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OPTIMISING LAUNDER DESIGN FOR GALVANIZING



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Laundry systems and associated heated covers are key items for consideration in molten metal delivery. Pyrotek's Mario Taddeo explores the nature and uses of these dedicated equipment devices and responds to some typical customer questions about their applications and specific production benefits.

Q: What are they and what do they do?

A: A launder is a trough from which molten metal is transferred to a specific location at a desired temperature. Over time, greater demands have been placed on launders to transfer metal longer distances with less heat loss, lower maintenance and greater durability.

To achieve this more thought has gone into reviewing the complete refractory lining design. It has evolved from being just a simple refractory cast in a steel shell to a series of refractory linings with an optimum profile. Advanced launder systems now include covers with integrated electric heater element systems.

Q: Why are they crucial systems in continuous galvanizing?

A: Not all continuous galvanizing plants have launders, but those that do have a premelt pot for separate zinc alloying for higher productivity and quality. Such launders typically operate with a relatively low 40–60°C (104–140°F) superheat and low flow rate (0.5–3 tonnes per hour). Given the continuous application, most traditional launders consist of a single high alumina refractory for chemical inertness and are gas fired over their length to abate any heat loss. Although this does transfer the metal, the expense is higher energy inputs, launder maintenance and increased dross.

Q: What are the aims and challenges of best practice launder design?

A: A launder should be designed with the view of transferring metal with the least amount of energy while offering optimum durability, metal yield and quality. Figure 1 shows that a single refractory material cannot offer all these performance characteristics. It will typically deliver one benefit at the expense of another.

To achieve the best performance, a composite design of up to three dedicated refractory linings is required. This practice has been developed by Pyrotek in the aluminium industry for several decades and, being fundamental to molten metal transfer, works equally well in the zinc smelter and galvanizing industries.

Therefore, the definitions of these linings are explained below:

1. **Working Lining (WL)** A premium material whose hot face is in contact with the molten metal and its dross. Has to be chemically inert to both and durable to the various thermal, chemical and mechanical forces.
2. **Safety Lining (SL)** A backup refractory lining that prevents metal penetration onto the shell. It is also designed to support the working lining and generally has better thermal insulating properties.
3. **Insulation Lining (IL)** A material that reduces metal heat loss and offers energy, productivity and quality savings and improves operator safety. When designed correctly, the insulation lining can minimise the thickness of either the working or safety lining to increase overall carrying capacity without affecting heat loss.

Figure 2 shows a typical three refractory lining design for improving performance, including simple hinged cover.

Q: What materials do you recommend in the construction of an advanced launder system?

A: The **working lining** consists of a pre-cast, prefired (Pyrocast) alumina material offering excellent non-wetting performance, durability and some insulation.

Pyrotek's preferred material for the **safety lining** is Wollite. This is a unique insulating foaming castable particularly suited for sidewalls. No anchors are required and it offers excellent support to the working lining as well as increased resistance

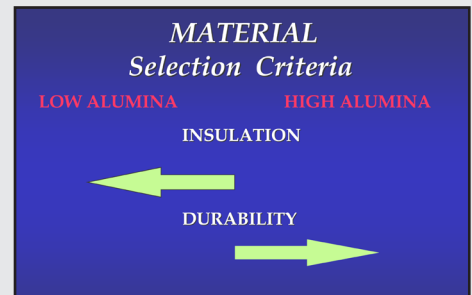


Figure 1: Typical properties of alumina based refractories

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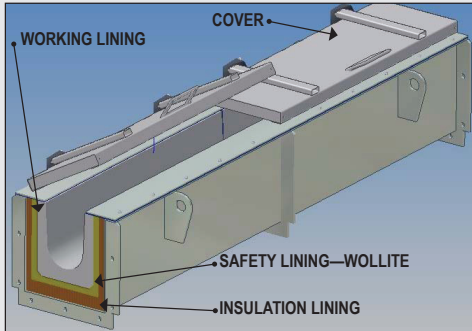


Figure 2: Typical launder segment showing refractory lining and covers
 Ref: M. Taddeo "Improved Launder Design for Continuous Galvanizing Lines" (GA Conference 2006)



Figure 4: Assembly of the insulated launder system with cover

to metal penetration.

A preferred material for the **insulating lining** is Isomag[®] 45 for the floor as it offers excellent strength and security to even the largest of precast shapes. Our range of microporous, silica boards offer optimum insulation in the sidewall.

Figure 3 shows the calculated heat loss profile of a composite launder lining compared with a conventional single high alumina refractory. A saving of 200°C (392°F) at the steel cold face is achieved whilst employing an equivalent wear lining of optimum durability.

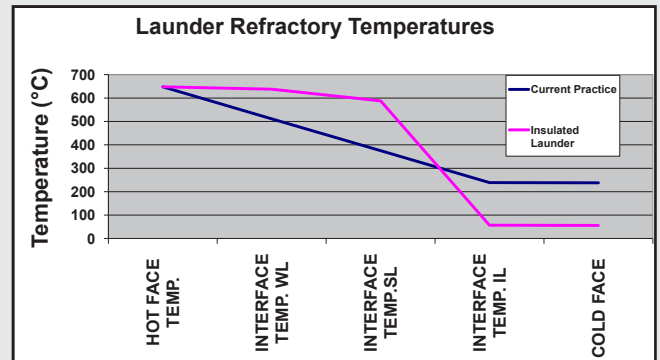


Figure 3: Calculated launder shell temperature, conventional v insulated refractory lining.

Q: What other things need to be considered before constructing this launder?

A: The next step is designing the launder profile that optimises minimum turbulence, skull build up, dross removal and heat loss. Pyrotek consulting engineers can recommend an optimum profile as well as the appropriate materials for customer specific operations. When all of the components are designed and delivered, careful assembly to the correct tolerances is required. Assistance from Pyrotek's specialists is recommended for a trouble free, get it right the first time, launder system.

Figure 4 takes these principles and shows the full assembly of the launder, including heated, ergonomic designed hinged covers with counterweights. This particular system was manufactured and tested by Pyrotek prior to its final installation at the customer.

Q: If a composite lining can save 200°C (392°F) shell temperature, how does a cover system further improve launder performance?

A: Figure 5 is a schematic launder section showing how an insulating composite refractory design minimises the heat loss through the sidewall and floor. However, most heat typically escapes up through the atmosphere. The remedy for this is an insulated and electrically heated cover system to compliment the insulated composite refractory launder lining.

The electrically heated system allows for better control of the molten metal stream temperature. The metal can flow through the launder at a lower temperature range with the benefit of reducing superheat and dross. Figure 6 shows a comparison between an electrically heated, composite designed launder system and a conventional design using gas burners for the transfer of molten zinc over 14 m (45.9 ft).

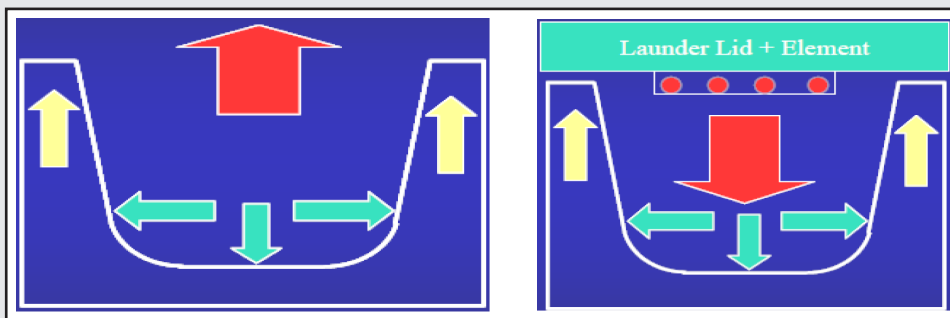


Figure 5: Schematic heat loss comparison of launder with and without heated covers

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The electrically heated insulated launder controls the temperature much better. The gas fired launder vaporises the zinc at the burner tip and increases its superheat by a further 40°C thereby creating more top dross—refer to Figure 7.

If the gas fired burners are removed it makes the situation worse since the superheat has to come from the pre-melt pot. Either way the best form of energy conservation while controlling the liquid metal temperature is with an electrically heated composite insulated launder.

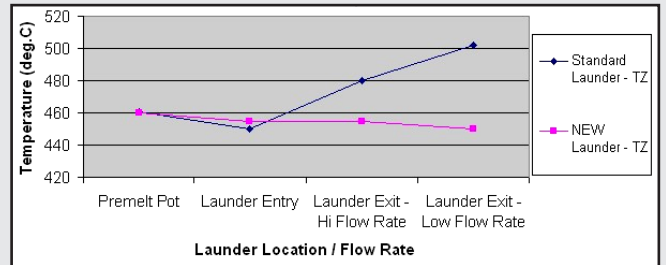


Figure 6: Exit molten metal temperature comparison

Q: So what are the economic benefits advantages of using an advanced launder system?

A: In this example the galvaniser has been using Pyrotek’s electrically heated launder design trouble free for the past three years. The customer has calculated energy (electricity vs gas) and green house gas savings at \$100,000 pa. Additionally, there are also benefits of less dross and its opportunity cost of yield savings, significantly reduced launder maintenance, enhanced launder life and improved operator safety. By comparison their traditional launder with gas burners causes corundum growth, cracking, hot spots and spalling of refractories (as shown Figure 7) making cleanouts more difficult and launder replacements more regular.

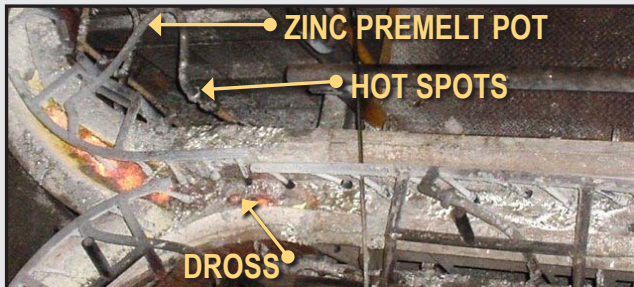


Figure 7: Traditional launder with gas burners showing hot spots and dross build up

Summary

An electrically heated composite launder system offers substantial energy savings, reduced green house gases and maintenance, longer system life and improved safety for the operators.