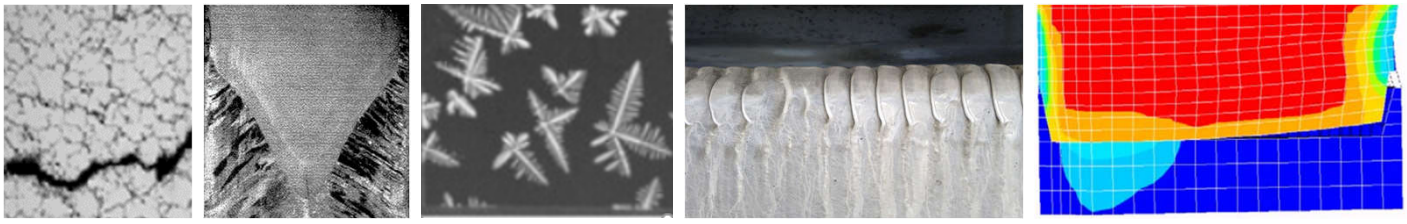
Direct Chill (DC) Casting: Science & Technology

Weekly Live Online Course

This online training course is presented over 8 weekly sessions. It covers the control of steady state ingot attributes, pull-in and shell zone, as well as the start-up requirements for reduced heat transfer to control curl. An introduction to solidification metallurgy is provided.



A fresh approach

Many technical training courses start from basic principles, building towards a detailed analysis of the particular technology. This often leaves attendees floundering in a sea of concepts and equations, unsure how the physical basics relate to the actual workplace.

Our approach, based on extensive experience in delivering training courses to industry, overcomes these difficulties. We first provide an appreciation of what the various technologies are expected to deliver to their customers, and why it is important. Only then do we consider how everyday operations relate to the physical basics.

Most importantly, we use workshops extensively, where attendees investigate the relationships between actuators they control (*e.g.* metal level, water flow rate) and the performance of each manufacturing stage. All workshops are computer based for the live online course.

Such 'discovery-based learning' results in a deeper understanding, and better knowledge retention and usage in the workplace.

'I should have done this ten years ago – it was very helpful, and the workshops gave it a practical relevance'

Course structure

The course focuses on:

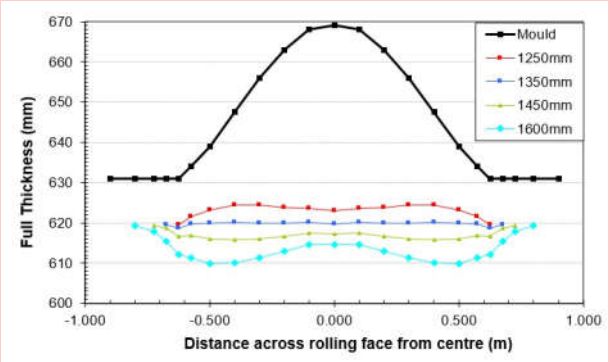
- ingot pull-in and mould opening design
- metal level control and shell zone formation
- heat management and water quality
- start up practices and curl control.

Each weekly session is centred on a seminar delivered live, allowing hand-raising and discussion.

Following the seminar, a related workshop is introduced, which attendees can tackle in their own time. This workshop is reviewed interactively at the start of the next live session.

Ingot Pull-in and Mould Opening Design

We review the required geometry for a DC rolling ingot, and deviations from the ideal shape. The "pull-in" deformation of rolling faces during casting is introduced and quantified with experimental observations on the effect of speed, thickness, and alloy. The absence of pull-in, and the consequent "butt bulge" or swell during the cast start-up is demonstrated. Strategies for mould design to achieve flat ingots are described. The use of variable width mould tooling, and the associated compromises for ingot flatness are analysed.



'Great course, there was something even for remelt personnel with lots of experience'

Technology Strategy Consultants

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tsc Training Courses: *Direct Chill (DC) Casting: Science & Technology*

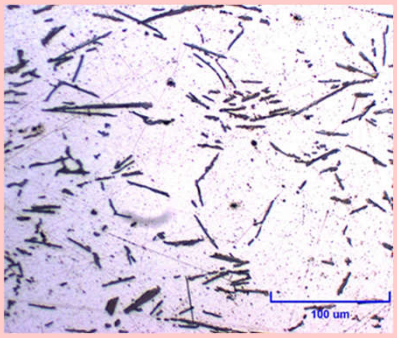
Direct Chill (DC) Casting: Science & Technology

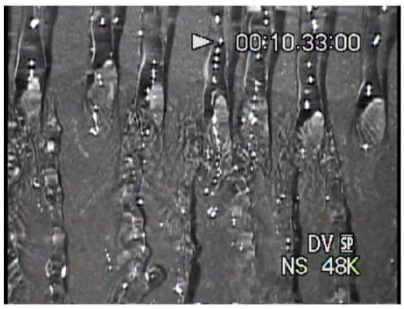
Course structure (cont.)

'The structure and presentation were excellent, but the workshops were the icing on the cake'

Shell zone and surface control

We look at the shell zone in DC casting, why it matters from a product and process perspective, and how it is controlled. The mechanism of shell formation, dictated by primary heat flow to the mould (slow heat transfer), and terminated by the influence of water cooling is explained. The three common methods to control shell zones are investigated: low head casting, electro-magnetic casting, and hot top casting.



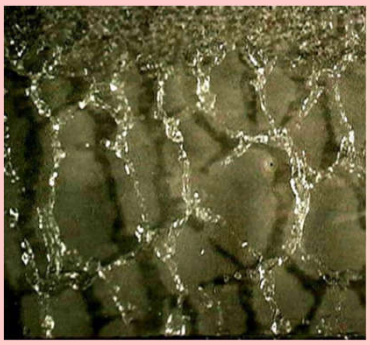


Heat transfer and water quality

Cooling with water sprays is shown to be crucially dependent on the surface temperature. The regimes of convective cooling, nucleate boiling and film boiling are quantified. The Biot number is shown to be the key metric used to compare the relative importance of sequential heat transfer processes. It is also shown that film boiling is a desirable phenomenon at the start of a cast to reduce the cooling rate, but that nucleate boiling is the mechanism operative in steady state.

Curl control

The causes of butt curl are summarised, and the potential detrimental effects demonstrated. The strategies available to minimise curl are discussed. The effect of a casting recipe using speed and water flow control during start up are demonstrated. Specific additional technologies such as water pulsing, or air injection of spray angle displacement are also found to be very effective. Likewise, starter block design can also help. It is emphasised that whatever solution is adopted, consistent water quality will be required to ensure reproducibility.



Presenters

Paul Evans and **Ricky Ricks** were formerly directors of research and innovation for Alcan. They set up *tsc* to help clients develop their technology strategy, including knowledge management and technical training.

David Humphreys has managed remelts and casthouses in Alcan and Alcoa and has extensive technical and practical expertise.

Registration

You may register online by following the details on the course website:

www.training.tecstrat.com

Alternatively, you may contact us directly at the email address: **equiries@tecstrat.com**

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