FACT SHEET | KIMBERLEY MINERAL SANDS

MINERAL SANDS MINING

Mineral Sands

Mineral sands are generally found in old beach, river or dune sands and originate from the erosion of ancient crustal rocks that have weathered over time to result in a residue of resistant hard minerals, such as the valuable zircon and titanium (ilmenite, leucoxene and rutile) minerals.

These harder heavier minerals are washed to the ocean and accumulate in zones when the lighter material is winnowed away, often resulting in concentrations of heavy mineral along beaches and shallow marine shoals.

Subsequent storms and fluctuations in sea-level can lead to the burial and preservation of the heavy mineral.

Thunderbird Mineral Sands Deposit

The Thunderbird deposit, located 70 kilometres from the coast and mid-way between Broome and Derby, contains one of the largest and highest-grade zircon mineral sands deposits in the world. It is also the first significant mineral sands deposit to be discovered in the Canning Basin.

Valuable heavy minerals contained within the deposit include ilmenite, zircon, leucoxene and rutile.

The Thunderbird mineral sands deposit stretches across an area of at least 11km by 7km and to a maximum known depth of 155 metres. The very high-grade zone contains above 7.5% heavy minerals.

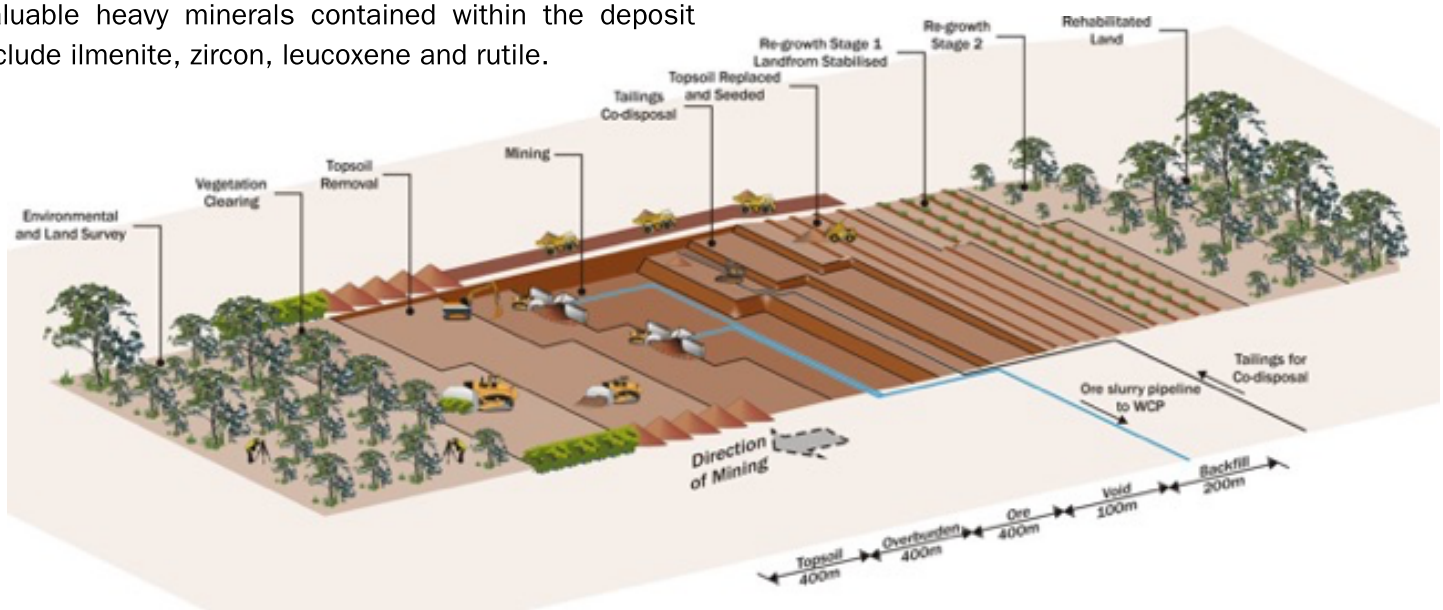
Progressive Mining and Rehabilitation

Thunderbird is a typical dry-mining mineral sand operation whereby a moving void extracts the valuable mineral sands, with waste materials returned to the void enabling progressive rehabilitation of the area.

Topsoil and overburden are excavated and transported using truck and excavator. Ore is excavated, screened, slurried and then pumped to the nearby Wet Concentrator Plant (WCP).

Retaining cells are constructed in the developed mine void for the return of process tails. Topsoil is returned in a continuous rehabilitation process.

As the mining void is established, increasing amounts of overburden are mined and then directly returned to the mining void as backfill.



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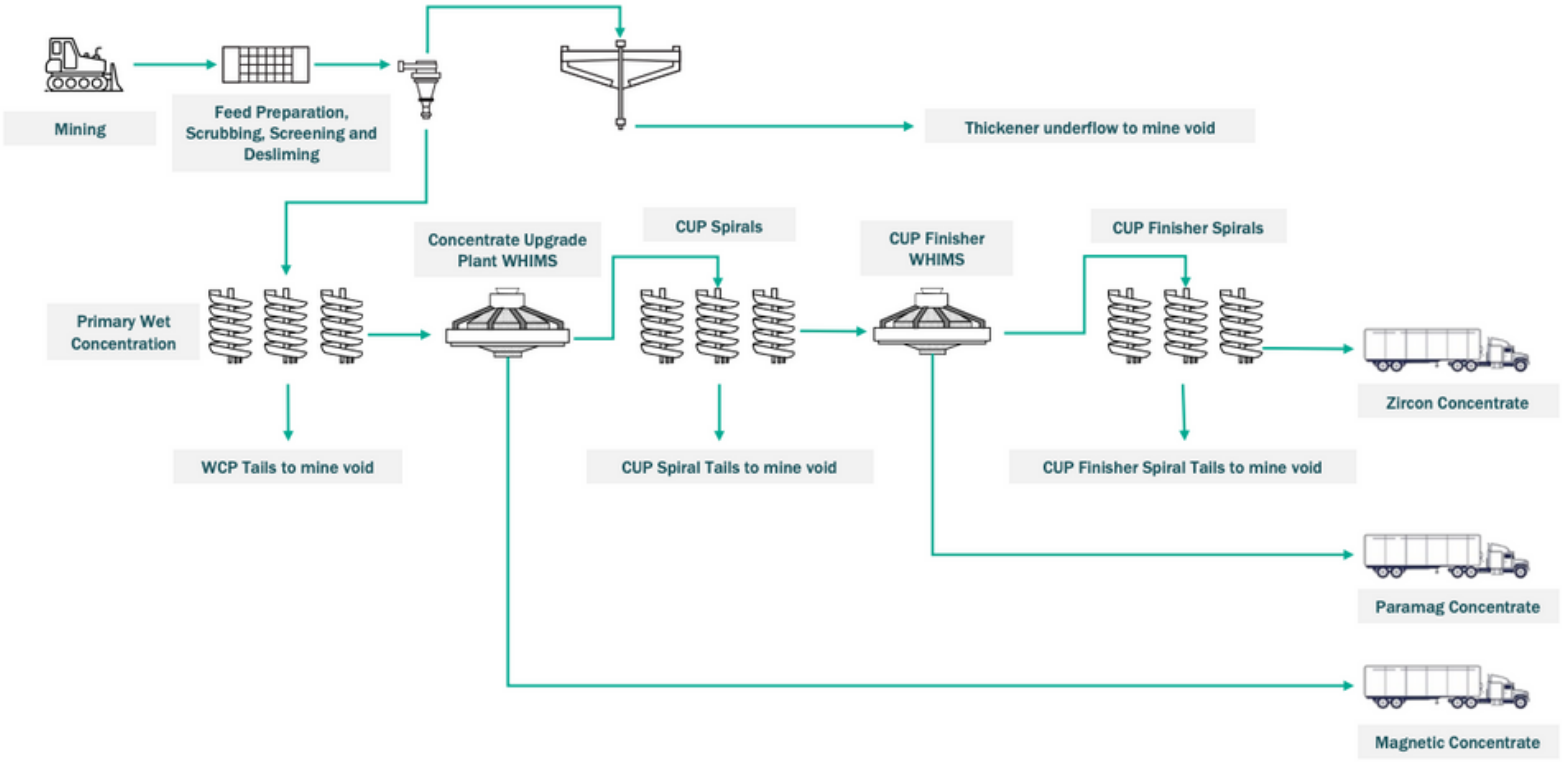
community@kmsands.com.au (08) 6118 9517

Mineral Sands Processing

Mineral sands processing consists of extracting valuable heavy minerals (mainly zircon and ilmenite with small quantities of leucoxene and rutile also captured). This is achieved through a series of processes involving gravity separation (spirals) and wet magnetic separation methods.

The non-magnetic fraction, containing zircon, rutile, leucoxene, is sold as a Non-Magnetic Concentrate (NMC). The magnetic fraction containing ilmenite and iron oxides forms the Magnetic Concentrate (MC).

Concentrate Producing Flowchart



Radiation in Mineral Sands Products

Radiation occurs in our natural environment and can be detected in soil, rock and fresh and salt water.

It also occurs in manufactured materials such as medical x-rays and radiation treatments for cancer and other medical purposes, air travel, televisions, smoke detectors, mobile phones and building materials.

We encounter it every day through the food we eat, through exposure to the sun, in building materials, items we commonly use and in undertaking daily activities.

Radiation levels in Thunderbird mineral sands products are naturally occurring and at low levels.

The specific radioactive concentrations of the mineral sands products are monitored and will be below 10 becquerels per gram (Bq/g).

At this level, the mineral sands products are not classified as ‘radioactive’ for transport purposes and no special containerisation or placarding is required.

Given the insoluble nature of the naturally occurring radioactive material in mineral sand products, specialised management is not required.

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Mineral Sands Types, Products and Uses

In general, mineral sands can be split into two major categories:

Non-magnetic and magnetic material.

The magnetic proprieties of the mineral sands products relate to how the two products can be separated during processing.

To assist with separation the process uses water and gravity as well as magnetic and electro-static separation.

Non-Magnetic Concentrate

Thunderbird will produce a **Non Magnetic Concentrate (NMC)** containing a level of zircon sand that requires further processing to be recovered. After the NMC is processed it is ready for supply into global markets with a wide range of applications.

Major uses for zircon sand include:

Ceramics – Zircon is used in both the body and surface of all ceramic products such as tiles, sanitaryware and tableware. Ceramics uses account for **~50%** of global zircon consumption.

Refractory accounts for **~16%** of global zircon sand consumption. The zircon is used as a base material for production of refractory bricks, ladles and protective plates in high heat applications.

Specialty Chemicals – Zircon is the base product for production of chemicals such as Zirconium Oxychloride (ZOC) and Zirconium Basic Sulphate (ZBS), which have a wide range of applications including as an additive for titanium dioxide pigments, furnace linings and foundry bricks as well as in antiperspirants and inks.

Foundry accounts for **~11%** of the global consumption, where the zircon is used in moulds for production of foundry products.

Zirconium is highly resistant to corrosion and is used as an alloying agent in materials that are exposed to aggressive environments e.g. surgical appliances.

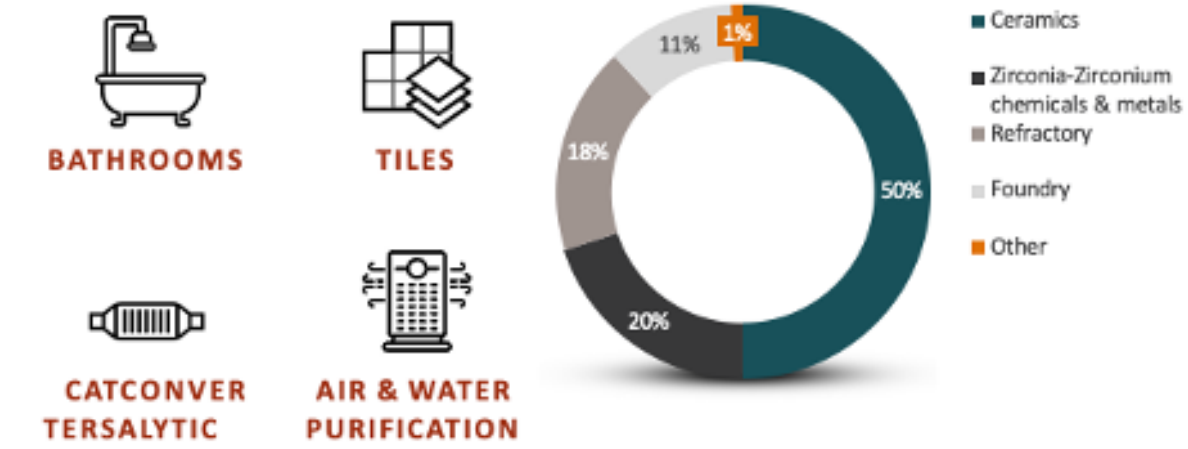
KMS has three offtake agreements with major processing groups in China, who largely supply into the ceramics and refractories industry, with a small quantity targeted at specialty chemicals and foundry applications.

Almost **100%** of Australian zircon sand is exported for further processing as the high end technology required doesn't yet exist in Australia.

China is the biggest importer of zircon material at just over **50%** of the global market. Other major markets include India, Europe, the Middle East and the US.

It is estimated Thunderbird will produce **3.5%** of global zircon supply.

Global zircon market



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Magnetic Concentrate

Thunderbird will produce a titanium and iron oxide product called a **Magnetic Concentrate (MC)** that will require further processing steps before it is ready for end use applications.

The titanium and iron are separated via a reduction process which enables the iron to be removed to produce a high-quality ilmenite.

The main market for the ilmenite material is sulfate or chloride pigment production (Titanium Pigment).

Titanium pigment is light refractive, and used in production of materials such as plastics, paints, paper, ink, rubber, sunscreen and even food additives and pharmaceuticals.

Other titanium-based minerals such as rutile, leucoxene, and synthetic rutile are also used to produce titanium dioxide pigment.

Titanium dioxide pigment is a white mineral powder and represents as much as **90%** of the global consumption of titanium based mineral products.

KMS's JV partner **Yansteel** is currently building a chloride pigment plant in China, including all associated processing equipment required for processing the Thunderbird MC, to produce chloride pigment (Titanium Pigment).

Thunderbird has an offtake agreement with Yansteel for 100% of the Stage 1 MC produced at the Project.

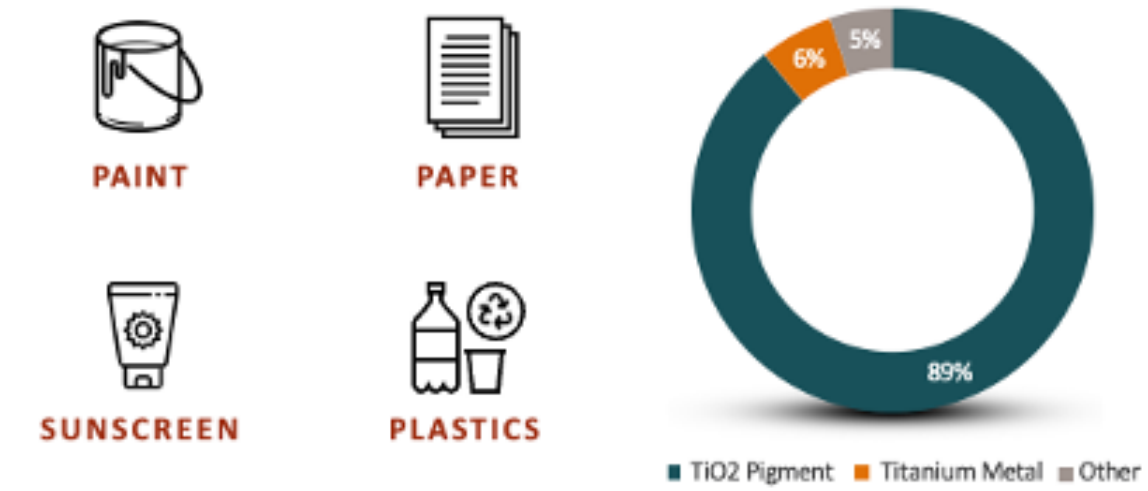
It is estimated Thunderbird will produce **6.5%** of global titanium dioxide supply.

Para-Magnetic Concentrate

Thunderbird produces a Para-Magnetic Concentrate (PMC) as a result of upgrading the quality of the NMC produced at the Project.

The PMC contains low levels of zircon and titanium minerals and will be processed in the same manner as the NMC, with the valuable minerals being extracted and supplied to similar markets.

Global TIO_2 market



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