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Mortimer Smelter: Operations Description

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Abstract – Mortimer Smelter is one of the three smelting operations in the Anglo Platinum Group. It is located in the Limpopo Province, approximately 100 km north of Rustenburg, and approximately 15 km west of Northam. The smelter operation is the smallest of the three smelting operations in the group, with a smelting capacity of 170 kt/annum.

The operation consists of a Larox filtration plant, a Drytech flash drying plant, a modified Elkem / Hatch 19.5 MVA furnace, and a 60 t/h matte crushing plant. The operation does not convert its furnace matte, and hence the final sulphide rich matte is transported to and processed further at the Anglo Platinum Converting Process (ACP) within the Waterval Smelter Complex in Rustenburg. Furnace slag is granulated, and processed through a slag mill, or transported to a slag dump.

INTRODUCTION

Mortimer Smelter went into operation in 1973, with the commissioning of #1 furnace and a pelletizing plant. In 1980, a second furnace was put online, together with a then state-of-the-art Polysius pelletizing plant. In 1994, a flash drier plant was commissioned, replacing the pelletizing plant. This was a fundamental technological shift in the furnace feeding system. Later that year, #1 furnace was de-commissioned, due to safety concerns and throughput requirements.

Commissioning and test work was conducted on a pilot matte granulation plant in 1999. This test work became instrumental in the design and commissioning of the matte granulation plants currently in operation at Waterval smelter. The pilot plant was subsequently de-commissioned in 2002.

A Larox filter plant was commissioned in 2003, replacing the Eimco drum filters and Bateman filter presses that were in use, producing a superior filter cake for subsequent flash drying.

In 2004, following the commissioning of the ACP process at Waterval Smelter, a matte crushing plant was commissioned. The crusher plant was designed to produce a final matte product suitable for feeding directly into the ACP converter.

A simplified plant flow diagram is shown in Figure 1.

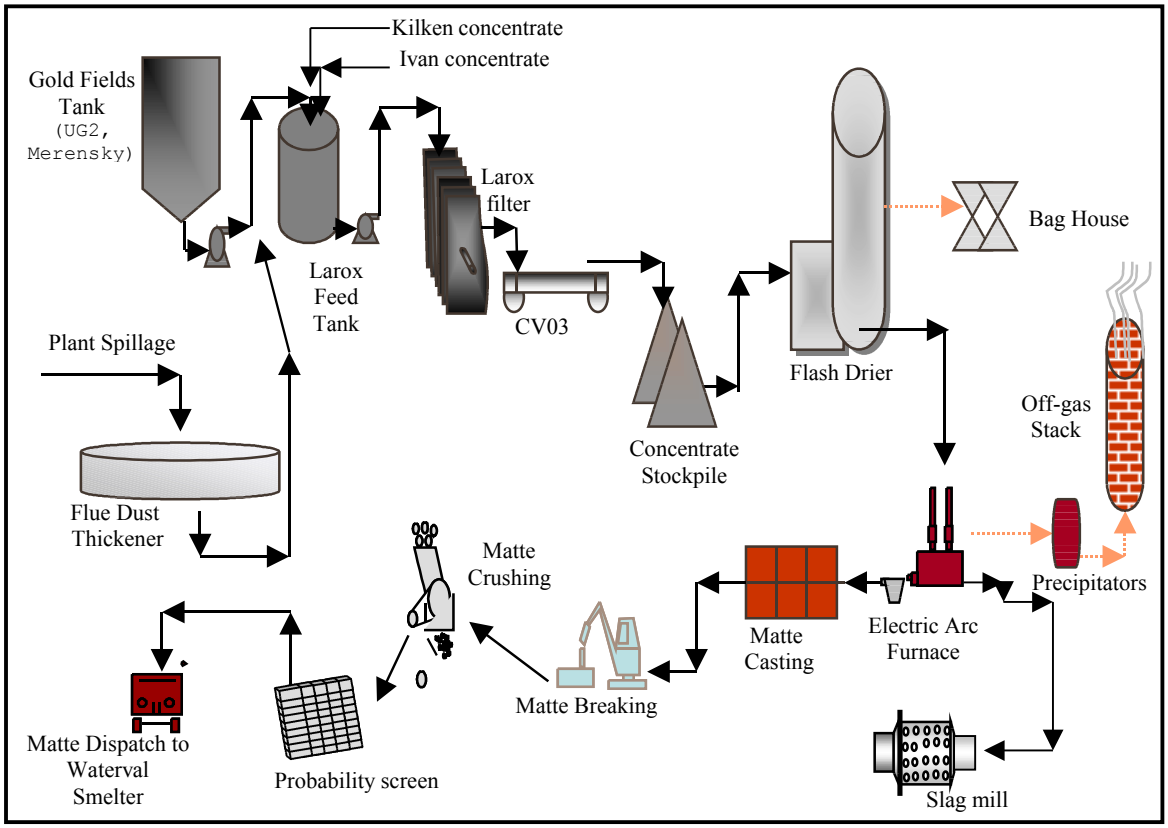

Figure 1: Mortimer Smelter plant flow

PROCESS DESCRIPTION

Concentrate handling

Mortimer Smelter currently receives concentrates in either a slurry or filter cake form. Filtered concentrates can be blended prior to drying, and fed into the flash drier. Excess filtered concentrates can be dispatched to other smelters within the group if required.

Filtered concentrate typically contains between 12–18% moisture. Concentrates in this form are received or dispatched by truck. Concentrates received are tipped onto a concentrate storage pad. The total filtered concentrate storage capacity at the smelter is estimated at 20 000 dry tons.

At Mortimer smelter, concentrate blending is an important step in the operation, to ensure chrome contents in the furnace feed are managed to avoid detrimental effects to furnace operations. Typical concentrate blending is done both on the storage pad and ahead of the wet feeder, before entering the flash drier operation.

Metal accounting and assay information is gathered by weighing individual trucks received or dispatched, and removing core samples by means of a sample auger.

Concentrates, in either of the two forms mentioned, are typically received from various concentrator plants both within Anglo Platinum and outside the group.

The smelter is flexible with regard to a number of concentrate input possibilities.

Slurries currently account for 80% of the total feed into the plant.

Slurries, on receipt, are transferred into batch weighing tanks, for mass and metal accounting. Typically, they would be introduced directly from concentrate thickener underflows. Slurry can also be received via tanker, and the weight recorded by means of a weighbridge.

Since there is only one filtering unit at the Smelter, all slurries after weighing and sampling get pumped and combined into a Larox feed tank. The filter is fed directly from the Larox feed tank. The Larox filter is a 144 m^2 unit, with 24 horizontal plates with 45 mm chamber heights. The unit can handle approximately 460 dry tons per day, at the current densities, which vary considerably between 1.45 – 1.65 t/m^3.

The filtrate from the filter, along with general plant concentrate spillages, is thickened in a 75 ft (~25 m) thickener and reintroduced into the feed tank, ahead of the filter.

Filter cake from the Larox unit is discharged into the concentrate shed. This concentrate can then be moved to the concentrate pad, blended in, or put directly into the wet feeder.

Drying

The drying plant capacity is determined largely by the energy generated by the hot gas generator (HGG) used in the drying plant. The unit at Mortimer is rated at 26.5 GJ/h for a concentrate feed rate of 34 t/h, with an average moisture content of 18%.

Designed to handle typical filter cake material, the flash drier has an approximate drying capacity of 6 t/h water. The energy required for drying is generated using a coal-fired HGG. Hot gas is mixed with the concentrate to produce a bone-dry concentrate with a final moisture content of about 0.5%.

Concentrates are introduced into a wet feeder, feeding the flash drying plant by means of a grab attached to an overhead crane; alternatively a front-end loader can be utilized in the same capacity.

The wet feeder discharges onto a conveyor belt feeding a paddle mixer, which discharges to the disintegrator. A metal detector mounted near the conveyor head pulley is used to prevent metal from entering the downstream process, causing possible damage to the paddle mixer and disintegrator components.

The disintegrator mixes and flings the wet concentrate into a stream of hot gas flowing up a drying column. The dried concentrate then passes though a pair

of cyclones. An extraction exhaust fan produces a vacuum throughout the system, to aid the flow of dried concentrate through the drier.

The cyclone spigots discharge directly into a final product bin. A diverter plate in one of the cyclones provides a recycle stream back to the paddle mixer, assisting with mixing and drying of high moisture content concentrates. The cyclone fines are collected through a series of multiclones and a bag house with the cleaned airflow exhausting to the atmosphere.

Dried concentrate, from the flash drier product bin, is fed into weighing vessels together with a predetermined proportion of limestone, typically ~3%. Limestone is used as a flux in the furnace operation, and is delivered in a finely crushed dry state.

The concentrate and limestone mixture is pneumatically conveyed to the furnace feed bins directly above the furnace.

Smelting

The furnace is a submerged arc, six-in-line, modified Elkem / Hatch design. It has a total power rating of 19.5 MVA. The furnace dimensions are 26 m x 7 m x 5 m. It is enclosed in a mild steel shell from the furnace floor level to the inspection door level.

The hearth consists of Verocon 65 FG Magnesite-chrome bricks. The end-walls all consist of Magnesite-Chrome D60/100 fused grain bricks. The freeboard and roof use alumina silicate bricks.

The furnace products exit via two matte and three slag tap holes.

The heating is done using 6 x 1.25 m diameter carbon electrodes. They are Söderberg electrodes, continually topped up using soft electrode paste, pre-baked and solidified. The electrode movement in and out of the bath is done automatically by the Pyromet controller. A manual system is also available as a back-up and during periods of maintenance.

Water-cooling is applied to the matte and slag end walls in the form of copper jackets against the furnace shell. Water-cooling is used at the slag end in the form of copper blocks, faceplate, and refractory-lined slag spouts.

The furnace sidewalls are air-cooled using a series of jet fans along the sidewalls. The floor is similarly cooled using floor fans, forcing air through the floor ducting underneath the furnace.

Furnace control is achieved by changing the electrical resistance through the slag; by changing the electrode current set points, a target power drawn objective is maintained.

Blended concentrate from the two feed bins, directly above the furnace, is fed to the furnace through two air slides along the length of the furnace. Diverter plates in the air slides cause concentrates to be channeled into the desired feed port for discharge into the furnace.

Dust levels are monitored on a 4 hourly basis, and loading into the furnace conducted accordingly. Liquid levels are also taken and recorded on an hourly basis, to monitor and control slag, matte, and solid build-up.

Slag is tapped almost on a continuous basis, apart from occasions where repairs to spouts are required or when liquid levels are low. Slag is channeled from the spout into a stream of water to granulate it, before being dewatered using a rake classifier. The classifier discharge is transferred onto a reversible conveyor, allowing for the option to discard the slag via a slag bin to a dumpsite or onto a series of conveyors returning the slag back to a slag mill.

Matte is tapped from the opposite end of the furnace into 9-ton ladles. Overhead hot metal cranes are used to remove and cast the matte into prepared silica moulds, approximately 1 m x 1 m x 0.4 m, and allowed to cool. Once cooled, the matte moulds are removed from the casting bay, and broken into lumps approximately 0.3 m in size, using a mobile pingon.

Matte Crushing

When a sufficient quantity of matte is available, tankers are arranged for shipment to ACP at Waterval Smelter.

The tankers, on arrival, are parked underneath the final plant fines discharge spout to load crushed matte into the tanker.

Matte is loaded into a hopper ahead of a primary Telsmith 18" x 24" jaw crusher. The crusher gap is set at 45 mm, and the crusher discharge is fed to a secondary Hazemag APKV0805 impact crusher that is in closed circuit with a Morgan sizer.

The Morgan sizer is an inclined compact three-deck probability screen. The screen returns +2 mm product back to the secondary crusher, while the –2 mm fraction is conveyed, sampled, and loaded directly into the tanker.

Dust is collected by means of an Ultra-pulse, cyclonic bag house with dust collection points located at all of the transfer points. Fines from the bag house are returned to the fines conveyor and loaded together with the final product into the tanker.

A belt scale is used to monitor the amount of matte loaded into the tanker, in order to prevent overloading. The correctly loaded tanker is then weighed on the weighbridge before dispatch.

Off-gas handling

Fine suspended dust particles are recovered from the furnace off-gas through three electrostatic precipitators. The collected dust is either pneumatically conveyed to the flash drier product bin or is discharged via rotary star feeders into water trenches and pumped to the 75 ft flue-dust thickener.

The remainder of the furnace off-gas exits the plant through the furnace stack.

ACKNOWLEDGEMENTS

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