The final stages of silver refining at Hoboken. Gold is the other main precious metal recovered from copper anode slimes

Work now in progress will turn Umicore's Hoboken site into a fully integrated facility for the recovery of precious metals from copper feedstock, writes **Patrick Weerts**.*

Umicore streamlines precious recovery

Originally dedicated to lead de-silvering and refining, Umicore Precious Metals' Hoboken site near Antwerp, Belgium later became a lead, copper and nickel smelter and then added precious metals refining with a specialisation in industrial by-products and recycled materials containing precious metals.

The plant has regularly been confronted with some significant changes in its raw materials supply, both in quantity and composition. Each time this happened it presented a challenge which forced the company's metallurgists to adapt processes and equipment, and consequently the site has become used to changing production environments and to operating flexible processing routes designed for multiple feed sources. Also, over the years extracting and refining capacities have been increased making Hoboken a major recycling facility.

For many years Hoboken has refined copper anode slimes and other precious metals bearing raw materials of various origin, and has accumulated considerable expertise in what is a complex area of metallurgy, but it relies on Umicore Copper's Olen refinery to provide a key part of the process loop.

The new unit will deal exclusively with the local blister, and it will be able to accommodate even more variation in the composition of this material

Now the company is spending €30m (US$27m) on a new copper leaching and electrowinning plant to process its own copper blister production for the first time, so streamlining precious metals recovery and releasing copper refining capacity at Olen for more productive use. The new plant is due to be commissioned in March next year.

The incoming mixed copper feed at Hoboken essentially acts as a collector for precious metals, but the present arrangement whereby the blister copper produced by Hoboken's Isasmelt smelter is transferred to Olen for final refining has several drawbacks.

Because of the nature of the source materials used, Hoboken blister copper has a high precious metals and impurities content. This results in an extended processing time in the Olen tankhouse, where more

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The hidden value of slimes

Copper and precious metals are frequently associated, since not only are they present in many copper deposits where the value of the gold and silver in the orebody can exceed that of the host metal, but the two also occur in a range of day-to-day items like electrical and electronic equipment. Extraction of these precious metals is therefore undertaken by both primary copper refiners and non-ferrous metals recyclers.

Copper anode, or tankhouse, slimes are a by-product of the electrolytic refining process. Although they are a rather complex product, their precious metals content makes them an attractive target for recovery even though a potentially wide spectrum of impurities makes this difficult.

An estimated 41,000 tonnes of copper anode slimes are generated annually, with around 17% of these being produced at refineries without equipment for processing them, thereby creating a need for independent recycling facilities such as those operated by Umicore Precious Metals.

The sulphate-based electrolyte used in electrolytic refining is chosen not only for its capacity to absorb copper ions (which transfer to the cathode), but also for its ability to reject precious metals. Some other base metals and chemical species are dissolved in the electrolyte, but are not normally deposited on the cathode.

As well as an accumulation of precious metals at the bottom of the cell, there are usually some other (non-precious) metals and refractory components present as well. The latter derive from the protective coating agents used on the anode caster moulds and typically include silica and barite, while the metals present can include antimony, arsenic, bismuth, lead, nickel, selenium, tellurium and tin.

The presence and concentration of these metals is dependent on their initial content in the anode material (and therefore on the origin of the copper concentrates or scrap), but is also affected by process parameters, since these influence the distribution of metals between the electrolyte and slimes.

Finally, copper is also a major constituent of anode slimes. It precipitates as a sulphate or in other combinations simply as a result of the high copper activity in the electrolysis cell.

A clear distinction can be made between anode slimes produced in primary refineries treating concentrates and secondary refineries dealing with scrap. The intermediate blister copper produced in both refining routes may look comparable, but the slimes they produce have some fundamental differences.

Slimes resulting from primary metal refining can have high selenium concentrations, 10% being a normal figure, increasing in a few cases to 40%. Tellurium generally is lower, 5% being a maximum. Other contaminations are specific to the concentrates and processing techniques, with maximum contents of 30% lead, 5% bismuth, 10% arsenic and 15% antimony.

Also, in primary copper refining the precious metals content is in direct relation to the feed, with numbers as high as 40% for silver and 6% for gold. Platinum and palladium values are often detected too, up to levels of 0.05% and more, especially in association with nickel.

In contrast the slimes generated during secondary refining contain those impurities typically associated with copper in its end-use applications. Lead (from cables) can represent up to 40% of the total mass, and tin (from welding alloys, coated wires etc) in some cases is as high as 15%. On the precious metals side silver can reach 10% (again from coated wires, electrical contacts etc) while gold is usually lower than 0.2-0.3%. Sometimes interesting palladium values occur (up to 0.1-0.2%), but this is the exception.

As already indicated, refractory components are present in all slimes – as much as 50% silica or barite. There is also 10-20% sulphate ions. A high copper content (30-40%) is not abnormal in raw slimes, but the copper is generally removed via acid leaching techniques prior to further processing for precious metals recovery. ■

capacity than usual needs to be reserved to treat the material.

Building copper refining capacity at Hoboken will not only speed up processing by bringing all stages onto one site while releasing Olen to concentrate solely on treating standard copper feed, but because the new Hoboken unit will deal exclusively with the local blister, it will be able to accommodate even more variation in the composition of this material.

The new plant will consist of a crushing and grinding area, a leaching reactor and an electrowinning section. The crushing and grinding equipment will reduce the size of the blister granules from the smelter to 0.5mm, with drying of the material occurring simultaneously in the impact crushers.

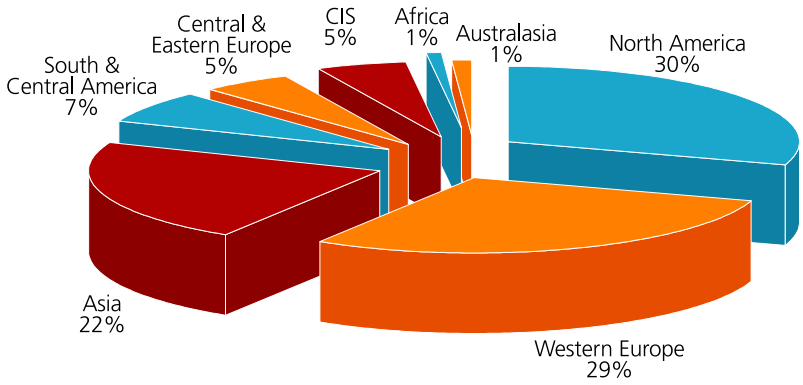
Precious metals slimes will be produced during the leaching stage, which is designed to operate at a temperature of 120°C and oxygen pressure of 600kPa using a sulphate ▷

medium comprising electrolyte recirculated from the new unit's electrowinning cells and concentrated sulphuric acid produced elsewhere on site. The full copper content dissolves in the sulphate solution together with some impurities.

Precious metal slimes will then be separated via filtration, and possible precious metal traces in the fluid cemented and precipitated by the addition of copper. The slimes will then be treated by the existing precious metals refinery on site (*see MBM September 1999 for a review of Hoboken's facilities*).

Electrowinning of the copper sulphate solution will take place in 200 cells each equipped with 39 cathode sheets and operating at a current density of up to 265 amps per sq metre and a temperature of 45°C. The bleed for impurity elimination is estimated at 25 cu metres of electrolyte per day.

Global arisings of anode slimes in 2001
(estimated world production, 41,000 wet tonnes)



Many copper refiners have traditionally developed their own methods for the recovery of precious metals from in-house anode slimes as a subsidiary operation to their main activity. However, at Hoboken, the processing of anode slimes and similar precious metal- bearing materials is the core business, and the site's flow sheet allows the most suitable process to be selected for each batch of slimes. ■

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