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Meeting with Pr. A. MITCHELL

2013 – 01 - 21

Les Ancizes

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Agenda

Description of the project

Open discussion on the different steps of the process

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Description of the project

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Description of the project

- Aim of the project : collect and recycle 6-4 massive scraps and chips in order to elaborate ingots for aeronautical applications.

- Recycling of different scraps coming from :
  - UKAD : ends of bar (∅ up to 300 mm), peeling chips.
  - A&D : ends of bar (forging and rolling mill), flashes (closed die forging), chips (milling, turning, peeling).
  - Our customers : scraps of cutting, chips (milling, turning, peeling).

- Preparation (make by a subcontractor) :
  - For bulky scraps : controls, cracks elimination, cuttings, shot blasting.
  - For chips : controls, crushing, degreasing, analysis.

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Description of the project

- Electrode process with Plasma Arc Remelting (PAR) :
  - For bulky scraps : like TIMET, use of consumable boxes, where the scraps are put.
  - For chips : weighing and blending with sponges, master alloys and alloying elements and then briquetting. These pucks/briquettes are put in drum feeders.
  - 2 sorts of cast : cast made with bulky scraps, cast made with chips.
  - PAR :
    - 5 torches : 2 above the melting hearth, 2 above the refining hearth, 1 above the crucible.
    - Around 7 MW installed.
    - Electrode dimensions : ∅ = 830 mm, H = 3150 mm, W = 7,6 tons.
    - 2 withdraw stations.
    - Mean melting speed = 1000 kg/h.
  - Helium recycling and purification unit.

- The PAR electrode isn’t machined, and is put directly in the VAR.

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Description of the project

- Ingot process with VAR :
  - Stub welding directly in the VAR.
  - Remelting :
    - Ingot dimension : ∅ = 920 mm, H = 2514 mm, W = 7,3 tons.
    - Wafer remaining : H = 60 mm.
    - Average melting speed : 750 kg/h (12,5 kg/min).
    - No lock valve.
    - 2 stations.

- After cooling, the ingot is stored and some samples are taken by machining, for chemical analysis.

- The VAR ingot isn’t machined before shipment to UKAD for heating and forging.

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Process discussions

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Bulky scraps preparation

- Cracks on bulky scraps :
  - PERRYMAN accepts cracks up to 1 inch deep.
  - Could we used grinding to eliminate cracks (risk of pollution with corundum, Silicon carbide, binder …) ?
  - Shot blasting will be systematically done.

- The consumable boxes will be in CP, so master alloys, aluminium will be added in each box, using some pucks (sponges + master alloys + aluminium).

- Dimension of these boxes : H = 300 mm, W = 350 mm, L = 600 mm (around 170 kg of material)

  - RETECH explains that the amount of 6-4 contained in each box must be smaller than the liquid bath of the PAR electrode ➔ homogenisation of the chemical composition.

  - RETECH announces a PAR liquid bath height of 300 or 400 mm ! ➔ estimation of around 240 kg.

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Chips preparation

- The chips will be degreased by :
  - Soap washing,

  or
  - Perchlorethylene washing.

- In the weighing and blending unit, sponges, master alloys, alloying elements will be mixed and sent to a briquetting press to obtain pucks:
  - ∅ = 100 mm
  - H = 100 mm
  - W = 2,5 kg.

- Pucks average composition :
  - Chips = 80 %
  - Sponge + master alloys + alloying elements = 20 %

  - Sponge coming from UKTMP.
  - Master alloys = Alu-Va…
  - Alloying elements = Aluminium, Iron, Carbon, Titanium dioxide…

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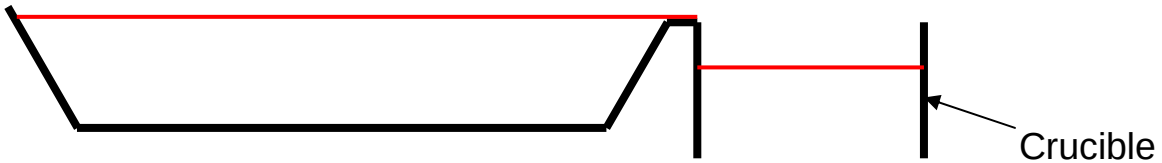
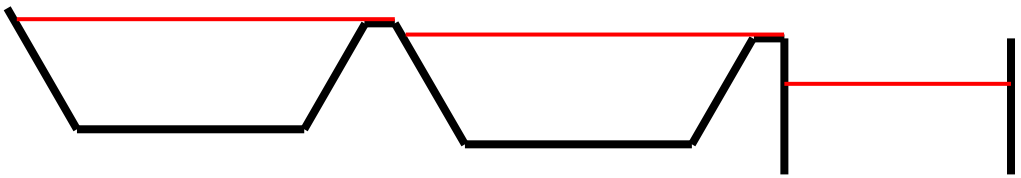
PAR Process

- PAR Melting rate (1000 kg/h ➔ 16,5 kg/min):
  - RETECH says the melting rate will be different between bulky scraps and chips ➔ what are the consequences in terms of :
    - Solidification,
    - Homogeneity,
    - Surface quality,…
  - What is the range of melting rate authorised during one cast ? 5%, 10%... ?
- Refining :
  - RETECH propose 2 sorts of hearth <u>for the refining zone</u> :
    - A long hearth



The best for HDI, LDI removal potential ?

    - 2 hearths



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PAR Process

- Electrode surface quality :
  - What are the main parameters to obtain a good surface?
  - Usefulness of a magnetic stirrer?
  - RETECH and ALD confirm that the electrode could be used directly in the VAR without machining.

- Torches
  - RETECH : water-cooled copper cathode issue? ➔ water leak in the torch…
  - something special to know about maintenance?
  - Beyond RETECH, that proposed us to make some experiments in their lab plasma furnace, which laboratory could be able to realise plasma studies?

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VAR Process

- We imagine to realise the stub welding directly in the VAR :
  - RETECH says that it is forbidden by SNECMA and CFM, for potential pollutions.
  - ↳ What is the common practice?
  - ALD propose to realise the sub welding in the PAR ! RETECH is sceptic about operational feasibility!
- Process :
  - Do melters continue to melt with large arc gaps? Do they explore smaller arc gaps?
  - Do they try to melt at smaller melting rate (< 12 kg/min)?
  - What is the recommended filling ratio?
  - What is the magnetic stirring strategy (frequency, I, …)?

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Technical expertise

- Do you know some engineers (coming from TIMET, ATI, RTI…) which could work for us, to optimize this industrial process?
  - Engineers with large experience in plasma (or EB) and VAR process

- Do you know laboratories which can realise R&D studies on the PAR?
  - Torches impacts on the liquid bath,
  - Solidification conditions,
  - Simulation model…

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Thank you for your attention.