ZINC OXIDE

ZINC OXIDE FROM SECONDARY ZINC (HZS, DROSS)

PROCESS INTRODUCTION

INTRODUCTION

When we started the zinc oxide project we set the following goals.

To design:

The most fuel efficient vaporizing furnace for making F.P. zinc oxide

A system that minimizes material losses

A system where the zinc oxide surface area is controllable

A system that minimizes maintenance costs and that is reliable and easy to operate

INTRODUCTION

- Along the way we had to figure out how to process hard zinc spelter (HZS). Take a look at the section on shipping to see where this name comes from and why it may be important to make a distinction.
- The BURNS process is designed to prepare hard zinc spelter (HZS), for use in a high capacity French Process vaporizing furnace.
- If HZS is used without preprocessing, it will be necessary to remove impurities from the crucible as they build up, reducing *production yield*
- Iron precipitating in the crucible can show up in the product, causing Quality Assurance problems and crucible life issues

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THE BURNS PROCESS

- Although not all HZS (Dross) is supplied in large blocks a significant quantity is available as pieces weighing between 800kgs and 1,200kgs.
- It is not practical to load large blocks into a vaporizing furnace therefore large format HZS requires pre-processing and the furnace has to be big enough to handle the pieces
- Bottom dross usually contains solid iron in the form of hooks, used to hold the parts on the rig and any parts that may have dropped off the rig during galvanizing
- Here dross is cast into smaller blocks that are easier to process
- This method has the advantage of catching most of the solid iron pieces that may have been collected with the dross

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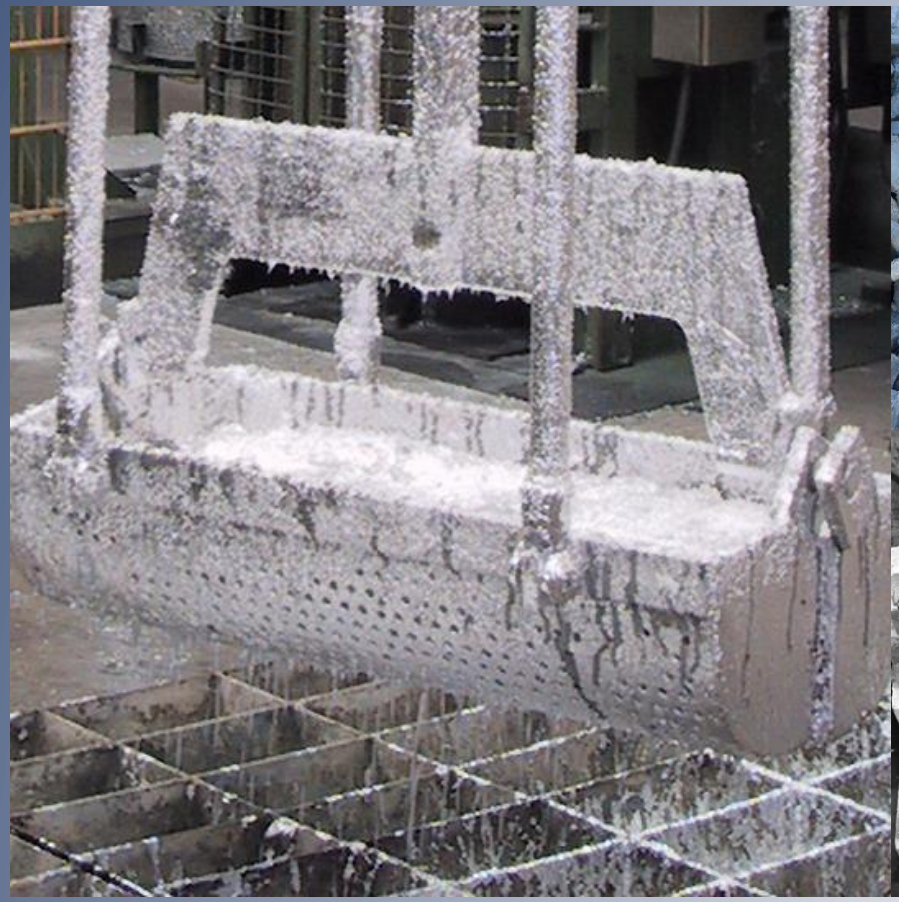
BOTTOM DROSS TOP DFROSS & HZS,



PRE-HEATING & MELTING

- Dry hearth melting allows the solid load to recuperate some heat
- Melted HZS leaves most of the solid iron on the shelf for removal by the operator
- The shelf is also used to drain the precipitate after the operator cleans the surface
- HZS is an alloy of iron and zinc that melts between 670^{O}C and 810^{O}C depending on composition
- In the BURNS process, blocks of HZA are dissolved at a relatively low temperature just above the melting point of zinc
- By maintaining the zinc at a temperature close to zinc melting point it is possible to deliver zinc with 0.03% Fe to the vaporizer

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IRON REMOVAL

- Iron dissolves in low iron, molten zinc
- As zinc in the swing furnace is usually <99.6% Zn & Fe < 0.05%, iron in the HZS dissolves and sinks to the bottom
- A reagent is added to the furnace and the iron rich layer at the bottom of the furnace is forced to circulate
- When iron and the reagent meet they react exothermically forming a precipitate
- The precipitate has a lower density than the liquid zinc
- Once formed the precipitate is stable and does redissolve at temperatures below 1,125^{O}C
- Precipitate containing all the iron and most of the other trace contaminants is removed by skimming

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RESULTS

- The process has been shown to reduce iron dissolved in zinc to it equilibrium content between 0.02 & 0.08% depending on the bath temperature
- The composition of
  - Copper, nickel, magnesium, manganese, titanium, & chrome are also reduced to equilibrium levels <.01% Typ.
- If titanium is present, tin is also reduced
- Lead must be managed separately in the vaporizer. For feed materials with >1% Pb the horizontal retort furnace is the best option
- Any cadmium present will contaminate the zinc oxdide and must be controlled when selecting materials for the batch.

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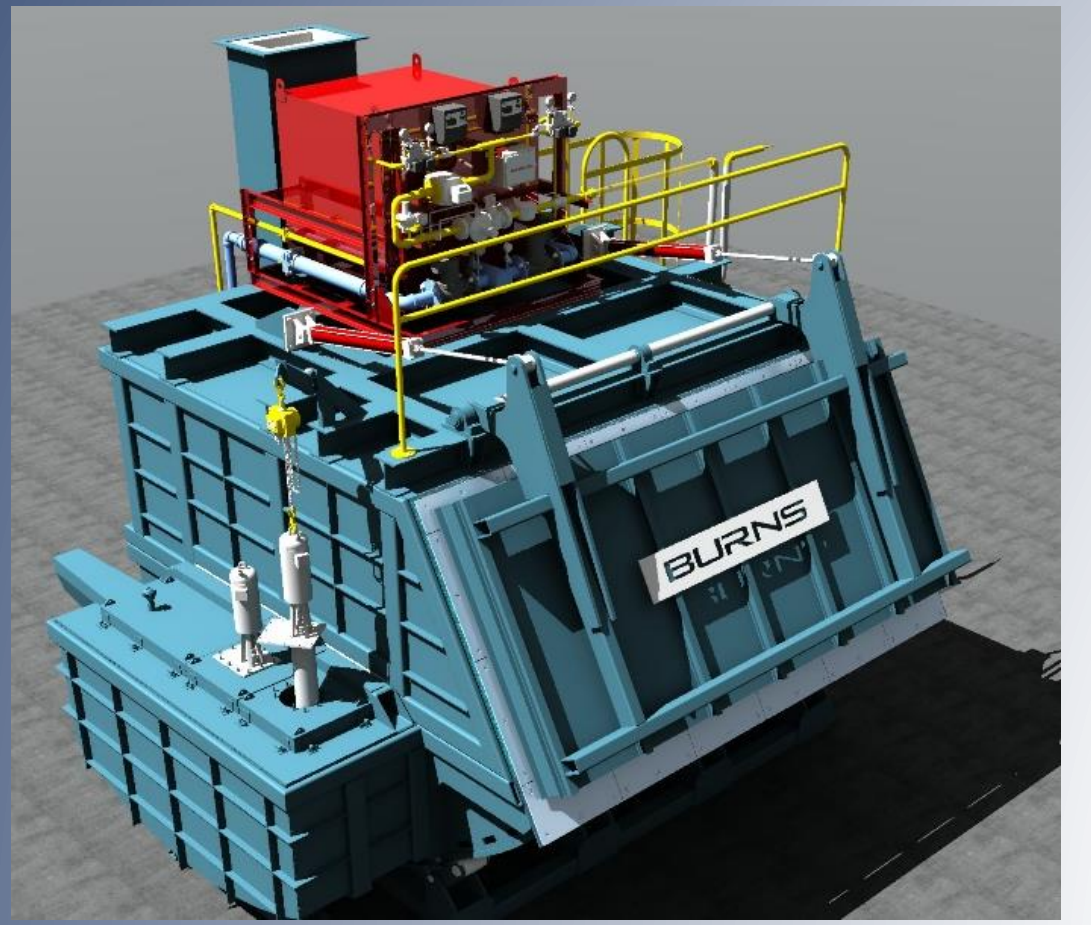
PROCESSING FURNACE



- The processing furnace is discharged by pump. A swing furnace option is available
- The zinc can be delivered manually via a joystick controller, or semi automatically from the control panel with a video feed as standard
- Preheated air for the combustion system is delivered by a cramic heat exchanger
- The door is designed with a floating mount for a hydraulically actuated door gas and heat seal.

LAUNDER

- The robotic launder is used to transfer metal to the vaporizer and may operate autonomously or under the direction of an operator in learning mode
- The launder requires a preheater to protects the launder lining and replacable SiC tip from damage during service
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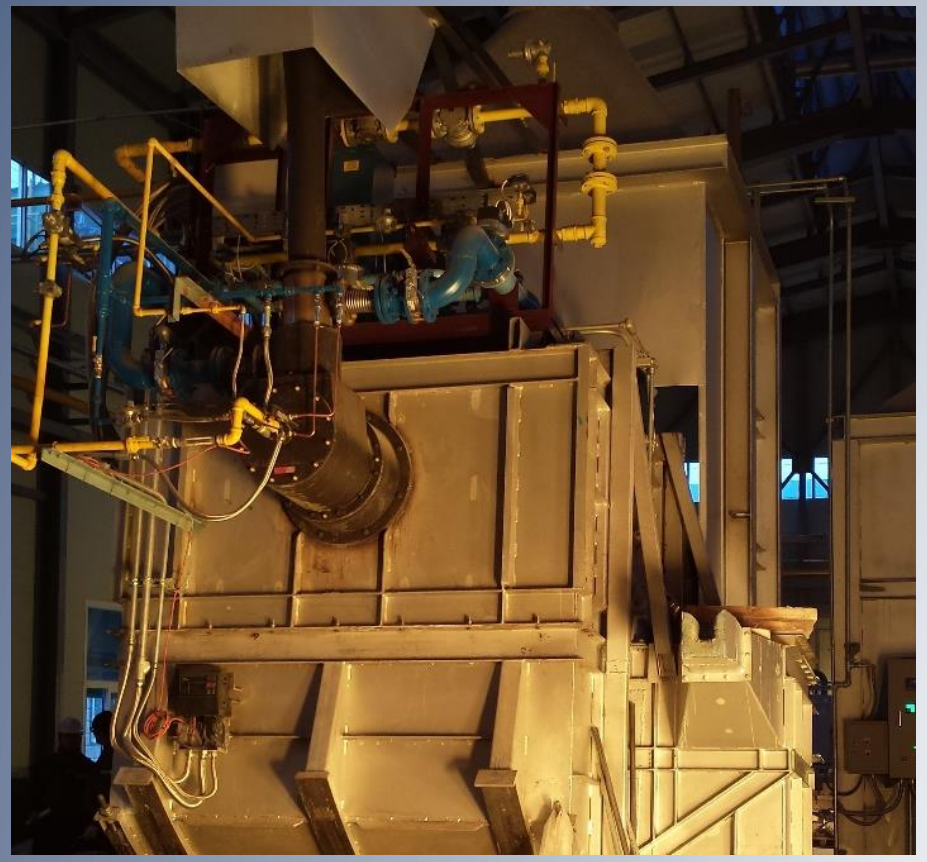
- Preheating the launder enables the processing furnace to be operated at a temperature just above the zinc melting point for maximum efficiency.

PROCESSING FURNACE



- The furnace operator selects materials for processing from the available inventory
- Blocks are added to the furnace along with a quantity of reagent.
- Provided there is enough reagent, processed metal can be discharged continuously to the vaporizer with minimum contamination

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PRECIPITATE HANDLING

- The BURNS squeezer is designed to release zinc encapsulated by the precipitate
- Zinc recovered is <99.6% Zn
- The Squeezer recovery efficiency is about 85%.*
- Use of the squeezer helps to maximize the HZS zinc yield

3 CRUCIBLE VAPORIZER

- Designed for
  - Maximum fuel efficiency
  - Maximum Grade A production efficiency
    - Low turbulence hood design
    - Product surface area control
    - High productivity
    - Low consumable costs
    - Low down time during crucible change
- Ideal for SHG, HG and low lead HZS
- PLC controls can be integrated with a plant wide DCS system
- Crucibles must be drained if Pb content in the crucible is too great.

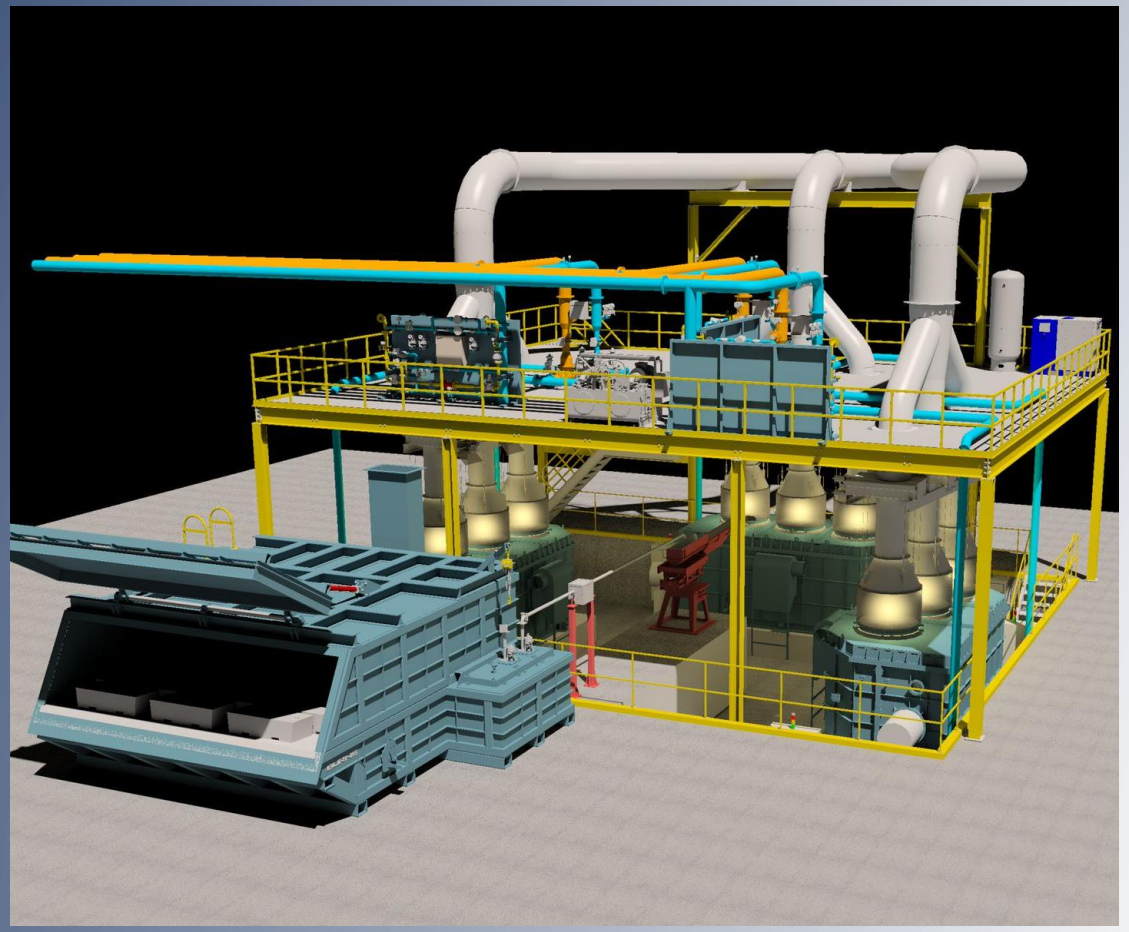
HIGH LEAD HZS

- Some Asian dross sources ship HZS with relatively high levels of lead
- *Lead* must be removed from the crucibles to keep lead levels in the product under control.
- This involves down time
- The alternate option is to use a BURNS twin retort furnace

TWIN RETORT VAPORIZER

- The twin retort furnace is designed to process high lead content feed materials
- The time from shutdown to production has been reduced from about 20 hours to about 4 hours
- Production loss due to lead control is minimized

ENGINEERING SERVICES



- BURNS provides enough information with the equipment to allow a client to arrange for a self installation
- BURNS offers *engineering services* to zinc oxide producers wishing to install new equipment
- Services provided ranges from full plant design services
  - Detailed installation drawings
  - EPCM services
  - EPCI services

SUMMARY

- HZS (hard zinc spelter) is a very good feed for a zinc oxide plant providing the operator with significant financial opportunities
- The BURNS process is a manageable process that reliably delivers low iron zinc for evaporation to the vaporizing furnaces
- If the average lead content of the feed is <0.3% then the technology of choice would be the 3 crucible vaporizer
- If the lead content is expected to be greater then it will be more efficiently processed in a twin retort furnace

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CONCLUSION

- The chances of contamination of the product by minor contaminants in the feed material are vanishingly small after processing in the Swing Furnace
- About 50% of the zinc oxide market is serviced from secondary zinc sources
- A very strong business case can be made for an investment in French Process zinc oxide production capacity especially from secondary zinc sources
- The process, if properly managed is capable of maintaining the quality required for all rubber batch mixing processes.