Hot Top Mould for Casting Aluminium T-Bar

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Abstract

There has been increasing interest in the potential productivity improvements available through the use of Hot Top technology for Vertical Direct Chill (VDC) casting of aluminium T-Bar. Hot Top technology greatly simplifies molten metal distribution and level control when multiple strands are being cast simultaneously. Aluminium T-bar is sold as high quality remelt ingot and often attracts a price premium because of its freedom from dross and dangerous shrinkage porosity. Hot Top T-bar technology can improve productivity without the complexity of additional metal control sensors and actuators. Modern VDC stations are large enough to accommodate as many as a dozen T-bar moulds at which point the simplicity of Hot Top becomes a significant operational advantage over conventional tooling which requires a dedicated level control system for each mould. Hatch has developed this technology for casting magnesium T-bar and believes that it can be easily adapted to casting aluminium. This paper discusses why Hot Top may offer advantages in aluminium T-bar production and also describes the Hatch technology, results obtained in magnesium casting, and the changes required in order to be used with aluminium.

Keywords: VDC Casting; semi-continuous casting; Hot Top T-bar; multi-strand casting

1. Introduction

In recent years, primary aluminium and magnesium producers have noted a market preference for DC cast T-bar over sow. As a firm that provides engineering services and technology to both industries, Hatch has responded to a range of requests from our clients reflecting this growing market preference. Starting with the magnesium industry, several clients have contracted Hatch to design and supply Hot Top systems for both large diameter billet and T-bar. Recently, Hatch designed and tested a T-bar mould prototype for another major primary magnesium producer. Although Hatch has never promoted its Hot Top technology for aluminium production we have received several unsolicited inquiries regarding its potential application.

2. Hot Top or Conventional Tooling Technology?

The decision to utilize Hot Top or Conventional tooling must consider a range of performance factors which are influenced by the particular circumstances of the Casthouse operation in question. The following discussion works through the factors that the Casthouse operations team must consider when making this decision.

2.1. Operational Simplicity and Robustness

Hot Top tooling is the dominant technology for the production of aluminium extrusion billet given that the number of strands cast each drop can often exceed 100. Conventional tooling would require individual control of metal level for each mould and with such a large number of moulds would simply be too complex to accept. Additionally, the desirable short effective mould lengths can be safely maintained with Hot Top technology independent of metal level

control. The lack of moving parts and the tolerance to metal level variation makes Hot Top technology a more robust process.

There are considerably less T-bar moulds installed on a typical VDC, so the level control hardware is correspondingly less onerous than would be the case for a billet table. Nevertheless, 10-20 laser sensors with their associated downspouts, motor driven control pins and metal distribution bags assembled on a mechanically actuated feed launder still makes this a very complex arrangement overall.

Conventional DC casting of magnesium requires even greater mechanical complexity with each mould being independently supplied from a dedicated metal pump that is speed controlled by a laser level sensor signal. It does not take much imagination to see that casting more than two strands simultaneously quickly becomes a nightmare of pipes, pumps and control elements. Additionally, using short mould technology requires precise metal supply control which is difficult to achieve and is often the cause of aborted casts and short drops. Hot top technology can reduce the complexity and improve reliability while at the same time increasing productivity by adding strands.

2.2. Productivity

Provided that metal supply is not a bottleneck, VDC productivity is driven by three factors:

- Number of strands
- Casting speed
- Pit turn-around time

The number of strands that may be installed in a table of given size will be controlled by:

- **Minimum centreline distances of the moulds** – Hot Top moulds and conventional moulds are similar in the horizontal plane but larger in the vertical dimension
- **Ability to feed metal to the moulds** – Hot Top moulds often have a trough in between the moulds whereas conventional moulds are fed from above. However, if necessary, Hot Top tooling may be configured with a perimeter trough which does not occupy table area.
- **Practicality of the level control hardware** - At a certain point the operational practicality of the level control hardware impacts the decision of how many moulds can be installed in the table. This always favours the Hot Top technology but may not be a significant factor if the number of moulds is limited by other factors.

Figure 6. Magnesium T-bar Cast using Hatch Hot Top Technology.

6. Reference

1. D. G. Harrington and T. E. Groce, US Patent No. 3612151, 1971.