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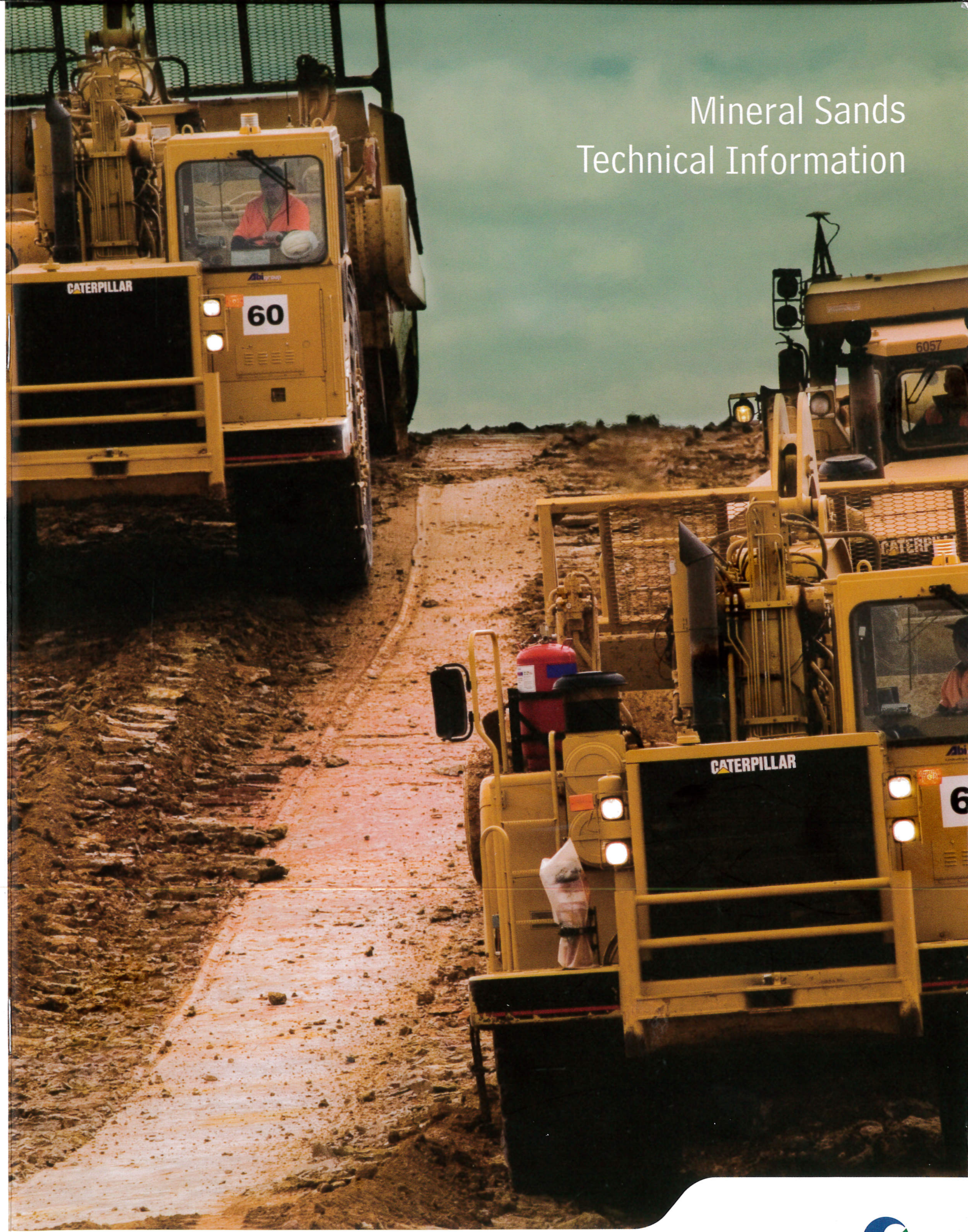
Insight Communication & Design

Mineral Sands Technical Information



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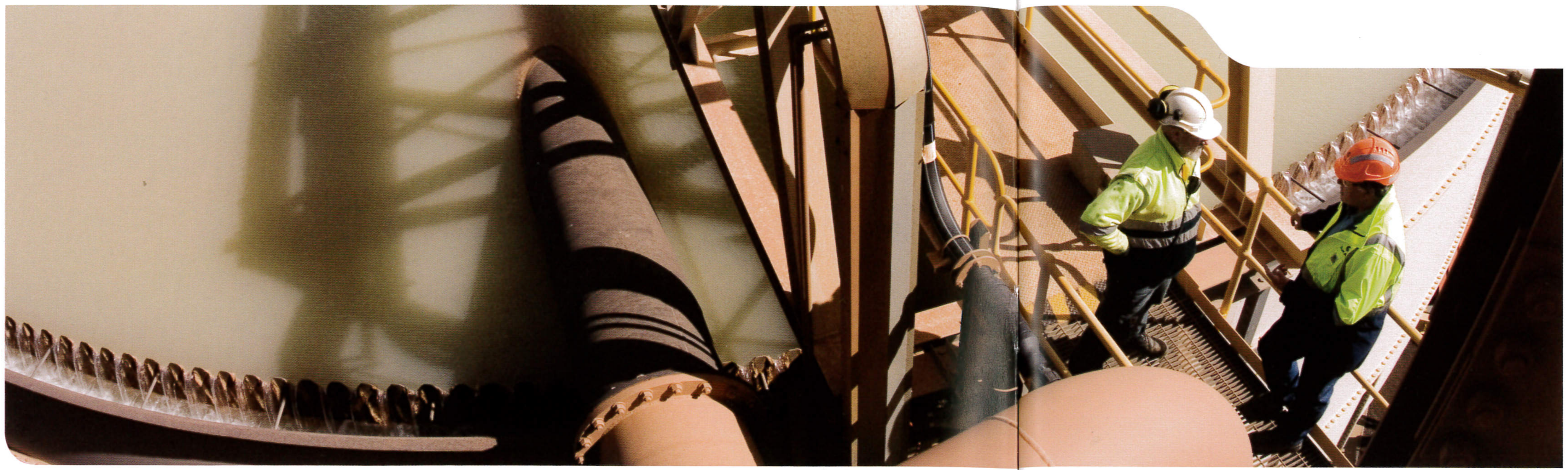


Mineral Sands Overview

Mineral Sands

The mineral sands industry consists of two core product streams:

- Titanium dioxide minerals - in the form of rutile, ilmenite and leucoxene. Ilmenite is also used to manufacture titanium slag and synthetic rutile products; and
- Zircon.

Mineral sands is the term used to describe heavy minerals ("HM") with a specific gravity greater than 2.85 t/m³.

Mineral sands deposits are characterised by their grade (the percentage of HM found in a deposit) and their assemblage (the relative proportion of valuable HM components of ilmenite, rutile and zircon). The typical composition of a mineral sands deposit has a HM grade ranging from 0.5 per cent to above 20 per cent. The differing grades and assemblage characteristics can influence the relative cost and value stream of product produced from any specific deposit.

Product Usage

The titanium dioxide products of rutile, leucoxene and ilmenite, are the principal feedstock for pigment production. Titanium pigments are used for the manufacture of paints, coatings and plastics, as well as in a range of other applications including inks, fibres, rubber, food, cosmetics and pharmaceuticals. Titanium dioxide products are also used in specialist applications including welding electrodes and the production of titanium metal used in commercial aerospace, military and industrial applications.

The value in the use of naturally occurring titanium and upgraded ilmenite products is in large measure influenced by their respective titanium dioxide content, shown in the following table.

TiO_2 Content of Titanium Dioxide Products

Form of Titanium	TiO_2 %
Rutile	95 - 97
Synthetic Rutile	88 - 95
Leucoxene	70 - 91
Ilmenite	
- Sulphate	52 - 54
- Chloride	58 - 62

Zircon is used predominantly in the manufacture of ceramics based products including tiles, sanitary-ware and tableware, as an opacifier in the surface glazes and pigments. A rapidly growing use of zircon is the production of zirconium chemicals used in paper coatings, paint driers, antiperspirants and catalysts, and the manufacture of zirconium metal for nuclear reactor cores. The other main end use markets for zircon include refractories, foundry sand and CRT glass (television glass).

Exploration

Most mineral sands deposits are produced by weathering and erosion of the earth's surface and are carried by sedimentary action to coastlines where a combination of wave action (strand deposits) and, to a lesser extent wind action (dunal deposits), resulted in concentrations in bodies of silica (quartz) sand along ancient beach lines and associated environments.

Mineral sand deposits are typically found in unconsolidated fossil shorelines up to hundreds of kilometres inland from present coastlines.

Mining and Processing

Iluka's operations use dry mining techniques. Dry mining utilises heavy machinery such as scrapers to collect and transport the ore into a hopper for subsequent processing. Wet mining, utilising a dredge, is employed within the industry, typically where the ore body is situated below the water table.

The valuable mineral sands are only a small portion of the total ore removed from the mining area, ranging from 0.5 to 35 per cent. Wet concentration is used to produce a high grade heavy mineral concentrate, containing titanium dioxide (rutile, ilmenite) and zircon, as well as other heavy minerals. As part of this process, ore is washed through a series of spiral separators that use gravity to separate the heavy mineral sands from the lighter quartz and clay. Attritioning and secondary concentration is also carried out to assist in upgrading the heavy mineral content of the mined ore.

Dry Mill Processing

Following the wet concentration stage the heavy mineral concentrate undergoes a number of dry processing stages to separate the valuable minerals.

The processes used to separate, concentrate and clean mineral sands include rare earth drum and roll magnets, electrostatic separation, air tables and high temperature contact acid leach.

Synthetic Rutile

Synthetic rutile is a chemically modified ilmenite which has had most of the iron removed. Typically one tonne of ilmenite will produce between 0.50 to 0.63 tonnes of synthetic rutile with a titanium dioxide composition of between 88 and 95 per cent. Iluka produces multiple grades of synthetic rutile from three different processes.

Quality Assurance

Iluka has various procedures in place to ensure the appropriate quality specifications for products to meet defined customer specifications. Final product sampling and preparation is carried out in accordance with the Australian Standard for Heavy Mineral Sand Concentrates Sampling Procedures, to ensure uniformity of material when submitted for testing and analysis. Iluka has achieved ISO 9001:2000 accreditation for the marketing, sales and order processing of mineral sands and process derivatives.

Post Mining Rehabilitation

The process for the rehabilitation of land mined commences with the collection of critical environmental data and the development of rehabilitation objectives, before mining commences.

Initial field surveys involve studies on current and proposed land use, topography, the condition of any infrastructure and flora and fauna populations. Any vegetation and infrastructure is removed before mining commences, while stockpiling of the surface layer and seed collection may also occur. This process varies depending on the post-mining objectives, such as restoration of land to agricultural use, native vegetation or commercial development.

Contents

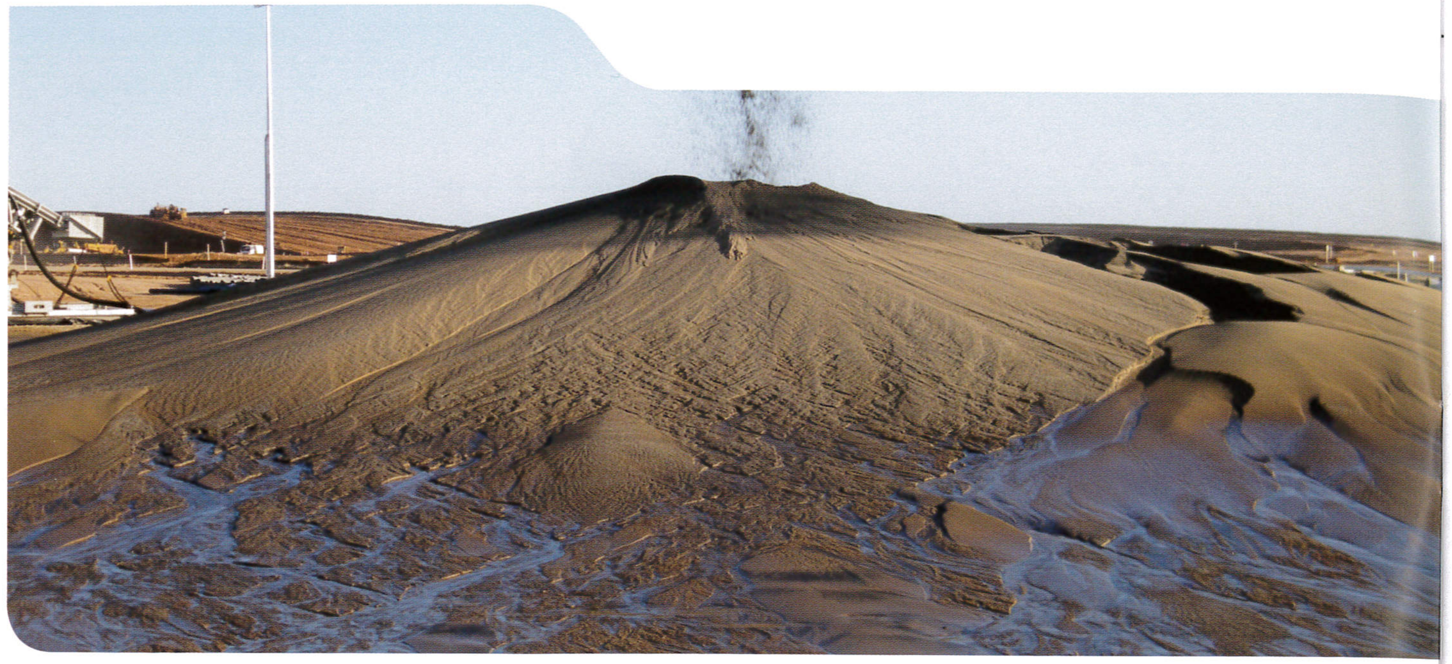
Introduction

Iluka's core business is in the exploration, project development, operation and marketing of mineral sands. Iluka conducts activities in Eucla Basin (South Australia/Western Australia), Murray Basin (Victoria/New South Wales), Western Australia and Virginia, USA.

Iluka is a major participant in the global mineral sands sector. The company has a leading global market share position in the production of zircon and high quality titanium dioxide products (rutile and synthetic rutile).

Iluka (and its predecessor companies) have been involved in the mineral sands sector for more than 50 years. The company commissioned its first mineral sands mine and processing plant in 1959. Since that time, Iluka has contributed to the development, adaptation and innovation of many physical and chemical processes used to produce a range of specific products, suitable to diverse market applications.

Iluka is committed to operating in a responsible manner to minimise the impact of mining and processing operations on the environment, while seeking to maintain environmental biodiversity, and facilitate successful rehabilitation of areas previously mined.



Mineral Sands

Mineral sands represent a relatively small, niche part of the global resources sector. The mineral sands industry consists of two core product streams:

- Titanium dioxide minerals - in the form of rutile, ilmenite and leucoxene. Ilmenite is also upgraded to titanium slag and synthetic rutile products; and
- Zircon.

Titanium is the ninth-most abundant element in the earth's crust. Titanium dioxide products are more prevalent than zircon, with an average titanium dioxide to zircon ratio of 5:1 in typical mineral sands deposits. Mineral sands products (titanium dioxide and zircon) possess a combination of unique physical and chemical properties which make their application important to a wide and increasing range of end use applications. (Refer to "Mineral Sands Products: Attributes and Applications" briefing paper available on Iluka's website www.iluka.com)

The predominant use of titanium dioxide is as a pigment feedstock for the manufacture of paints, coatings and plastics, as well as in a range of other applications including inks, fibres, rubber, food, cosmetics and pharmaceuticals. Titanium dioxide products are also used in specialist applications including welding electrodes and the production of titanium metal used in commercial aerospace, military and industrial applications.

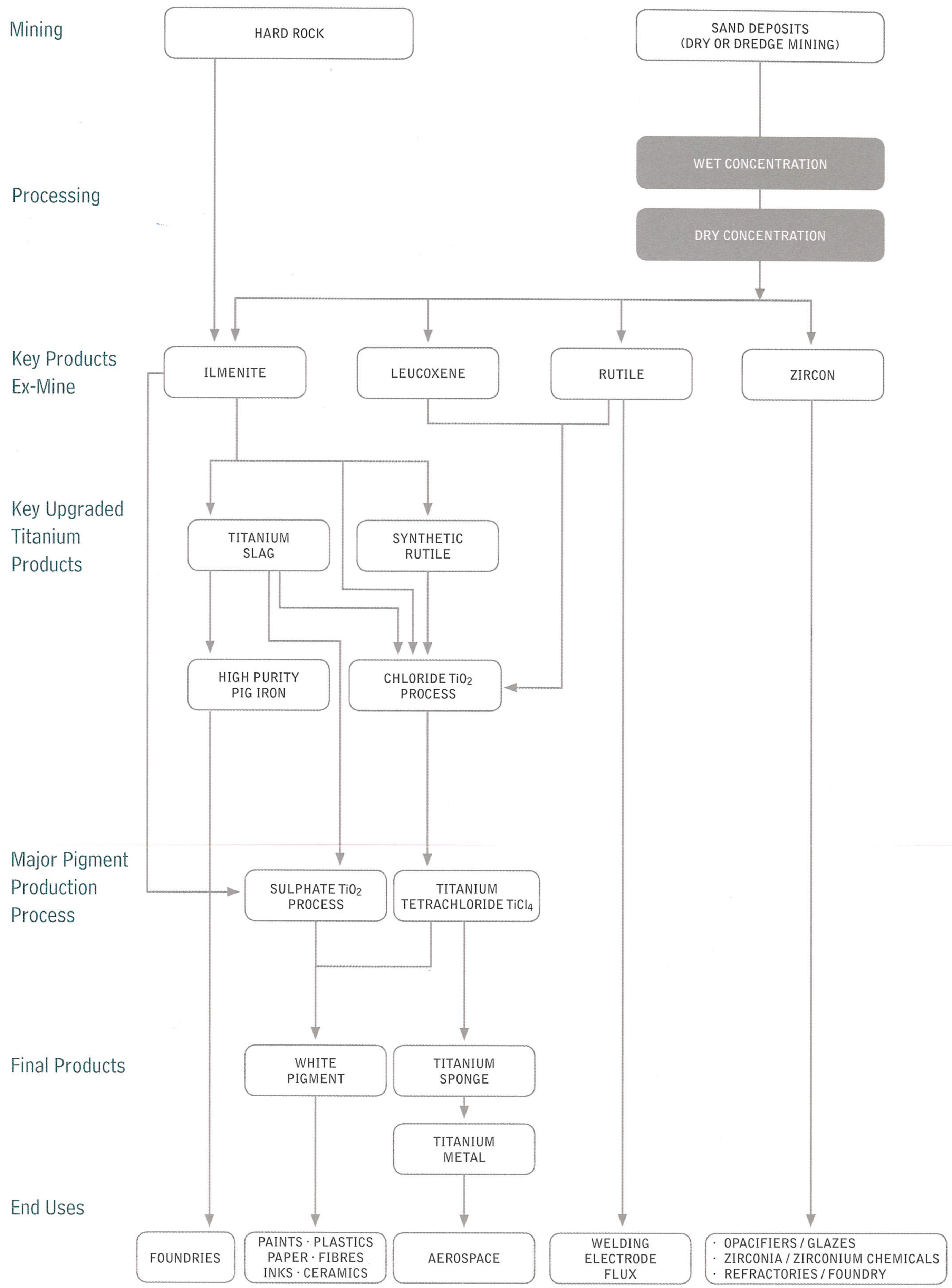
Zircon is used predominantly in the manufacture of ceramics based products including tiles, sanitary-ware and tableware, as an opacifier in the surface glazes and pigments. A rapidly growing use of zircon is the production of zirconium chemicals used in paper coatings, paint driers, antiperspirants and catalysts, and the manufacture of zirconium metal for nuclear reactor cores. The other main end use markets for zircon include refractories, foundry sand and CRT glass (television glass).

The major known locations of mineral sands ore bodies are Australia, India, southern Africa and southern USA. The majority of mineral sands occur in sand style deposits, although the titanium-bearing mineral, ilmenite, is also mined from hard rock deposits in Canada, China and Norway. Australia's mineral sands deposits occur along the coast of eastern Australia from central New South Wales to northern Queensland and in Western Australia. Ancient beach deposits are also found in Victoria, New South Wales and South Australia.

Mineral sands deposits are characterised by their grade (the percentage of heavy mineral ("HM") found in a deposit) and assemblage (the relative proportion of valuable HM components of ilmenite, rutile and zircon). A typical mineral sands deposit has a HM grade ranging from 0.5 per cent to above 20 per cent, with titanium dioxide products normally being in the greatest preponderance, relative to zircon. As such, the value of a mineral sands deposit is influenced as much by the revenue per tonne as by the cash cost per tonne.

The following diagram illustrates the main stages of mineral sands production processes from mining through to final product.

Titanium Feedstock Processing Routes



Exploration

Mineral Sands Deposits

Mineral sands deposits are typically formed as a result of coastal marine sedimentary processes and are found in unconsolidated fossil shorelines up to hundreds of kilometres inland from present coastlines.

A link exists between marine erosion and mineral sand deposits where wave and current action creates conditions in which lighter sand particles are transported more readily than heavier mineral sands particles, creating a build up of mineral sands. Mineral sands are supplied to the coast through rivers draining the hard-rock hinterland. The size of mineral sand deposits vary, but are typically 100 or 200 metres wide, 5 to 20 metres thick and 2 to 20 kilometres long.

Most mineral sand deposits were formed between 1.8 and 12 million years ago. During this period immense changes in the sea levels resulted in repeated reworking of sediments deposited by rivers in coastal shorelines. The composition of mineral sand deposits reflects the type of rocks from which the sands containing the heavy minerals derive.

Exploration Process

The process for mineral sands exploration and resource development is summarised in the flow chart on page 7. Exploration originates at the target generation stage where data is obtained from currently mined deposits and available geological data; this is applied to other selected parts of Australia and the world. Through data interpretation and concept development, potential areas are checked with reconnaissance. Upon confirmation of potential mineral sand deposits, the land access process is initiated.

When a favourable deposit has been identified, the principal exploration method is drilling. Usually small, four wheel drive mounted reverse circulation drilling rigs are used. This drilling method, where air or water is forced down an annular tube and cuttings are returned up the central tube, produces a clean uncontaminated sample at the surface. These are bagged at 1 or 1.5 metre intervals and, if heavy mineral is present, sent to a laboratory for analysis. Samples are wet sieved and the amount of heavy minerals, clay and sand is determined.

Ore Resource and Reserve Delineation

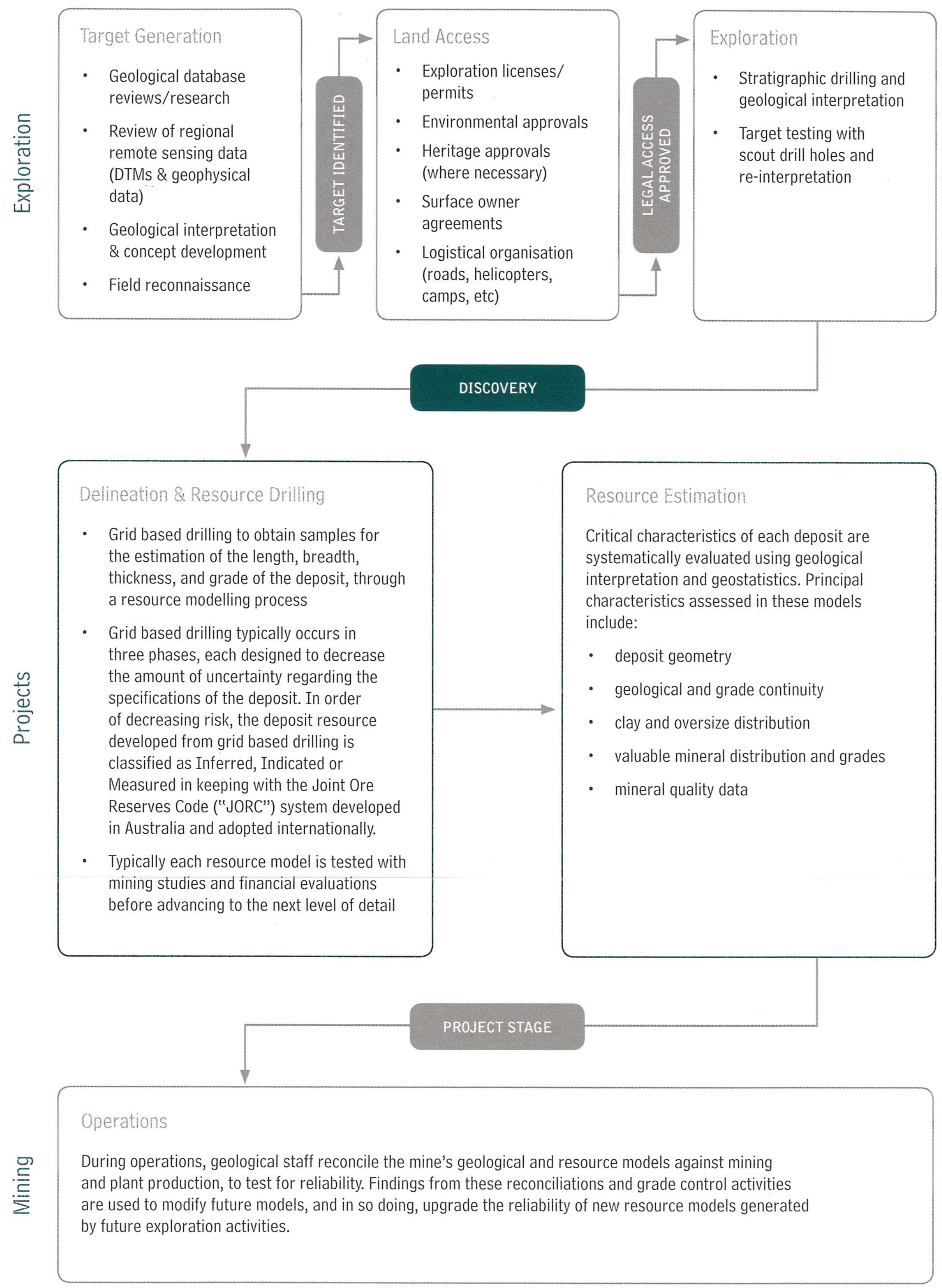
Exploration establishes the presence or absence of potentially mineable ore. If a potential ore body is identified, additional drilling is carried out on a tighter grid. Samples collected at 1 metre intervals are assayed for heavy mineral, clay, sand and moisture content.

A small number of bulk samples are collected and the mineralogy and chemistry of the minerals are analysed and recorded for use in the development of a mineral resource geological model.

The information gained from the drill hole intercepts and bulk sampling is used to develop a three dimensional model of the ore body using industry standard software. This is undertaken according to defined and auditable processes which will allow the resultant mineral resource to be reported in accordance with the industry standard Joint Ore Reserves Code ("JORC").

The mineral ore resource is optimised using industry standard optimisation software to estimate the ore reserve. The estimation of the ore resource and ultimately ore reserve takes into account mining, metallurgical, economic, marketing, legal, environmental, land access and approval factors.

Simplified Heavy Mineral Exploration Process



Mining

Iluka mines for mineral sands in a variety of different land use settings. Much of the land to be mined has often been cleared for agricultural use; other may be lightly cleared sand dunes, heath land or bush.

Mining commences with land clearing activity, where any millable timber is harvested, and the rest is used for fencing, firewood or chipped for use in dust suppression or rehabilitation. Topsoil and subsoil is stripped and stockpiled separately from the underlying overburden material.

The inherent seed bank is maintained to prevent potential sterilisation from saline soils. Overburden is removed and stockpiled for replacement at the end of the mine life. In previously mined areas it may be placed in adjacent previously mined pits or voids, or on sand tailings.

Iluka's operations currently use dry mining techniques. These techniques vary across sites although, in all cases, the ore is deposited into a hopper, usually adjacent to the active mining area. The ore is fed to the hopper by front-end loaders, dozers, self-elevating scrapers, or trucks. Where appropriate, a consistent grade and quality of the mined ore is blended prior to being fed into the hopper.

If scrapers or dozers are being used, ore is mined from the top of the face to the toe of the face and across the face. If trucks are being used, ore is transported to a pad adjacent to the hopper and then a front end loader is employed to blend the ore, bucket by bucket.

The valuable mineral sands are only a small proportion of the total ore removed from the mining area, being mixed with clays, silts, quartz sand and rock.

Depending on the type of waste material associated with the ore, the primary separation may vary but, in general:

- material in the ore that is 150 millimetres ("mm") or greater is screened out using vibrating grizzlies and returned to the mining pit;
- the mixture of mineral sand, quartz sand, clays, silts, and rock (less than 150mm) is passed through a rotating screen (trommel) where the clays, sand and silt are washed away from the rock;
- if the clay content is high or forms balls entrapping the mineral sand, it is passed through a similar rotating screen (a scrubber) prior to entering the trommel. In the scrubber the ore is subjected to high pressure water sprays. These break up the clay balls releasing the mineral sand.

The mineral sand, silt and clay mixture, now in a slurry form, is pumped to the wet concentrator.

Wet Concentration

Iluka's concentrators vary in size from 200 to 1,200 tonnes per hour. The land-based concentrators are a modular design making them easy to assemble and disassemble to move around a site or to other sites.

Wet concentration produces a high grade heavy mineral concentrate, maximising the content of valuable mineral sand whilst minimising the amount of non valuable mineral (gangue).

The slurry of mineral sands, silts and clays is further screened at a smaller aperture to remove such gangue material as fine rock, tree roots, other organic matter and fine clay balls. It is imperative that this material is removed before passing into the next stage of the concentrator as much of the equipment used has fine apertures, pipes and cutters which could become blocked.

The slurry is pumped to a bank (or banks) of hydrocyclones. These remove very fine, predominantly clay and silt particles.

The underflow from the hydrocyclones is fed to a constant density ("CD") tank. This is then pumped, at a constant density and feed rate (to optimise performance), to the distributors above the primary spirals in the wet concentrator.

The slurry then passes to the spiral banks where separation of heavy mineral from the quartz sand occurs through gravity separation. The spiral troughs are angled and the heavy mineral sand moves to the inside and the lighter gangue minerals to the outside of the trough as the slurry travels down the spiral. Re-pulpers on the spirals aid in the recovery process.

Iluka concentrators consist of the following spiral stages:

1. primary or rougher
2. middlings
3. cleaners
4. recleaner and/or upgrade and finally
5. scavenger

Heavy mineral concentrate from each stage passes on to the next upgrading stage to be further concentrated, middlings are usually recirculated, and tails scavenged to collect any left-over valuable heavy mineral.

Heavy mineral concentrate is stockpiled on site before being transported to the secondary concentrator or dry separation plant. It is stockpiled using dewatering cones or cyclone stackers. The concentrate is allowed to drain to minimise moisture before transportation.

The fine clay and silt minerals, previously separated by the hydrocyclones are mixed with flocculant, thickened in high rate thickeners, remixed with the quartz sand residue and pumped to the mining void. Alternatively, the thickener underflow is pumped to solar evaporation dams to dry. The dried clay is reclaimed by machine and returned to the mining pit or mixed with soil to enhance the rehabilitation process.

Sand residue is pumped to the mining pit and discharged via a monitor or cyclone stackers. The sand is re-contoured before overburden and topsoil replacement, ready for rehabilitation.

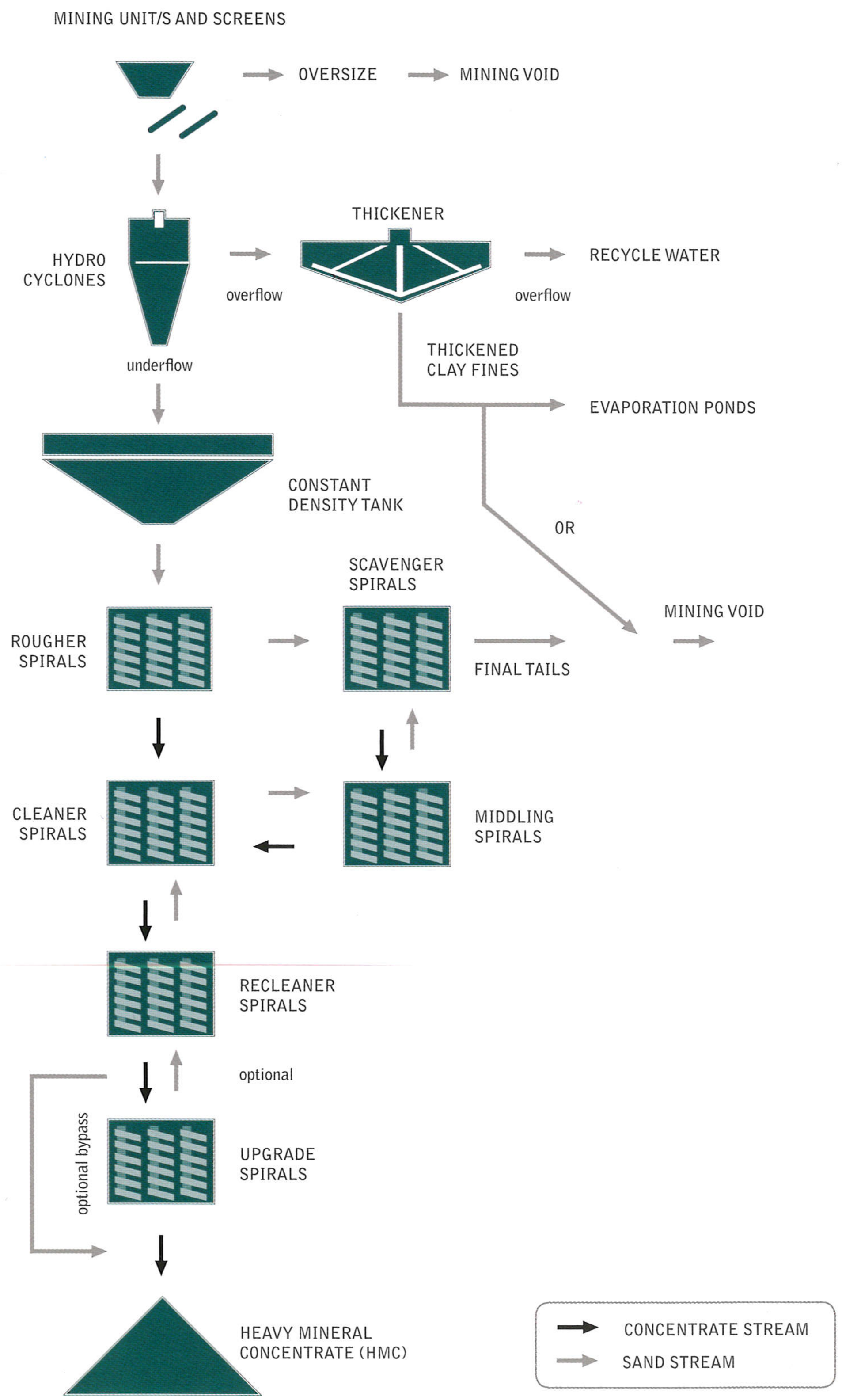
The return water from the cyclone stackers and solar evaporation dams is recycled to a clean water dam from which process water is drawn.

Attritioning and Secondary Concentration

Attritioning is carried out on heavy mineral concentrate to clean the mineral surface. It increases separation efficiencies in electrostatic separation performed during dry separation. This is done by agitating the mineral slurry vigorously causing the mineral particles to collide together and scrub the surfaces. Chemicals are occasionally added to aid this process.

Secondary concentration uses an up-current classifier to remove fine quartz and non-valuable heavy minerals from the wet concentrator heavy mineral concentrate to achieve a heavy mineral content of approximately 98 per cent.

Concentration Process Flow Chart



Dry Mill Processing

Following wet processing the heavy mineral concentrate undergoes a number of dry processing stages to separate the valuable minerals. The design of each flow sheet will differ depending on the mineral assemblage.

Dry mill processing relies upon the unique physical properties of each mineral (refer below table) to separate the gangue minerals from the valuable heavy minerals.

Rare earth drum and roll magnets remove most of the ilmenite as it is the most magnetic of the minerals in the dry mill feed.

Electrostatic separation, using high tension roll and plate electrostatic machines, separate the non-conductive minerals such as zircon, kyanite, staurolite, quartz and monazite from conductive minerals such as rutile, leucoxene and residual ilmenite.

Mineral Properties

Form of Titanium	TiO_2 %	Magnetic Susceptibility	Electrical Conductivity	Specific Gravity	Chemical Formula
Ilmenite - Sulphate - Chloride	 52 - 54 58 - 62	High	High	4.5 - 5.0	$FeO.TiO_2$ $Fe_2O_3.3TiO_2$
Rutile	95 - 97	Low	High	4.2 - 4.3	TiO_2
Synthetic Rutile	88 - 95				
Leucoxene	70 - 91	Semi	High	3.5 - 4.1	$Fe_2O_3.TiO_2.mH_2O$
Zircon	N/A	Low	Low	4.7	$ZrSiO_4$
Monazite	N/A	Semi	Low	4.9 - 5.3	$(Ce,La,Th,Nd,Y)PO_4$
Staurolite	N/A	Semi	Low	3.6 - 3.8	$Fe_2Al_9O_6(SiO_4)_4(O,OH)_2$
Kyanite	N/A	Low	Low	3.6 - 3.7	Al_2SiO_5
Garnet	N/A	Semi	Low	3.4 - 4.2	$(Mg,Ca,Mn,Fe)_3(Al,Cr,Fe)_2(SiO_4)_3$
Quartz	N/A	Low	Low	2.7	SiO_2
Cassiterite	N/A	Low	High	7.0	SnO_2

The conductive minerals are further cleaned by

- electrostatic separation to remove residual non-conductive contaminants to marketable levels; and
- magnetic separation to separate rutile, leucoxene and residual ilmenite into rutile, Hyti and ilmenite products.

The non-conductive minerals pass through a wet gravity circuit to separate the light quartz, kyanite and staurolite from the heavier zircon.

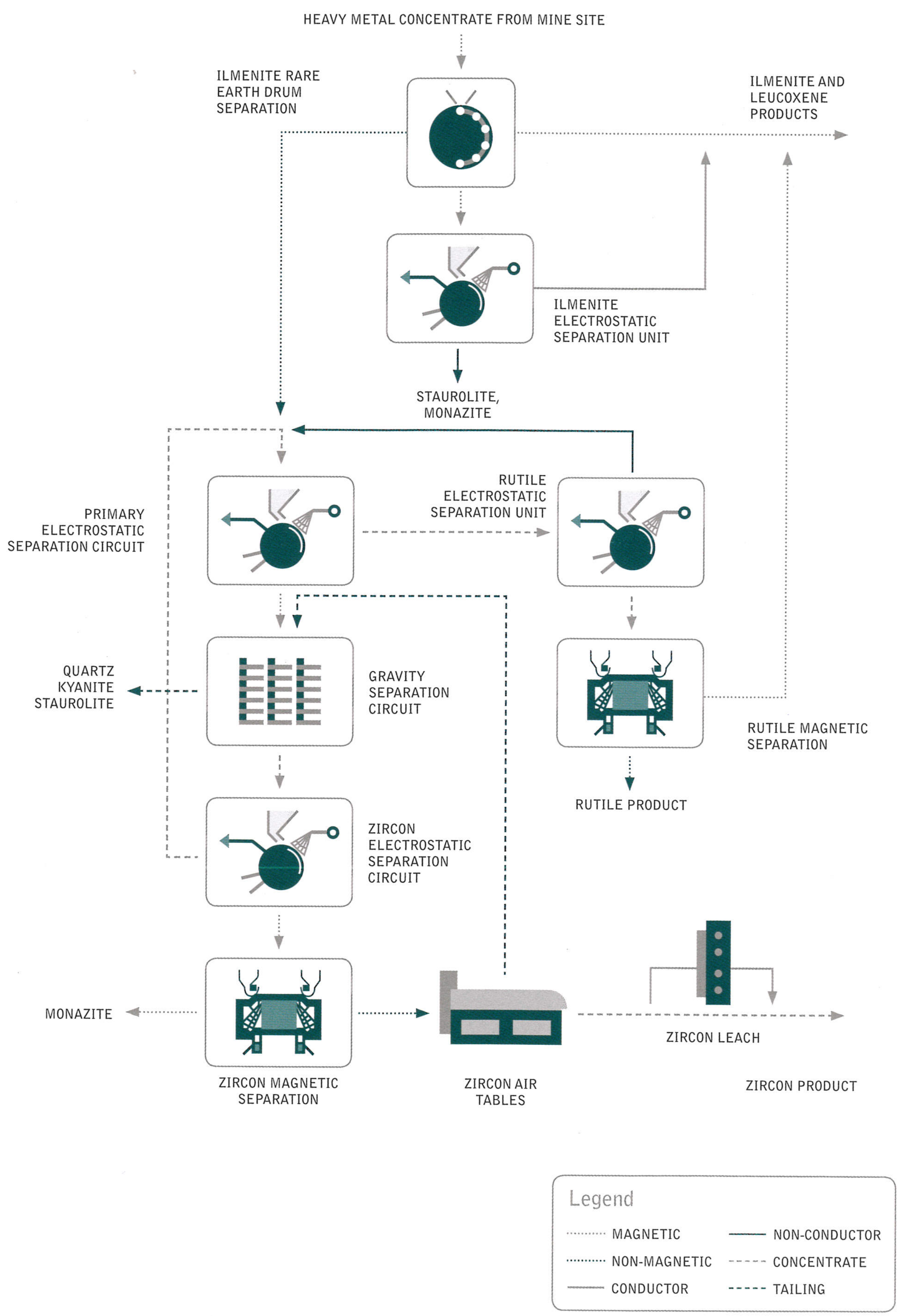
The zircon concentrate is dried and cleaned by further

- electrostatic separation to reduce the titanium dioxide content to below 0.15 per cent; and
- magnetic separation to remove weakly magnetic monazite and residual staurolite.

Air tables are used to remove residual fine quartz and kyanite to market specifications.

A high temperature contact leach is used to remove surface iron coatings. Rare earth roll magnets then remove weak magnetic zircon from the leached product to produce a high value ceramic grade zircon.

Typical Dry Mill Process Flow Chart



Synthetic Rutile

Synthetic rutile ("SR") or upgraded ilmenite ("UGI") is a chemically modified ilmenite, which has had most of the non titanium components removed. Its composition is between 88 and 95 per cent titanium dioxide. This is similar to the naturally formed rutile mineral from which it derives its name.

Iluka produces multiple grades of synthetic rutile from three different processes. The processes and their stages are described in the below table.

Reduction involves reacting the ilmenite in large rotary kilns for approximately twelve hours. The heat source is coal, and the source of the chemical reductant (carbon monoxide) is also coal. Controlled air addition allows enough heat to be generated for reduction reactions to occur (~1,100 degrees Celsius), and carbon monoxide to be generated. The carbon monoxide is oxygen deficient, and scavenges some of the oxygen from the ilmenite structure. Most of the iron portion of the ilmenite is converted to metallic iron.

Synthetic Rutile Processes

	Standard SR	Premium SR	SREP SR
Reduction	Yes	Yes	Yes
Boron Addition	No	No	Yes
Sulphur Addition	No	Yes	No
Dry Separation	Yes	Yes	Yes
Aeration	Yes	Yes	Yes
Wet Separation	Yes	Yes	Yes
Acid Leaching	No	Yes	Yes
Caustic Leaching	No	No	Yes

The kiln product is a highly magnetic sand grain, due to the presence of metallic iron. It is the same size as the original ilmenite and is slightly more porous.

Boron addition only occurs in the Synthetic Rutile Enhancement Process ("SREP"). The boron reacts with the clay coatings on the ilmenite grain to form a slag. Radionuclides (thorium, uranium, radium) are absorbed into this slag for later removal.

Sulphur addition only occurs in the Premium SR process. The sulphur improves iron and manganese removal in the downstream process by reacting with the manganese, and stopping the stabilisation of an irreducible iron/titanium compounds.

Dry separation involves screening and magnetic separation of the kiln product.

The reduced ilmenite is separated from excess partially burnt coal (in the form of char) and some of the other impurities by screens and magnetic separators.

Aeration, or accelerated rusting, involves the removal of the metallic iron from the reduced ilmenite grain.

The reduced ilmenite is mixed in tanks with water and air. A salt catalyst (ammonium chloride) is added to accelerate the process. Preheating of liquor using heat scavenged from elsewhere in the process, is also used to accelerate the process. In these conditions the metallic iron dissolves, migrates through the pores within the particle and precipitates in the bulk solution as very fine iron oxides, 0.1 to 10 microns in diameter.

After aeration, the sand grain has lost up to 40 per cent of its original weight and is a porous matrix of titanium dioxide of about 88 per cent purity.

Wet separation of the fine iron oxide from the coarse titanium mineral particles is done using hydrocyclones and spiral classifiers.

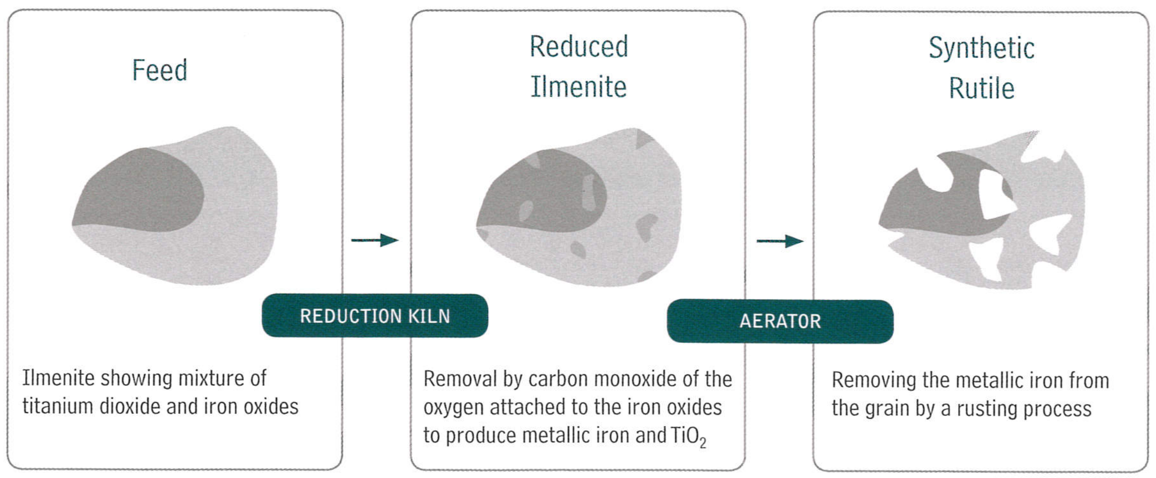
The iron oxides are deposited in settling dams, and the ammonium chloride liquor is recovered and recycled.

In the Standard SR process, the synthetic rutile is filtered and dried, and is ready for sale.

In the Premium SR process, the synthetic rutile is upgraded by leaching with dilute sulphuric acid to remove the iron and manganese phases resulting from sulphur addition to the reduction process and produces a synthetic rutile of 92 to 93 per cent grade. After filtering and drying the Premium SR is ready for sale.

In the SREP process, the synthetic rutile is upgraded by leaching in a concentrated counter current acid leach, followed by a caustic leach. The acid leach removes residual leachable iron and iron oxides, thorium and some residual slag. The caustic leach removes some residual silica. After filtering and drying, the SREP product is available for sale.

Three Basic Grades of Synthetic Rutile



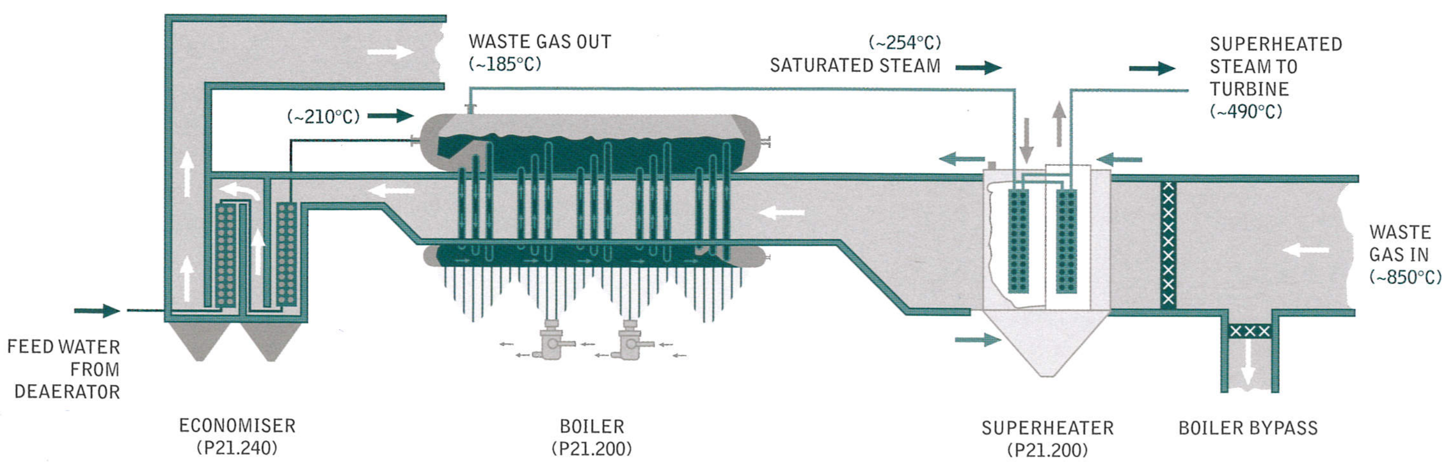
Waste Heat Recovery Plant

A waste heat recovery power generation plant operates at one of the two synthetic rutile kilns ("SR2"), at Iluka's South West operation in Western Australia. Incorporated into the kiln waste-gas circuit, it recovers the residual energy from the reduction kiln process.

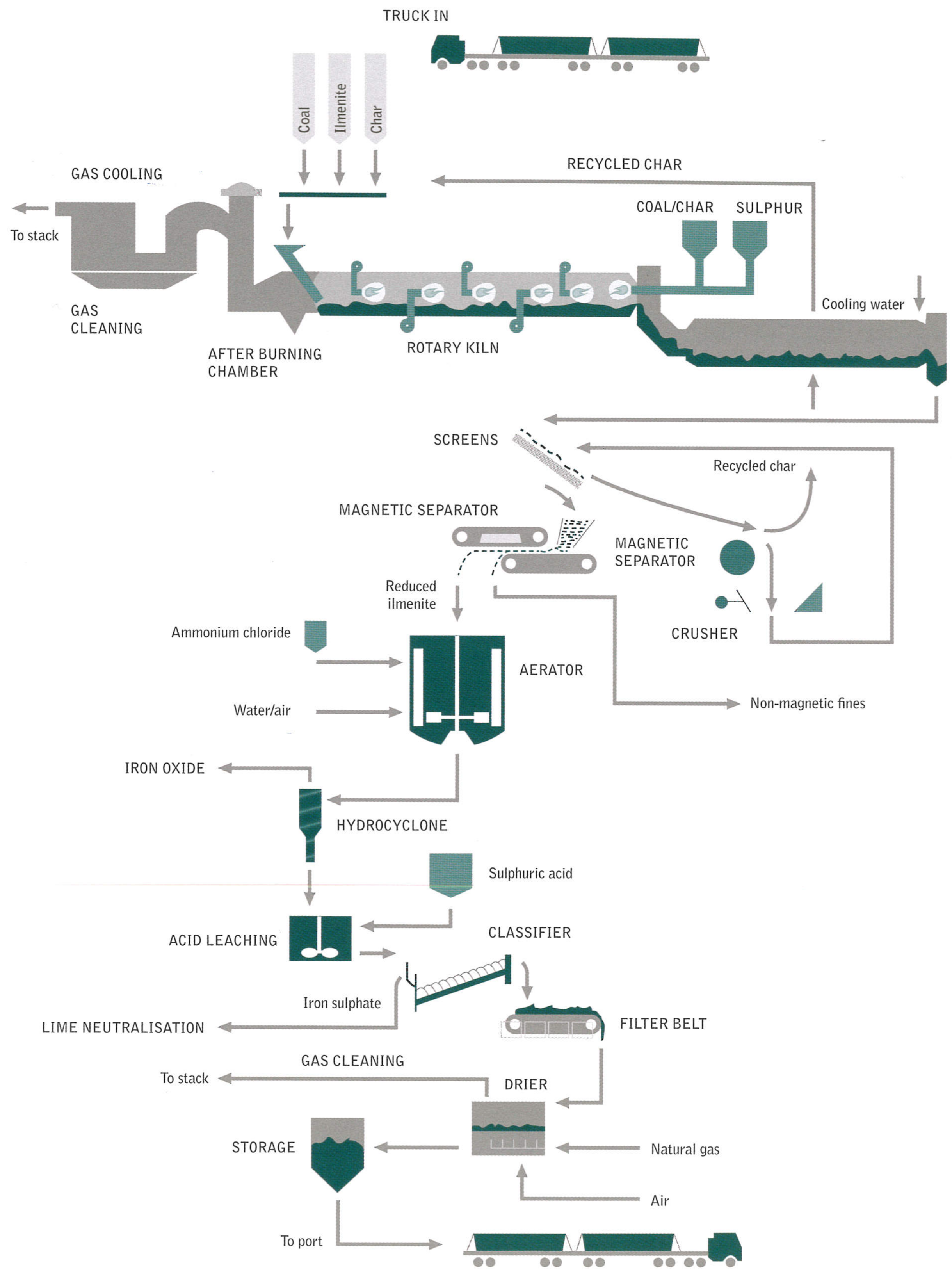
Power is produced by an alternator that is driven by a steam turbine. Steam production is achieved by scavenging waste heat from the kiln off gas using a three-stage counter current heat exchange system.

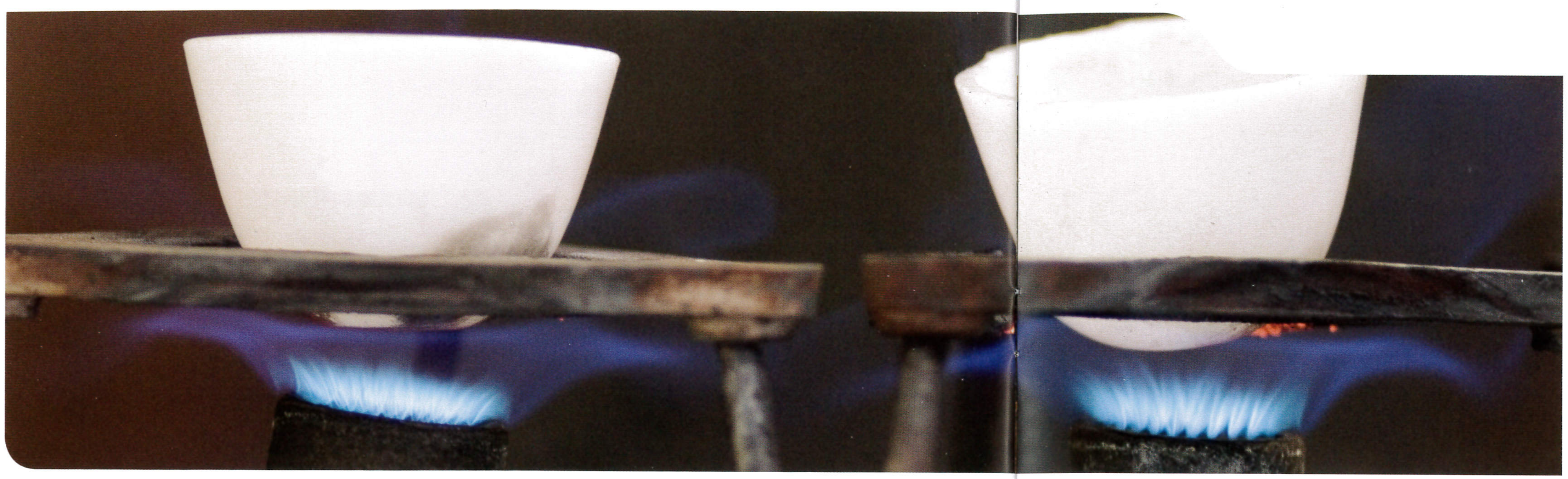
This superheats and pressurises the steam to 490 degrees Celsius and 4,000 kilopascals. The heat exchange system also has the desired effect of cooling the waste-gas prior to cleaning and exhaust.

Approximately 6 megawatt ("MW") of electrical energy is produced with SR2 consuming approximately 5MW, with the excess (approximately 1MW) exported to the power grid. Iluka obtains partial credits for this power, which offsets power use from other sites.



Synthetic Rutile Process Flow Chart





Quality Assurance

Sampling

Samples are taken in all stages from mining and processing of mineral sands, through to the final product. These are statistically representative of the mining procedure or processing task.

Final product sampling and preparation is carried out according to the following Australian Standards:

- AS2884.1-1997 Australian Standard Heavy Mineral Sand Concentrates – Sampling Part 1 – Moving Streams;
- AS 2884.2-1993 Australian Standard Heavy Mineral Sand Concentrates – Sampling Part 2 – Sampling from Stationary Situations; and
- AS 2884.3-1986 Australian Standard Heavy Mineral Sand Concentrates – Sampling Part 3 – Preparation of Samples.

On Stream and Plant Based Analysis

Processing plants are equipped with on-stream-analysers that continuously monitor and graph key controllable parameters.
To help "trouble-shoot" processing difficulties, bench top X-Ray Fluorescence ("XRF") machines are used as they allow plant personnel to prepare and run spot samples in the plant control room.

Laboratory Based Analysis

Physical Analysis

1. Sizing

   A sample is separated into different sizes by passing through a number of sieves that are ordered in decreasing aperture sizes from 300 micrometres (μm) down to 75 μm for shipments, and from 870 μm to 53 μm for research and development.

2. Heavy Mineral Separation

   A sample is separated according to the density of its components. It is placed in a dense liquid where the heavier particles (titanium minerals, zircon and monazite) sink to the bottom and the less dense material (silica and other impurities) float to the top. This technique is extremely useful and important for exploration and mining samples.

3. Magnetic Separation

   A sample is separated according to its magnetic properties. This technique is used to simulate some of the processes that occur in the dry processing plant. That is, to separate the magnetic material (ilmenite) from the non-magnetic material (rutile, leucoxene and zircon).

Chemical Analysis

1. Wet Chemistry

   This is a traditional analytical procedure where a sample is dissolved in acid and/or fused in flux and then dissolved in acid. The resulting solution is then reacted with a standard reagent to achieve an endpoint to calculate the percentages of Ti (IV), Fe (III) and Fe (II).

2. Instrumental

   XRF spectrometry is the major instrument analysis technique used in the quality assurance of mineral sand samples. Samples are prepared as fused glass discs and analysed in accordance with the Australian Standards:

   - AS 4392.1 – 1996 Heavy Mineral Sands – Analysis by Wavelength Dispersive X-ray Fluorescence Spectrometry Part 1: Titaniferous Mineral Sands; and
   - AS 4392.2 – 1997 Heavy Mineral Sands – Analysis by Wavelength Dispersive X-ray Fluorescence Spectrometry Part 2: Zircon Materials.

X-Ray Diffraction (XRD) is used to determine the degree of titanium reduction in synthetic rutile, Ti (III), and to assist in determining the mineral species present in exploration, process and research samples.

Atomic Absorption Spectrometry ("AAS") is used for environmental monitoring and other water analyses.

Ion Chromatography ("IC") is for specialised environmental and water analyses.

The combination of physical and chemical analyses provides assurance that the final product is made to specified quality standards.

Rehabilitation

The process for the rehabilitation of land mined commences with the collection of environmental data and the development of rehabilitation objectives, before mining commences.

Initial field surveys can involve studies on:

- current and proposed land use;
- flora and fauna populations with an emphasis on rare and endangered communities and species, restricted vegetation units;
- groundwater dependent ecosytems and dieback status;
- soil physical and chemical properties in the proposed mining area;
- soil fertility, pasture composition and productivity, crop yields, tree yields, stocking rates and plant nutrition;
- topography;
- local weather conditions, using remote automatic weather stations;
- groundwater conditions, using piezometer bores;
- surface water flows, through installation of gauging station and weirs; and
- the condition of any infrastructure.

This information, as well as the specific requirements of the landowner, is essential in developing a mining and rehabilitation management plan.

Before mining commences all vegetation and infrastructure is progressively removed from the disturbance area. Any timber present (where not retained as part of offsets) is harvested for habitat re-establishment, mill logs, fence posts or firewood. Other vegetation is mulched for re-use in the rehabilitation process.

In areas containing bushland, an intensive seed collection program is undertaken before any clearing takes place. Top soil is stripped in two cuts - a first cut to concentrate seed and propagules from the top 50 to100 millimetres and where possible to spread directly onto prepared rehabilitation sites, and a second cut making up the remainder of the topsoil layer. In agricultural areas a single topsoil layer is taken and stockpiled.

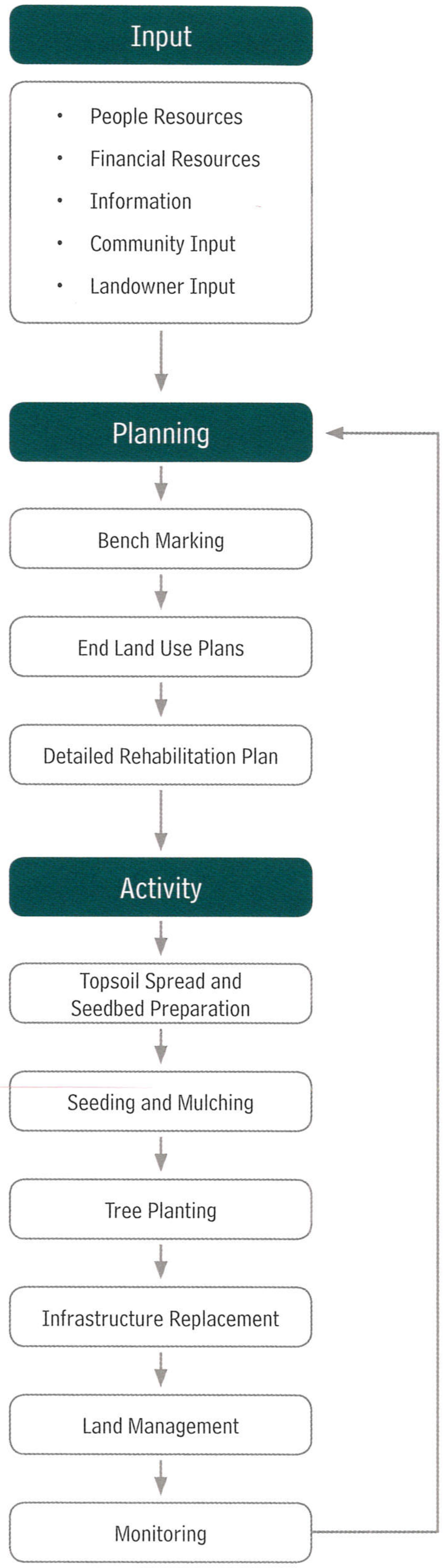
The surface layer of the soil is the biologically active component, containing the bulk of the nutrient, organic matter, soil fauna and microbial activity that is essential for effective mine rehabilitation.

In areas where the ore body is close to the surface, only the topsoil is stripped and stockpiled and the rest is mined.

In deposits deeper underground, subsoil or overburden layers are stripped and stockpiled separately so they can be used to reconstruct the original soil profile. Once the required topsoil and subsoil layers have been stripped the mining operation commences.

As the active mine area moves forward, the mining pit or void is backfilled with overburden, oversize material and with sand and clay extracted during the separation process. This is then covered with the stockpiled soil materials using low compaction earthmoving equipment to recreate the original or desired soil profile and final landform.

Rehabilitation Process



In some operations the sand and clay from the separation process is mixed and deposited hydraulically into the mine void. In other operations the clay is first dried in solar evaporation drying dams and used as dry fill in the backfill process.

In dunal deposits that lack stockpiled subsoil, the dried clay is often spread onto a finished sand landform and mixed using earthmoving and agricultural equipment to form a sandy loam and improve water holding and agricultural productivity.

Once the design landform is achieved, the area is ripped to loosen the soil and then graded smooth. Stockpiled or freshly stripped topsoil is spread before the seasonal onset of rain.

The rehabilitation objectives for a site will specify the required vegetation cover. Iluka's sites have a mix of rehabilitation objectives but typically require rehabilitation to productive farmland or stable native vegetation.

In rehabilitating pasture or cropping areas the rapid establishment of plant cover to prevent erosion is important. Initial seed and fertiliser application rates are high to ensure good cover of the soil surface and rapid root growth to aid the build-up of organic matter. This is designed to ensure the long-term stability and productivity of the rehabilitation programme. High rates of fertiliser are needed in the following few years to replace nutrients lost during handling and storage of topsoil.

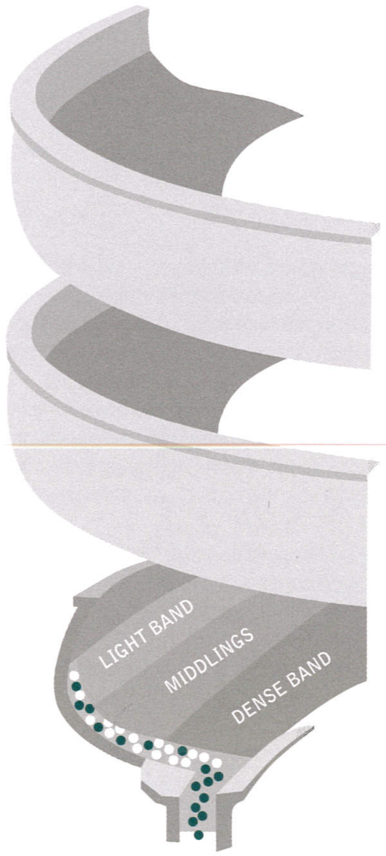
Soil and plant tissue samples are taken each year and analysed for major and trace nutrients. The results are used to ensure correct quantities of fertiliser are applied and any deficiencies are corrected in the following growing season. Pasture productivity and quality are monitored and performance is assessed against other properties in the district or within selected sites.

Infrastructure is replaced to the agreed end land use plan after land stability and productivity are established.

Where native vegetation is specified, the spread of topsoil is followed by an application of mulch and/or native seeds. The mulch and seeds are processed and collected from the proposed mine area to replicate original species. After seasonal rain, seedlings are planted to provide a framework of established plants and to add plant species that are difficult to grow from mulch, seed or topsoil.

Each rehabilitated block is monitored to ensure ecosystem development and progress. Monitoring records plant numbers, density and species diversity, which are compared with previously agreed rehabilitation outcomes.

Appendix 1: Mineral Sands Separation Equipment



Gravity Separators

Spirals

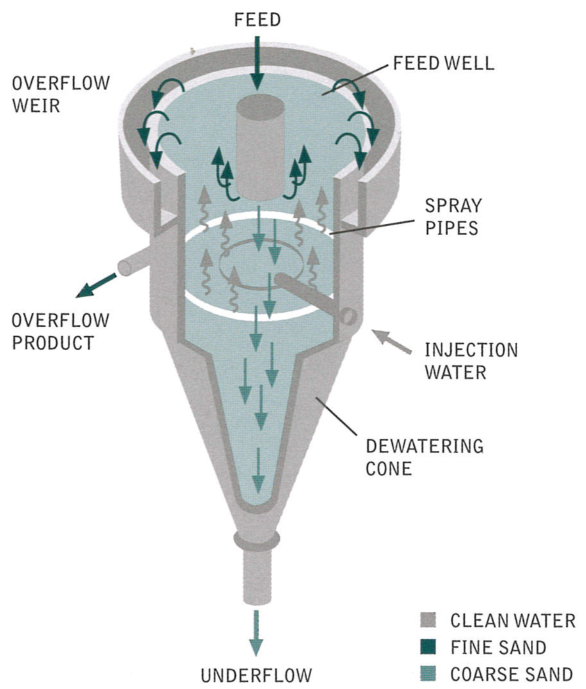
Spirals use differences in specific gravity and the effects of hindered settling to separate light and heavy minerals.

A spiral consists of a curved trough formed into a spiral around a vertical axis. Feed pulp enters the top of the spiral column and flows down.

The particles sort themselves according to size, shape and density with the lighter, coarser and rounder particles carried by the flowing water to the outside of the trough. Heavier, finer and flatter particles stay close to the inside of the spiral.

The heavy mineral concentrate is progressively removed from the trough by splitters located along the length and at the base of the spiral.

Spirals are used at the mine sites to separate large quantities of quartz sand away from the valuable heavy minerals. The final product from the spirals is a heavy mineral concentrate that is suitable for dry mill processing. Spirals are also used in the dry mill to remove residual quartz and aluminosilicates that have the same electrostatic and magnetic properties as zircon but have a lower specific gravity.

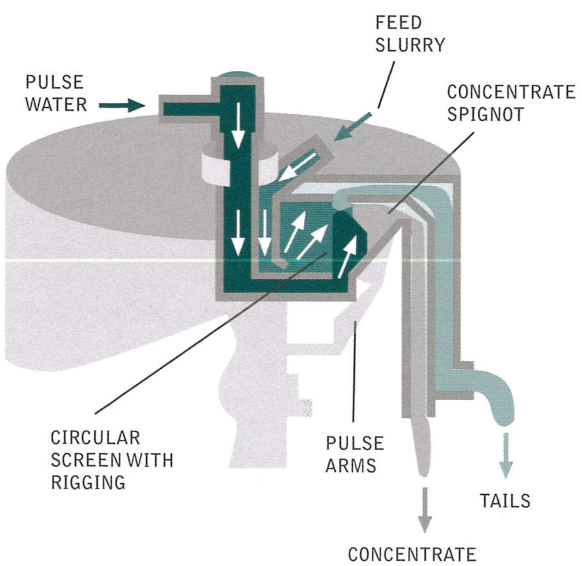


Up-Current Classifiers

Up-current classifiers act on the differences in size and density of mineral particles. Water is injected through perforated spray pipes, providing a rising up-current of water. Mineral feed entering the top of the classifier meets the rising current.

The interaction of the rising current and the settling solids creates a fluidised bed of particles that causes fine and low density mineral grains to rise over the overflow weir together with the process water. Coarser and higher density grains pass through the fluidised bed to the lower tapered dewatering section.

Up-current classifiers are used at the mine sites to remove fine quartz and clay from heavy mineral concentrate.



Kelsey Centrifugal Jigs

Kelsey centrifugal jigs combine the pulsation principles of conventional jigs with the application of a centrifugal force. This force is several times that of gravity (which a conventional jig must rely on) which improves the performance on minerals that have similar specific gravity (such as zircon and kyanite).

The spinning rotor consists of a circular screen mounted vertically and layered with a bed of ragging. Feed pulp passes down the fixed central feed pipe and is distributed over the ragging.

Those particles whose specific gravity are higher or equal to that of the ragging material (typically coarse garnet for zircon/kyanite separation) will settle in the ragging bed.

Pulsing of the ragging bed results in the expansion and compression of the ragging allowing the heavier particles to move through the retention screen.

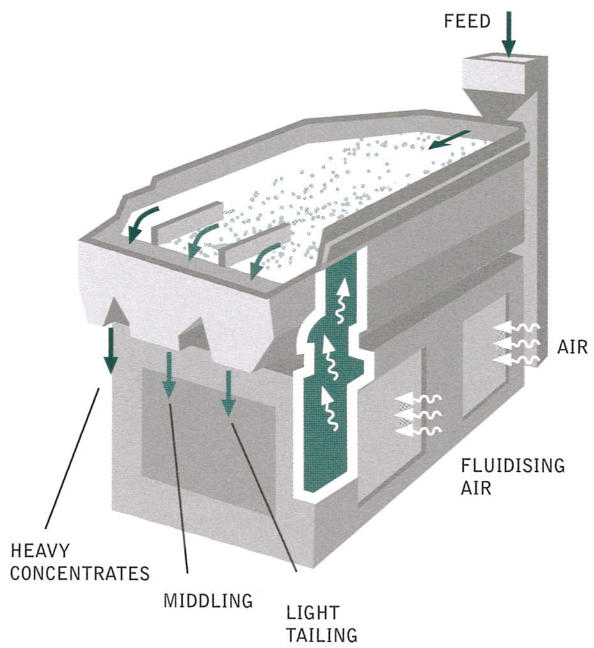
The light particles cannot penetrate the ragging bed and overflow the top of the retention screen to become tailings.

Kelsey Jigs are typically used within dry mill wet separation circuits to scavenge zircon from tailings streams high in kyanite.

Air Table Separators

Air table separators use a combination of differential longitudinal shaking and air fluidisation to separate particles of similar size range but different specific gravity.

Feed is presented to the top of an angled, vibrating table deck covered with woven cloth. Clean, filtered air is blown by fans through the woven deck surface. The air fluidises the bed of mineral travelling down the deck, allowing heavier, larger grains to sink through the mineral bed towards the table surface, while smaller, lighter grains rise to the top.

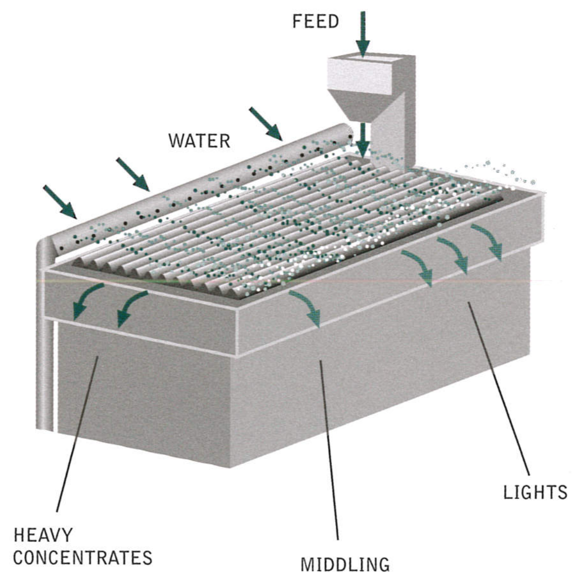


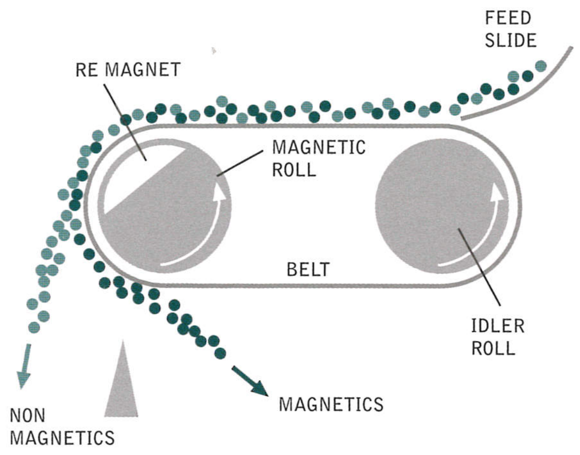
Wet Table Separators

Wet table separators use a combination of differential longitudinal shaking, vertical stratification behind longitudinal riffles, and differential water velocity with depth, to separate particles of differing size and specific gravity.

Unlike an air table, where size and density decrease from the top of the concentrate band to the tailings, on a wet table size increases and density decreases from the top of the concentrate band to the tailings.

This makes wet tables very well suited to separating fine heavies (zircon) from coarse lights (kyanite and staurolite).





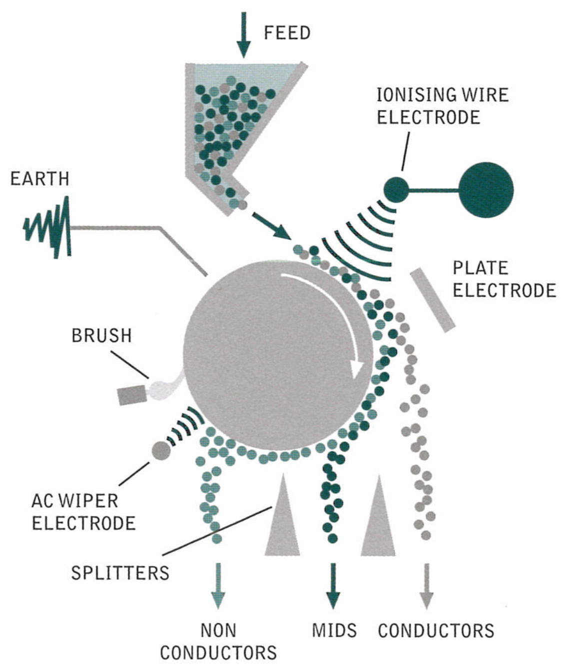
Magnetic Separators

Rare Earth Magnetic Roll Separators

Mineral is fed as a layer onto a thin belt (0.5 millimetres) that carries the feed to a magnetic roll. The magnetic roll consists of alternate slices of rare earth magnet and mild steel. The rare earth produces a magnetic field that converges (is strongest) at the mild steel slices. Magnetic mineral on the belt is drawn towards the mild steel slices and is pinned to the belt by friction. Non-magnetic minerals are not influenced by the magnetic field and are thrown from the roll by centrifugal force.

After the belt passes around the roll, magnetic particles are released when they leave the influence of the magnetic field.

Rare earth magnetic roll separators are applied to a wide range of separation duties that include improving the ceramic quality of zircon by rejecting weakly magnetic contaminants, to production of ilmenite products.



Electrostatic Separators

High Tension Roll Separators

An ionising electrode running parallel to the roll generates an electrostatic field between itself and the earthed roll. Mineral is fed onto the rotating roll and is carried into the zone of influence of the ionising wire. All grains passing through this zone receive an electrical surface charge.

Non-conductor particles acquire an opposite charge to the roll surface and are thus attracted to the surface until brushes dislodge them. This effect is called the "pinning" effect. The pinning effect is very strong.

Conductor particles quickly lose their charge to the earthed roll and are thrown by centrifugal force from the roll. As they are thrown, they come under the influence of a secondary plate electrode. The large field generated by the plate further attracts the conductor particles and generates particle lift. This widens the separation band between conductors and non conductors, improving the efficiency of separation.

High-tension roll separators are commonly used to separate conductive rutile and non-conductive zircon, kyanite and staurolite.

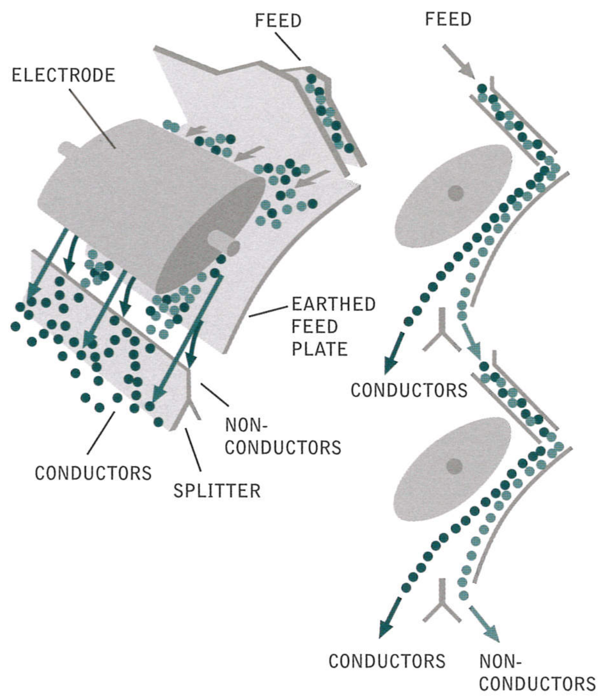
Electrostatic Plate Separators

Plate separators use the lifting effect exclusively. Feed gravitates down an earthed plate into an electrostatic field induced by a large curved plate electrode.

A conductor particle acquires a charge opposite to that of the electrode. As the charge is of opposite polarity to the electrode, the particle is attracted toward the electrode.

The non-conductive particle is unaffected by the weak forces involved and it continues down the earthed plate under the influence of gravity only.

Electrostatic plate separators are best for removing fine conductors from coarse non-conductor-rich streams.



Appendix 2: Resources

Further information about the mineral sands industry and Iluka's operations can be found on the company website www.iluka.com

The following are recommended resources of further information:

Mineral Sands: An Overview of the Industry by Greg Jones, Manager Development Geology, Iluka Resources - available on the website www.iluka.com

Minerals Sands Products: Attributes and Applications - available on the website www.iluka.com

Also refer to TZ Minerals International Pty Ltd, an independent mineral sands consulting group for industry publications – www.tzmi.com