
  - **Need for more fundamental data for extremely low total oxygen content**

The Ladle Furnace

Requirements on ladles in the LF process

- Refractories
  - Other lining concepts are conceivable
  - dolomite bricks with magnesia slag line and fully magnesia or magnesia-chrome lining.
  - Fireclay refractories cannot be used as wear lining because of low refractoriness.

The Ladle Furnace

Requirements on ladles in the LF process

- Refractories
  - The suitable refractories have
    - high density
    - high thermal conductivity
    - hence it is needed to have ladle preheating to high temperatures, > 1000°C, to avoid thermal spalling and high thermal losses from the steel

The Ladle Furnace

Requirements on ladles in the LF process

- Refractories
  - The suitable refractories
    - The increase refractory weight is substantial compared with ordinary fireclay bricks
    - Limit the useful steel weight in case crane lifting capacity is restricted.

Thank you for your attention!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för att skapa industrinytta.
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