Energy Saving in the Foundry Industry: CRIMSON

26th January 2010
Timing

- 42 months
- Started 1st April 2009
- 2.5 yr PDRA (Dr Xiaojun Dai 1/12/09)
- 3 yr PhD (not recruited yet)
Funding

- EPRSC £526.5k
- UoB £106.5k
- In kind from partners ~£150k
- Total Project value ~£780k
CRIMSON: Aim and Objectives

To quantify and model the energy savings achieved by a novel single shot casting process and compare with traditional foundry process routes.

- Heat in bulk metal melting, holding and transfer
- Energy in post-casting processes
- Comparison of: scrap, quality and yield
What we’re not doing!

- Looking at low grade heat recovery!
  - Solidification
  - Post Casting Heat treatment
Crimson: Partners

- Aeromet
- Cast Metals Federation (CMF)
- Federal Mogul (Germany)
- Global Technologies rep. Ford
- Grainger & Worral
- N-Tec
- Environmental and Sustainability KTN
Why?

Theoretical energy for melting 1 T of Al 1.1 GPa
- Actual energy usage maybe 80 GJ to 1 TJ
- Embedded energy from extraction is 55 GJ
- Process energy wastage:
  - Liquid metal holding
  - Recycling due to high scrap rates → low yields
  - Attitude that as long as re-melt in-house is ok
Energy Input
To raise to Tm+100°C
Al & Mg ≈ 1.1 GJ/tonne
Cu ≈ 0.7 GJ/tonne

Charge
Ingot
or
DC cast billet
In-house returns from scrap and machining

Melting Furnace
Tower
Bale out*
Crucible*
Induction
(Oil, gas or electricity)

Holding Furnace
Bale out*
Crucible*
Induction
(*Gas or electricity)

Metal cleaning
Degassing
Drossing off

Casting process
Gravity
Counter-gravity
Pressurised Mould material
Sand
Ceramic
Metallic

Finishing
Fettling
Grinding
Machining

Finished Casting
Quality Inspection

Losses
Oxidation
(2% by wt)
Conduction
Radiation
(50% Furnace efficiency claimed)

Aggregated Energy required to produce 1 tonne Al castings (GJ)
2.20 Efficiency
2.25 Losses

Output
Fettling
(up to 60% by wt)
Grinding and machining
(up to 25% by wt)
Scrap
(up to 20% by wt)

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What is CRIMSON process?

- Two aspects
  - Melting
  - Casting
Melting

- Constrained Rapid Induction Melting
  - 350 KVA
  - 3000 Hz
  - Melting time for 10 kg Al about 60 s
  - Melting time for 33 kg Al about 200 s
  - Lid and coil design
The CRIM Equipment

Billet loaded, load cell waiting to be lowered into position.

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Casting: philosophy

- Uphill (counter gravity)
- PC Controlled
- Reusable crucible
Casting: the equipment
Casting: the equipment
Casting: the equipment
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Deliverables

- Understanding that could deliver 30% savings in energy
- Software tools that will help foundries achieve energy savings
Project structure

- WP0 Project Management and Infrastructure
- WP1 Assessing energy requirements in traditional foundries including knowledge management
- WP2 Assessing the energy required for degassing and other post-casting processes
- WP3 Measuring the energy input for CRIMSON melting and the up-casting process
- WP4 Estimating the energy of quality from the CRIM process
- WP5 Developing a model of foundry processes
Crimson: Progress

- Equipment infrastructure now in place
- Post doc employed
- 2 steering meetings with companies
- Collaboration Agreement: 50% signed
- First assessment meetings to take place before Easter
- Need a PhD student!