Laminar Barrier Inerting and Metal Production

Basic Concept

Each diffuser, placed on two sides of the opening of an induction furnace, consists of a gas inlet, a plenum chamber, and a porous face. The gas is introduced into the plenum and flows out through the porous face as an evenly distributed, low-velocity flow.

Because the flow is laminar, air is prevented from passing into the chamber below. Solid objects, however, can easily pass through the laminar barrier without creating turbulence.

An LBI system typically uses argon gas to create a barrier. If nitrogen pick-up in the melt can be tolerated, nitrogen may be used. With either gas, oxygen content of the furnace atmosphere is easily kept below 1 percent.

With argon as a barrier gas, the nitrogen content of the head space can be kept below 4 percent. At one investment casting foundry, a continuous argon purge with a nitrogen laminar barrier was used for melting nitrogen-sensitive alloys. For alloy grades that were not sensitive to nitrogen pick-up, the nitrogen gas alone was adequate.

Purge Flow

No separate purge flow is needed. The barrier gas flowing across the opening sweeps the air out of the chamber. Purge flows may be used, however, to remove unwanted atmosphere from the chamber more rapidly or to maintain a controlled furnace atmosphere with a composition different from that of the barrier gas.

Product Quality

Minimal Metal Loss

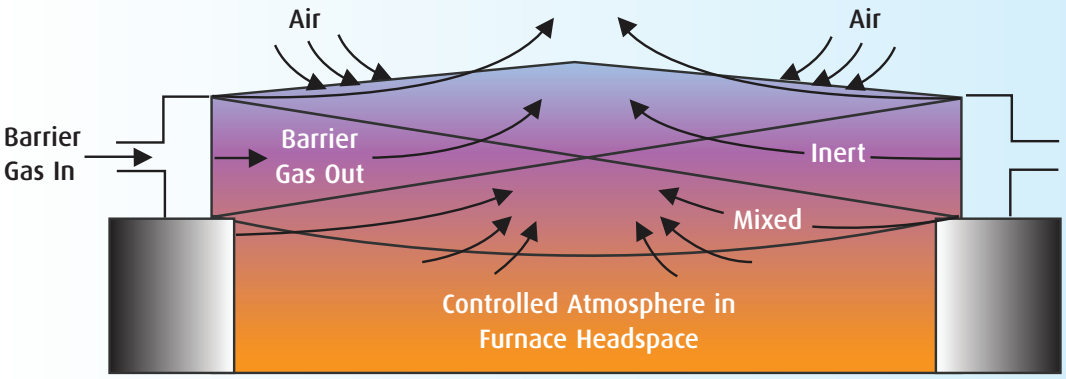
There is minimal loss through the oxidation of the melt. Any slag formed has a lower metallic oxides content. In tests, heats melted in air required five to six deslagging operations, while heats protected by the LBI process needed only one to three.

Because oxygen is kept out of the furnace, silicon, aluminum, and other deoxidizers are unnecessary or are added in greatly reduced amounts.

Less Dissolved Gases

in the Metal The dissolution of less oxygen, nitrogen, and hydrogen in the melt prevents out-of-spec gas contents, provides better fluidity and easier casting, and results in fewer inclusions. In operations at customer plants, reject rates were reduced 20 to 100%, depending on the steel grade and the part.

Gas Flow Diagram



The wide laminar barrier issues from the porous face of the plenum and flows across the furnace opening. Close to the furnace opening, some of the controlled atmosphere from the head space mixes with the barrier gas. Above the laminar barrier flow, a small amount of air mixes with the barrier gas, but essentially no air is allowed to pass through the barrier and into the furnace.

Product Quality (Con't)

Gas hole and slag inclusion defects were particularly reduced. Linde's patented Laminar Barrier Inerting (LBI) process has been proven in many diverse applications. These include:

- → Aluminum melting and casting
- → Stainless and alloy steel melting and casting
- → Nickel-based and cobalt-based alloy melting and casting
- → Copper-beryllium melting and casting
- → Tundishes for powder atomizing
- → Inert atmosphere soldering and welding
- → Semiconductor processing

Linde's LBI process provides inert atmospheres in open-ended enclosures, such as induction furnaces.

By excluding unwanted gases, especially oxygen, the LBI process reduces alloy oxidation, reduces slag formation, and lowers dissolved oxygen, nitrogen, and hydrogen contents in the metal.

Principle of Operation

By creating a laminar flow of gas across an opening, a barrier, or gas curtain, is formed that prevents air from infiltrating the enclosure. In practice, the principle is not simple to carry out.

Gas jets, such as those produced by pipe with a row of holes, produce turbulent flow and often aspirate air into the enclosure. The LBI process overcomes this problem and effectively excludes air from the enclosure.

Operational Advantages

Linde's LBI process has several distinct advantages over airmelts and covers. Complete access to the furnaces (both visual and physical) is maintained, while unwanted gases are excluded.

Linde engineers have designed various gas control and distribution systems for use with the LBI process. The LBI process is adaptable to nearly every system. Since the LBI process can be designed to handle both nitrogen and argon, the composition of the inerting gas can be tailored to the application.

Contact Linde Today

For more information about laminar barrier inerting or other metal production applications, call Linde at **1-844-44-LINDE**, or visit our webiste at **www.lindeus.com**

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