

VACUUM ARC REFINING (VAR)

Giving you a clear edge

APPLICATION NOTE



Where is vacuum used?

Vacuum Arc Refining (VAR) is a secondary melting process that allows ingot structure, homogeneity and cleanliness to improve. A cylinder type consumable electrode (produced with Vacuum Induction Melting (VIM)), is placed into a cylindrically enclosed copper crucible cooled by a water jacket.

The DC power supply activated between the electrode and crucible base creates an electrical arc which melts the extremity of the electrode. Metal droplets falling through the arc gap are exposed to vacuum and extreme temperature conditions causing the removal of dissolved gases, vaporization elements with high vapor pressure such as carbon, sulfur, and magnesium and improvement in oxide cleanliness. A new ingot is formed in the cooled crucible by directional solidification from bottom to top avoiding macro and micro segregation.

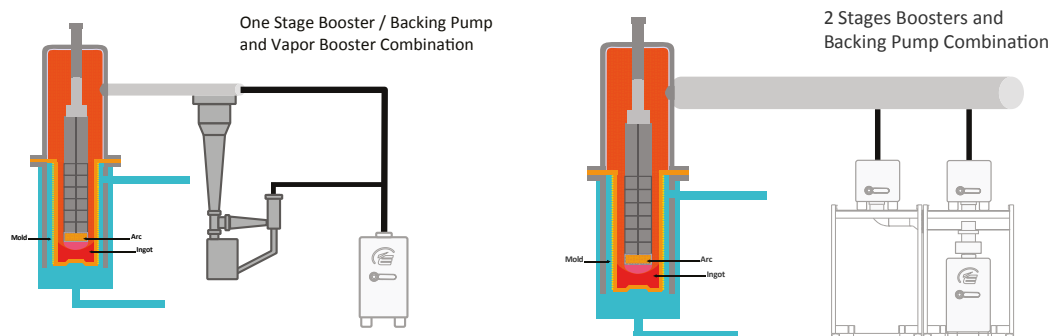
Typical vacuum levels are in the range of 10^{-1} to 10^{-3} mbar. No carrier gas is used in the process; gas load is from the outgassing of absorbed gases and vaporization of impurities.

Magnesium Chloride is the main impurity in Titanium VAR process. Even if it is collected in cold traps and chambers attached to the reactor, it can reach the vacuum system during pump down. Magnesium Chloride has corrosive effects if it comes into contact with water vapour or if it is trapped in oil.

Typical vacuum arc refining systems

The required vacuum levels can be achieved with a vapour booster backed by a booster-primary pump combination or with a three stage booster combination.

Typical Layout For Vacuum Arc Refining



Solutions

Dry pumping systems - Recommended technology

GXS dry screw pumps and
GMB booster combinations

- GXS160, GXS160/1750
- GXS250, GXS250/2600
- GXS450, GXS450/2600, GXS450/4200
- GXS750, GXS750/2600, GXS750/4200

Benefit: Dry pump systems substantially reduce maintenance and operating costs.

- Increased tolerance to particles created by the melt
- Capability to handle effectively corrosive dusts
- Clean residual vacuum
- Elimination of oil back streaming which is a source of contamination and de-gassing in the furnace
- Large water vapour pumping capacity aids drying of the new chamber lining
- Elimination of oil mist at the exhaust and external oil leaks

MAXX vacuum systems

GXS pump range is systemised with pXH
mechanical boosters available in two models:

- pXH4500, displacement 6,766 m³/h
- pXH6000, displacement 8,358 m³/h

Oil Sealed pumping systems - Conventional technology

Stokes microvac rotary piston pumps
with EH and 6" Stokes booster combination

- 212J
- 412J
- 612J

Vapour booster

- 18B4B
- 30B5M

Benefit: Generally, oil sealed pumps have high operating and maintenance costs. Between oil sealed technology, piston pumps are the vacuum pump of choice.

- Rugged and less sensitive to dust and vapour handling
- Low rpm operation for the longest pump life cycle
- Efficient, time proven design to deliver ease of maintenance

Edward's Benefits

GXS dry screw pumps

160 m³/h -750 m³/h primary pumps with pumping speeds up to 3,450 m³/h with vacuum boosters. Equipped with an intelligent on-board controller with extensive communication and automated control capabilities.

Highly reliable

Ability to handle harsh processes

Low maintenance cost

No unplanned down-time

Increased productivity

Longer intervals between services

Safe operation, consistent output

Automated control of your process



MAXX vacuum systems

The GXS pump range is complemented by the new generation of pXH large mechanical boosters for an integrated flexible modular skid design.

Variety of pump combinations ensure optimised configurations

Delivering the performance required by your processes

Easy to upgrade

Whenever you need more capacity



Microvac rotary piston pumps

Packaged with EH range or 6" series of mechanical boosters.

Value for investment

Low rotational speed enables the longest pump life cycle

Robust simple mechanism for high reliability and ease of rebuild

Easy maintenance on site

Proven, tested; peace of mind

Over 80 years of time tested proven performance



Vapour boosters

Unique product for providing maximum pumping speed at VAR pressures in between mechanical boosters and diffusion pumps – 4,000 and 12,500 l/sec.

Highly reliable

Tolerant to pumping contaminated systems and processes

Flexibility and ease of use

Tolerant to various inlet and exhaust pressures

Proven, tested; peace of mind

Over 40 years of time tested proven performance



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Publication Number: M11100895, Issue A
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