

Hindalco Innovation Centre-Semifab (Taloja) Hindalco Industries Limited

<u>Microstructure - Ultrasonic Treatment</u> of Molten Aluminium

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Mr. Kedar Bhojak, a Ph.D. student of by KSV University, Gandhinagar, Gujarat conducted some experiments to assess the effect of using an ultrasonic device to treat molten aluminium alloy during casting as part of his Ph.D. work. Samples of 2 different alloys (AA8011 and AA1100) were collected at various stages of the DC casting process (before / after Alpur and with / without ultrasonic treatment) as detailed hereunder. The samples were cast in a metal mould normally used for collecting Optical Emission Spectroscopy (OES) samples.

A request was made to look at the cast structure of these samples. The following slides document the cast structure observed in the six different samples.

Sample details are as follows

- 1) Without Alpur without Ultrasonic (AA8011)
- 2) After Alpur No Ultrasonic (AA8011)
- 3) Before Alpur With Ultrasonic (AA8011)
- 4) Without Ultrasonic (AA1100)
- 5) With Ultrasonic (AA1100)
- 6) A.CCF Alpur no ultrasonic (AA1100)

Observations:-



- □ The structure near edge (surface) and center region are different.
- □ Near the edges the grains are very fine as compared to centre.
- □ Sample 1 &3 have similar structure but sample no 2 which is after Alpur without ultrasonic has very coarse structure. It consists of large colony of coarse grains.
- □ The structure in sample 1 & 3 having fine dendrite. Dendrite arm spacing is greater in center as compared to surface.
- Sample no 4 have more fine dendrite and improper grain boundaries. (See slide no 10 and 11)
- □ In sample 5 & 6 we can see mixture of fine and coarse dendrite cell. Coarse dendrite may generate from presolidified metal. (See slide no 13 and 14)
- Some locations in the various samples show porosity. Porosity levels are higher towards the sample center as expected since these regions solidify later than the edge. These are shrinkage porosities probably due to low casting temperatures. Data on casting temp for the different samples is not available.
- Cooling rates and degree of under cooling as well as Grain refiners play an important role in the formation of fine and coarse dendrites arm spacing.

Sample no 1 (Magnification Low)





Sample no 1 (Magnification High)



Edge





Sample no 2 (Magnification Low)





Sample no 2 (Magnification High)



Edge





Sample no 3 (Magnification Low)





Sample no 3 (Magnification High)



Edge





Micro Structure – Samples 1,2,3 Edge/Center Low mag



1-Without Alpur without Ultrasonic (AA8011)

2-After Alpur No Ultrasonic (AA8011)

3-Before Alpur With Ultrasonic (AA8011)



Edge

Micro Structure – Samples 1,2,3 Edge/Center High mag



1-Without Alpur without Ultrasonic (AA8011)

2-After Alpur No Ultrasonic (AA8011)

3-Before Alpur With Ultrasonic (AA8011)



Sample no 4 (Magnification Low)











Sample no 4 (Magnification High)



Edge





Sample no 5 (Magnification Low)



500 µm



Centre



500 µm



Sample no 5 (Magnification High)





Sample no 6 (Magnification Low)



500 µm

Edge



Sample no 6 (Magnification High)

50 µm



50 µm

Edge

Mixture of fine and coarse dendrites



,50 µm,

Micro Structure – Samples 4,5,6 Edge/Center Low mag



4-Without Ultrasonic (AA1100)

5-With Ultrasonic (AA1100)

6-A.CCF Alpur no ultrasonic (AA1100)



Micro Structure – Samples 4,5,6 Edge/Center High mag



4-Without Ultrasonic (AA1100)

5-With Ultrasonic (AA1100)

6-A.CCF Alpur no ultrasonic (AA1100)





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THANK YOU