EXHIBIT A

TITAN Advanced Metals

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Titanium Overview

Ore Processing, Smelting and Refining

Ore from hard rock deposits is crushed to reduce the material to a size where the impurities are liberated. The titanium minerals are concentrated using magnetic separators or froth flotation. Heavy-mineral beach sands are typically mined with dredges and the heavy minerals are separated from quartz using gravity concentration (spirals, cones or sluices). The heavy-mineral concentrates are then fractionated using magnetic and high-tension separators (ilmenite and altered ilmenite are magnetic, whereas rutile is nonmagnetic).

There are two main methods of manufacturing titanium dioxide, the traditional sulphate process and the more modern chloride process that now accounts for more than 50% of production capacity. Each requires a different feedstock. In the sulphate process, ilmenite with 45–65% TiO2 or titanium slag with 70–72% TiO2, is dissolved in sulphuric acid to form titanyl sulphate and ferrous sulphate. Titania is precipitated by hydrolysis, and is then filtered, washed, and calcined to produce TiO2. This method has the disadvantage of producing substantial acidic wastes of ferrous sulphate, causing widespread environmental concern and criticism.

The chloride process requires a feedstock with a higher TiO content, such as rutile, synthetic rutile, or a slag with more than an 85% TiO2. This is mixed with high-purity coke and chlorinated at 850–950oC in a fluidised bed reactor to produce titanium tetrachloride (TiCl4 or "tickle"). This is oxidised in air at elevated temperatures to produce TiO2, which is then calcined to remove residual chlorine and hydrochloric acid. The absence of an effluent and a consequent disposal problem has helped make the chloride process the preferred route in modern plants despite the disadvantage of a complex process and the necessity for a high-TiO2 feedstock.

Rutile production capacity is limited, and therefore the shortfall in natural high-TiO2 feedstock is made up by upgrading ilmenite. One method is the conversion of ilmenite containing 42–58% TiO2 to a "beneficiated ilmenite" or "synthetic rutile" containing 91–96% TiO2 by reduction of the iron in ilmenite to the metallic state using sub-bituminous coal both as a source of fuel and as a reductant. Another method is the production of a titaniferous slag, which involves smelting a mixture of ilmenite concentrate and coal in a large rectangular electrical furnace equipped with graphite electrodes.

Titanium metal is obtained in the pure form by the Kroll process. The oxide is treated with chlorine to form titanium tetrachloride, a volatile liquid, and the liquid is reduced with magnesium in a closed iron chamber to yield metallic titanium. The metal is then melted and cast into ingots.

ERMS and EARS

Austpac Gold NL has developed a specialised proprietary process, termed Enriched Roasting Magnetic Separation (ERMS; Austpac, 1997), for producing synthetic rutile from ilmenite sands at Westport, and are now seeking to also apply the process in other parts of the world. In the ERMS process, a heavy mineral concentrate is roasted in a controlled atmosphere to selectively induce very high magnetic susceptibility in any contained ilmenite. This is followed by magnetic separation of the ilmenite. The ilmenite is leached with hydrochloric acid to remove iron and produce synthetic rutile with 96-97% TiO_2. Further processing reduces the iron content to less than 0.1% and results in "Supergrade" pigment with more than 99% TiO_2. Another Austpac Gold process, the Enhanced Acid Regeneration System (EARS), regenerates hydrochloric acid from the iron chloride produced during synthetic rutile manufacture. The solution is evaporated to produce iron chloride pellets which are fed into a pyrohydrolysis reactor, producing hydrochloric acid, magnetite, steam and carbon dioxide.