# Indian Minerals Yearbook 2020

**(Part- III : Mineral Reviews)**

## 59th Edition

# ZIRCON

## (ADVANCE RELEASE)

**GOVERNMENT OF INDIA**
**MINISTRY OF MINES**
**INDIAN BUREAU OF MINES**

Indira Bhavan, Civil Lines,
NAGPUR – 440 001

PHONE/FAX NO. (0712) 2565471
PBX : (0712) 2562649, 2560544, 2560648
E-MAIL : cme@ibm.gov.in
Website: www.ibm.gov.in

**January, 2022**

# 29 Zircon

Zirconium is the twentieth most abundant element in the Earth's crust and occurs in a variety of rock types and geological environment but most often, in the form of zircon ($ZrSiO_4$) found usually as a constituent in heavy mineral sand assemblages, which include ilmenite, rutile, leucoxene, monazite and garnet in varying proportions. Zircon sand and baddeleyite (an oxide-$ZrO_2$) are used via their salts to extract zirconium and hafnium. Normally, all zirconium compounds contain between 1.4% and 3% hafnium. Zircon is very stable at high temperature and has excellent thermal shock resistance, low thermal conductivity and chemical inertness. It finds use chiefly in industries like ceramic, refractory, abrasive, foundry, chemical and speciality alloys. Gem variety of zircon is used in jewellery. Ministry of Mines vide Notification No.S.O.2356 (E) dated 11.07.2016, zircon covered under beach sand minerals was inserted as entry 12 of Part B of the First Schedule to the MMDR Act, 1957.

**Table – 1: Resources of Zircon**

(In million tonnes)

| State | Resources# |
|---|---|
| **Total** | **33.71** |
| Andhra Pradesh | 11.94 |
| Bihar/Jharkhand | 0.08 |
| Gujarat | 0.01 |
| Kerala | 7.83 |
| Maharashtra | 0.01 |
| Odisha | 3.25 |
| Tamil Nadu | 10.20 |
| West Bengal | 0.39 |

***Source:****Department of Atomic Energy, Mumbai*

*# :Inclusive of indicated, inferred and speculative categories. As per letter received from Department of Atomic Energy dated 26.07.2018.*

## RESERVES/RESOURCES

Zircon occurs in close association with other heavy minerals, such as, ilmenite, rutile and monazite in beach sands, along the coastal tracts of the country. Its concentration in the deposits is about 0.6–18.7% of the total heavy minerals. Indian zircons analyse 63–66% $ZrO_2$. AMD has carried out reconnaissance investigation in parts of Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Odisha and West Bengal during 2008-14. The resource estimation in these areas have been carried out up to March 2020. The resources of zircon are placed at 36.56 million tonnes as per Department of Atomic Energy (DAE). However, the Statewise break-up as on March 2020 is not available, so far the breakup of 33.71 million tonnes resources up to 2016 is furnished in Table-1.

## EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Reviews".

## PRODUCTION AND PRICES

Production of zircon increased to 15,600 tonnes in 2019-20 from 11,906 tonnes in the preceding year. The production of zircon is provided in Table-2. Prices of zircon as furnished by IREL and KMML are detailed in Table- 3.

**Table – 2: Production of Zircon**

**2017-18 to 2019-20**

**(In tonnes)**

| Year | Production of Zircon* |
|---|---|
| 2017-18 | 9107 |
| 2018-19 | 11906 |
| 2019-20 | 15600 |

****A reported by Indian Rare Earths Ltd.***

**Table – 3: Prices of Zircon, 2017-18 to 2019-20**

(₹ per tonne)

| Period | Grade | Price | Remarks |
|---|---|---|---|
| **IREL** | | | |
| 2017-18 | Q | 70,215 | - |
| | MK | - | - |
| | OR | 61,638 | - |
| 2018-19 | Q | 1,05,245 | - |
| | MK | 1,03,099 | - |
| | OR | 90,149 | - |
| 2019-20 | Q | 1,06,790 | - |
| | MK | 1,07,032 | - |
| | OR | 95,297 | - |
| **KMML** | | | |
| 2017-18 | Zircon Gr.I | 85,167 | Average |
| | Zircon Gr.II | 80,167 | Average |
| | Zircon Gr.III | 76,167 | Average |
| | Zircon Gr.IV | Nil | |
| 2018-19 | Zircon Gr.I | 1,09,750 | Average |
| | Zircon Gr.II | 1,04,750 | Average |
| | Zircon Gr.III | 1,00,750 | Average |
| | Zircon Gr.IV | 98,500 | Average |
| 2019-20 | Zircon Gr.I | 1,15,000 | Average |
| | Zircon Gr.II | 1,10,000 | Average |
| | Zircon Gr.III | 1,06,000 | Average |
| | Zircon Gr.1V | 1,02,000 | Average |

***Source:*** *Department of Atomic Energy, Mumbai.*

# MINING AND PROCESSING

As per Gazette Notification No. S.O. 2685 dated 27.07.2019, grant of operating rights in any offshore in terms of any reconnaissance permit, exploration licence or production lease of atomic minerals as defined in Part B of the First Schedule of the Mines and Mineral (Development and Regulation Act, 1957 is prohibited to any person, except the Government or Government Company or a Corporation owned or controlled by the Government. The Indian Rare Earths Ltd (IREL), a Government of India Undertaking and Kerala Minerals and Metals Limited (KMML), a Kerala State Government Undertaking, are engaged actively in mining and processing of beach sands in India. Zircon is recovered by these companies as a co-product of mining/dredging of heavy mineral sands which include ilmenite, rutile, leucoxene, monazite, sillimanite and garnet. Beach sand deposits containing these minerals are obtained from coastal tracts of Manavalakurichi in Tamil Nadu, Chavara in Kerala and Gopalpur in Odisha. As such, no deposit is being worked exclusively for zircon alone. For details regarding mining and processing, etc., Review on 'Ilmenite and Rutile' may be referred. Plantwise capacity and production of zircon during 2017-18 to 2019-20 are given in Table- 4.

**Table – 4: Plantwise Capacity and Production of Zircon Ore, 2017-18 to 2019-20**

(In tonnes)

| Company | Location | Specification | Installed capacity** (tpy) | Production | | |
|---|---|---|---|---|---|---|
| | | | | 2017-18 | 2018-19 | 2019-20 |
| **Total** | | | **39000** | **13951** | **-** | |
| Indian Rare Earths Ltd | Manavalakurichi, Kanniyakumari distt., Tamil Nadu | 65% $ZrO_2$+$HfO_2$ (min) | 10000 | * | 2190 | |
| | Chavara, Kollam distt., Kerala | 65% $ZrO_2$+$HfO_2$ (min.) | 17500 | 2649 | 3072 | 11490 |
| | Orissa Sand Complex, Ganjam distt., Odisha | 64.25% $ZrO_2$ (min) | 5000 | 6458 | 6694 | |
| Kerala Minerals & Metals Ltd | Chavara, Kollam distt., Kerala | Zircon Gr.I 64.0% (min.) Zircon Gr.II 62% (min.) | 6500 | 4844 | 4762 | 4110 |

***Source:*** *Respective Producers and Department of Atomic Energy, Mumbai.*

** During 2017-18 plant was not operating from Jan. 17 because of non-availablity of environment clearance.*

*** Excluding the V.V.Mineral's installed capacity of 18000 tpy vide their letter and e-mail dated 09.09.2019 regarding non-operation of mining.*

# INDUSTRY

IREL has set up a dry grinding mill at Chavara, Kerala to produce Zirflour for its application in the Ceramic Industry. A wet grinding mill was also set up at Chavara to produce micro-zir for its specialised application as opacifier. Besides, IREL established a small chemical plant at Manavalakurichi, Tamil Nadu to produce zircon frit, zirconium chloride, etc., primarily for supply of zircon frit to Department of Atomic Energy's Nuclear Fuel Complex (NFC), Hyderabad. A pilot plant (3.5 tpy capacity) was set up at Orissa Sand Complex (OSCOM) to produce a whole range of zirconia stabilised with CaO, MgO and rare earths.

The NFC manufactures and supplies fuel bundles for Pressurised Heavy Water Reactors (PHWRs) and Boiling Water Reactors (BWRs) of NPCIL. Highest ever production of PHWR fuel bundles, Zirconium Oxide, Zirconium sponge and Niobium metal was achieved during the period. The NFC, Hyderabad, has different types of production facilities which include the zirconium oxide plant for processing of zircon to pure zirconium oxide and zirconium sponge plant for conversion of zirconium oxide to pure sponge metal and Zirconium Complex (ZC) at Pazhayakayal, near Thoothukudi, Tamil Nadu. NFC Hyderabad produced 165 tonnes, 424 tonnes and 585 tonnes of zirconium oxide during 2017-18, 2018-19 and 2019-20, respectively. ZC, Pazhayakayal, produced 351 tonnes, 573 tonnes and 454 tonnes of $ZrO_2$ in 2017-18, 2018-19 and 2019-20, respectively. Besides, the Zircaloy Fabrication Plant produces various zirconium alloy tubings and sheet, rod and wire products. The plant also has facilities for reclamation of zircaloy mill-scrap. Zircon sand is processed through caustic fusion, dissolution, solvent extraction (to remove hafnium), precipitation and calcination to obtain zirconium oxide. The pure oxide is then subjected to high temperature chlorination, reactive metal reduction and vacuum distillation to obtain homogeneous zirconium sponge. The sponge is briquetted with alloying ingredients and melted in vacuum to produce zircaloy ingots. The alloy ingots are extruded to convert into seamless tubes, sheets and bars. The total installed capacity and production of zirconium oxide and zirconium sponge plants at NFC and ZC are furnished in Table-5.

Besides, Bhalla Chemical Works Pvt. Ltd operates three plants—two of which are located in Gurgaon, Haryana to manufacture zirconium derivatives ($ZrO_2$), based on imported zircon ore (capacity 10,000 tpy) and zirconium silicate opacifiers (capacity 5,000 tpy). The third plant of the Company in Rajasthan manufactures zirconium oxychloride crystals and special zirconias (capacity 10,000 tpy).

**Table – 5 : Production of Zirconium Oxide and Sponge Plants of DAE at NFC and ZC, 2017-18 to 2019-20**

(In tonnes)

| Plant/Location | Installed capacity (tpy) | Production | | |
|---|---|---|---|---|
| | | 2017-18 | 2018-19 | 2019-20 |
| Zirconium Oxide Plant, NFC, Hyderabad | 600 | 165 | 424 | 585 |
| Zirconium Sponge Plant, NFC, Hyderabad | 400 | - | - | - |
| Zirconium Oxide Plant, ZC, Pazhayakayal | 500 | 351 | 573 | 454 |
| Zirconium Sponge Plant, ZC, Pazhayakayal | 250 | - | - | - |

Source: *Department of Atomic Energy, Mumbai.*

## USES & CONSUMPTION

Zircon's exceptional qualities of hardness and durability make it a must-use for the manufacture of ceramics and refractory tiles and also for a range of other high-tech applications, such as, armour plating on military aircraft, heat shield in space shuttles, potentially as solid oxide fuel cells in hydrogen-powered vehicles and in many industrial & chemical applications. Owing to its chemical inertness, very low heat conductivity, high specific gravity, low expansion, good resistance to abrasion, high melting point and no shrinkage on being heated up to 1,750$^0$ C, zircon is found to be an outstanding refractory material. Zircon finds its application in ceramics, zirconia, chemicals, refractory and foundry & castings which accounts for zircon's total world estimated consumption. Zirconia and Zirconium chemicals can be used for a variety of uses. Yttria-stablised zirconia (YSZ) is used in the manufacture of oxygen sensors that control combustion in automobile engines and furnaces. In Foundry Industry, zircon is used as facing for foundry moulds as it increases the resistance to metal penetration and accords a uniform finish to castings. Zircon sand is preferred to silica sand because of its uniform size, higher melting point, low thermal expansion and resistance to molten metal, acidic chemicals, slag, etc. Zircon containing 64% $ZrO_2$ is used generally for foundry applications. In Ceramic Industry, finely ground high-grade zircon and zirconium dioxide are used as opacifier in melts for vitreous enamelling and as pigment in ceramic glazes. Zirconium oxide is considered as a potential ceramic material for high temperature applications like engine components. Usually, zircon containing 65% $ZrO_2$ is preferred in ceramics. The toughened zirconia finds its use in ceramic coatings in jet aircraft engines and in other applications where strength and high temperature oxidation resistance are important. Zirconia ceramics are also used in automobile sensors for the microprocessor control of engines. In Chemical Industry, its property of high resistance to corrosion is used where dry chlorine, hydrochloric acid and caustic alkalies are involved. Abrasive and grinding wheels made from zircon sands are used for polishing optical glasses. Zircon powder is used as a medium in waterjet cutting machines.

Zirconium and zirconium powders are used in ammunition, primers, detonation caps, flashlight mixtures, radio tubes and in various heating elements. Hafnium-free zirconium metal is used as cladding material in atomic reactors due to its low absorbing cross section for thermal neutron. Green, blue, indigo, red, orange coloured zircon is used as a natural gemstone and also processed to produce cubic zirconia — a synthetic gemstone resembling diamond. Zircon compounds have a very low toxicity and are not perceived as a potential environmental hazard. They are even said to have some medicinal properties and are now increasingly preferred in the manufacture of food products and pharmaceuticals too. It is also widely used in television and computer screens, resistance to corrosion and erosion makes zircon products ideal for use in the Chemical Industry and in desalination plants. Zircon flour is manufactured by milling zircon sand. It is used in ceramic frits, foundry mould coatings, ceramic shells for investment casting, refractories, friction products, insulating fibres and glass. Zircon opacifier are used in refractories and friction products. Zirconium metal or sponge is used mainly in the Nuclear Industry with a requirement for minimum content of hafnium.

Consumption of zircon/zirflour decreased considerably by 17% to 13,829 tonnes in 2019-20 from 16,600 tonnes in 2018-19. The consumption of zircon during the year 2019-20 was only reported by IREL. Consumption of zircon/zirflour during the year 2017-18 to 2019-20 is furnished in Table- 6.

**Table – 6: Estimated Consumption * of Zircon 2017-18 to 2019-20 (By Industries)**

(In tonnes)

| Industry | 2017-18 | 2018-19 (R) | 2019-20 (P) |
|---|---|---|---|
| **All Industries** | **17500** | **16600** | **13829#** |
| Ceramic | 7200 | 6300 | 3963 |
| Refractory | 9700 | 9400 | 1153 |
| Others (Alloy steel,iron& steel, Chemical, foundry, paint and cement) | 600 | 900 | 8751 |

*Figures rounded off.*

** Includes actual reported consumtion and/or estimates made wherever required. Due to paucity of data, coverage may not be complete.*

*# only reported by IREL.*

## RESEARCH & DEVELOPMENT

Various R&D studies have been conducted by R&D Laboratory, OSCOM, Department of Atomic Energy, to improve the metallurgical performance of mining and mineral separation plants. As a result throughput of the plants has increased and the grade and recovery of heavy minerals in concentrate has been enhanced. The two most outstanding contributions of this laboratory in the areas of value addition are development of new process flow sheets for the preparation of synthetic rutile from OSCOM ilmenite and zirconia from zircon.

IREL Technology Development Council (IRELTDC) has been formed with an objective of promoting industrial scale R & D that would be beneficial to the overall programme of DAE in both strategic and non-strategic fields utilizing mineral & value added products of IREL.

## POLICY

Zircon was earlier classified as a 'prescribed substance', as per notifications issued under Atomic Energy Act, 1962. From the revised list notified vide S. O. No. 61(E), dated 20.1.2006, zircon has been deleted, subject to the condition that the mineral shall remain a prescribed substance till the policy on exploration of beach sand minerals notified on 6.10.1998, is adopted/revised/modified by Ministry of Mines or till 1.1.2007, whichever occurs earlier and shall cease to be so thereafter. Recently, vide Notification No.S.O.2356(E) dated 11.07.2016, zircon covered under beach sand minerals was inserted as entry 12 after entry 11 of Part B of the First Schedule to the MMDR Act, 1957. As per the Foreign Trade Policy, 2015-20, the export and import of zirconium ores and concentrates under ITC ( HS) Code 26151000 are freely allowed. The notification reads:

S.O. 1592(E)—In pursuance of Clauses (f) and (g) of Sub-section (1) of Section 2 and Section 3 of the Atomic Energy Act,1962 (No. 33 of 1962) and in supersession of the notifications of the Government of India in the Department of Atomic Energy vide Number S.O. 61(E) dated 20th January 2006, the Central Government hereby notifies the substances, equipment and technology specified in the Schedule appended hereto as 'Prescribed Substances, Prescribed Equipment and Technology'.

Under Category 0A303 and under Heading Nuclear materials, nuclear-related other materials, equipment and technology—"Zirconium with hafnium content of less than 1 part to 500 parts of zirconium by weight (i.e. less than 2,000 ppm) in the form of metal, alloys containing more than 50% zirconium by weight, compounds, manufactures thereof, waste or scrap of any of the foregoing".

G.S.R. 134(E) dated 20.02.2019 — In exercise of the powers conferred under Section 11B of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957) and Rule 36 of the Atomic Minerals Concession Rules, 2016, the Central Government hereby makes the following amendments further to amend the Atomic Minerals Concession Rules, 2016, namely—

2. (1) These rules may be called the Atomic Minerals Concession (Second Amendment) Rules, 2019.

(2) They shall come into force on the date of their publication in the Official Gazette.

3. In the Atomic Minerals Concession Rules, 2016, for Schedule A, the following Schedule shall be substituted, namely—

**PARTICULARS OF THRESHOLD VALUE FOR ATOMIC MINERALS**
**[See Rule 2 (1) (m) and Rule 36]**

| | | |
|---|---|---|
| 10. | Uranium bearing tailings left over from ores after extraction of copper and gold, ilmenite and other titanium ores. | 60 ppm $U_3O_8$ and/or 250 ppm $ThO_2$. |
| 11. | Zirconium bearing minerals and ores including zircon. | All cases of zirconium-bearing minerals occurring in Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e. the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade.<br>In other cases, zircon containing less than 2,000 ppm of Hafnium. |
| 12. | Beach Sand Minerals, i.e., economic heavy minerals found in the teri or beach sand, which include ilmenite, rutile, leucoxene, garnet, monazite, zircon and sillimanite. | All cases of Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e., the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade. |

# WORLD REVIEW

World reserves of zirconium are placed at 64 million tonnes in terms of $ZrO_2$. The world's largest reserves are with Australia (67%), South Africa (10%) and Mozambique (3%). The world production of zirconium minerals was estimated at 1.34 million tonnes in 2019 which increased by 9.5% as against 1.22 million tonnes in the previous year . Australia (35%), South Africa (28%) and USA & Mozambique (7% each) are the principal producers of zirconium minerals (Tables- 7 & 8).

**Table – 7: World Reserves of Zirconium (By Principal Countries)**

(In '000 tonnes of $ZrO_2$)

| Country | Reserves |
|---|---|
| **World: Total (rounded off)** | **64,000** |
| Australia | 43,000[a] |
| China | 500 |
| Indonesia | NA |
| Kenya | 55 |
| Mozambique | 1,800 |
| Senegal | NA |
| South Africa | 6,700 |
| USA | 500 |
| Other countries | 11,000 |

***Source:*** *USGS, Mineral Commodity Summaries, 2021.*
*[a]For Australia, Joint Ore Reserves Committee-compliant reserves were 22.1 million tonnes.*

**Table – 8 : World Production of Zirconium Minerals (By Principal Countries)**

(In tonnes)

| Country | 2017 | 2018 | 2019 |
|---|---|---|---|
| **World: Total (rounded off)** | **1399000** | **1221000** | **1337000** |
| Australia [(i)] | 583339 | 414672 | 472009 |
| South Africa* | 377000 | 350000 | 370000 |
| USA | 80000 | 100000 | 100000 |
| Mozambique | 74000 | 76600 | 87100 |
| Indonesia [(d)]* | 29000 | 54000 | 73000 |
| Senegal | 61562 | 64278 | 58432 |
| Kenya | 65324 | 36604 | 48356 |
| China* | 33500 | 33500 | 33500 |
| Madagascar | 21000 | 22757 | 28500 |
| Other countries | 74771 | 68145 | 66566 |

***Source:*** *BGS, World Mineral Production, 2015-19.*
***Note:*** **) Estimate*
*(i) Years ended 30 June of that stated.*
*(d) Conservative BGS estimates, based on exports.*

Although zircon inventories and production were sufficient for global demand at the beginning of 2017, Iluka's suspension of operations at the Jacinth-Ambrosia Mine, which began in April 2016 and continued until December 2017, contributed to a tightening of zircon supply, which was evident at year-end. Owing to depleted supplies, shortages of zircon resulted in the increased prices of downstream products.

To provide a generalised view of the development in various countries, country-wise description as sourced from latest available publication of Minerals Yearbook 'USGS' -2017 is furnished below :

## Australia

Iluka produced 3,12,000 t of zircon from its operations in Australia, a decrease of 10% from that of 2016. In December, Iluka announced the resumption of mining activity at the Jacinth-Ambrosia Mine in the Eucla basin of South Australia. Iluka had suspended mining activities at the mine in April 2016 to draw down the heavy-mineral-concentrate inventory held there. Jacinth-Ambrosia was the primary source of zircon for Iluka. Also in December, the Cataby project in Western Australia was approved. With a projected mine life of 8.5 years, zircon production was anticipated to average about 50,000 tonnes per year and was expected to begin in the second quarter of 2019. MZI Resources Ltd produced 18,341 t of zircon concentrate at its Keysbrook project in Western Australia, an increase of 15% from that of 2016. Tronox Ltd produced 34,000 t of zircon from its Cooljarloo Mine in Western Australia, an increase of 6% from production in 2016. The total heavy-mineral reserves at year-end 2017 for Tronox's operations in Western Australia was 481 Mt of ore containing 11.1 Mt of heavy minerals and 1.2 Mt of zircon, a 4% decrease from reported reserves at year-end 2016. Sheffield Resources Ltd obtained multiple offtake agreements to account for almost all its zircon and zircon concentrate production during the first 4-year phase of its Thunderbird project. Production of zircon in the first year was expected to be about 80,000 t, which would gradually be scaled up to

1,10,000 t in the fourth year of production. Contingent on financing, Sheffield was expecting to commence production at Thunderbird in 2020.

### China

As the leading consumer of zirconium mineral concentrates, China imported 1.01 Mt in 2017, a decrease of 4% from 1.05 Mt imported in the previous year. During the year, many zircon consumers shut down operations to perform plant modifications to ensure compliance with environmental policies.

### Kenya

Base Resources Ltd produced 42,200 t of zircon from its Kwale operation in 2017, a decrease of 3% from that of 2016. The Kwale Phase 2 mine project was approved in May and was designed to increase the input of heavy-mineral concentrate into the mineral separation plant to maintain output of finished products despite declining ore grades for the remaining life of the mine.

### Madagascar

Base Resources announced an agreement with World Titane Holdings, Ltd to acquire an initial 85% interest in the Toliara Mineral Sands project. If the project proceeds to mine development, Base Resources planned to acquire the remaining interest in the project. Measured and indicated resources were 612 Mt containing 6.7% heavy minerals. A decision to begin construction was expected in the second half of 2019.

### Mozambique

Kenmare Resources plc produced 74,000 t of zircon in 2017, an increase of 9% from that of 2016. Increased production of heavy-mineral concentrates (HMC) was attributed to improved dredge and dry mining techniques.

### Senegal

Mineral Deposits Ltd produced 81,750 t of zircon, an increase of 55% from that of 2016, owing to the introduction of medium-grade zircon sand to the company's product line, which added an additional 20,200 t of zircon production in 2017.

### South Africa

Tronox produced 1,21,000 t of zircon from its Namakwa Sands operation and 46,000 t of zircon from its KZN Sands operation in South Africa, adding to a total of 1,67,000 t, an increase of 2% from that in 2016. The total reported reserves at year-end 2017 for Tronox's operations in South Africa was 864 Mt of ore containing 54.7 Mt of heavy minerals, a 6% decrease from those at year-end 2016.

In 2017, Mineral Commodities Ltd produced 22,111 t of zircon-rutile concentrate, containing 71% zircon and 18% rutile, at its Tormin Mine in Western Cape Province, a 38% decrease in production from that in 2016. Although the amount of ore processed was greater than that in 2018, the zircon and rutile ore grades decreased from those of 2017. The Company's production guidance for 2018 was projected to range from 20,000 to 25,000 t of zircon-rutile concentrate.

### Tanzania

In October, Strandline Resources Ltd announced the maiden ore reserves for its Fungoni heavy-mineral-sands project. Using a cut-off grade of 1.5% heavy minerals, reserves were estimated to contain 3.9% heavy minerals and were estimated to support a mine life of 6.2 years.

## FOREIGN TRADE

### Exports

Exports of zirconium ores and concentrates decreased drastrically by 99% to one tonne in 2019-20 from 89 tonnes in the previous year. Exports were mostly to Austria and meagre quantity to Germany. Exports of zirconium and scrap also sharply decreased by 75% to one tonne in 2019-20 as against 4 tonnes in 2018-19. Exports of zirconium waste & scraps were at only one tonne in 2019-20 as compared to 3 tonnes in the preceding year (Tables-9 to 12).

### Imports

Imports of zirconium ores and concentrates decreased by 26% to 56,168 tonnes in 2019-20 from 76,078 tonnes in the previous year. Main suppliers were Australia (33%), Indonesia (25%) , Malaysia (16%) and South Africa (15%). Imports of zirconium and scrap drastrically decreased by 33% to 41 tonnes in 2019-20 as against 61 tonnes in 2018-19. Imports were mainly from China (68%), Germany & Sweden (10% each).

Similarly imports of zirconium waste & scrap also decreased substantially by 33% to 40 tonnes in 2019-20 as compared to 60 tonnes in the preceding year. Imports were only from China (70%) and Germany & Sweden (10% each) & remaining quantity was contributed by USA, UK & Malaysia (Tables-13 to 16).

**Table – 9: Exports of Zirconium Ores & Conc. (By Countries)**

| Country | 2018-19 (R) | | 2019-20 (P) | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **89** | **4470** | **1** | **78** |
| Austria | - | - | 1 | 78 |
| Germany | - | - | ++ | ++ |
| Italy | 72 | 2378 | - | - |
| Bangladesh | 10 | 1243 | - | - |
| UAE | 6 | 676 | - | - |
| Israel | 1 | 158 | - | - |
| Korea, Rep. of | ++ | 7 | - | - |
| UK | ++ | 7 | - | - |
| USA | ++ | ++ | - | - |

*Figures rounded off*

**Table – 10: Exports of Zirconium & Scrap (By Countries)**

| Country | 2018-19 (R) | | 2019-20 (P) | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **4** | **18427** | **1** | **21799** |
| Taiwan | - | - | ++ | 6510 |
| USA | ++ | 4476 | ++ | 5834 |
| Iraq | ++ | 2967 | ++ | 3399 |
| Australia | ++ | 985 | ++ | 2409 |
| Israel | ++ | 40 | ++ | 792 |
| Saudi Arabia | ++ | 271 | ++ | 676 |
| Korea, Rep. of | - | - | ++ | 425 |
| UK | - | - | ++ | 409 |
| Qatar | - | - | ++ | 190 |
| Ukraine | ++ | 179 | ++ | 186 |
| Other countries | 3 | 9508 | ++ | 970 |

*Figures rounded off*

**Table – 11: Exports of Zirconium Waste & Scrap (By Countries)**

| Country | 2018-19 (R) | | 2019-20 (P) | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **3** | **10386** | **1** | **13252** |
| USA | ++ | 1161 | ++ | 5336 |
| Taiwan | - | - | ++ | 4267 |
| Australia | ++ | 985 | ++ | 2409 |
| UK | - | - | ++ | 409 |
| Korea, Rep. of | - | - | ++ | 241 |
| Qatar | - | - | ++ | 190 |
| Sweden | - | - | ++ | 124 |
| Nepal | ++ | 25 | ++ | 109 |
| Spain | - | - | ++ | 58 |
| Turkey | - | - | ++ | 47 |
| Other countries | 3 | 8216 | ++ | 64 |

*Figures rounded off*

**Table – 12: Exports of Zirconium Unwrought Powder (By Countries)**

| Country | 2018-19 (R) | | 2019-20 (P) | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **1** | **8040** | **1** | **8547** |
| Iraq | ++ | 2967 | ++ | 3399 |
| Taiwan | - | - | ++ | 2243 |
| Israel | ++ | 40 | ++ | 792 |
| Saudi Arabia | ++ | 271 | ++ | 676 |
| USA | ++ | 3315 | ++ | 498 |
| Ukrain | ++ | 179 | ++ | 186 |
| Canada | - | - | ++ | 185 |
| Korea, Rep. of | - | - | ++ | 184 |
| Germany | - | - | ++ | 165 |
| Finland | - | - | ++ | 165 |
| Other countries | ++ | 1267 | ++ | 100 |

*Figures rounded off*

**Table– 13: Imports of Zirconium Ores & Conc.**
**(By Countries)**

| Country | 2018-19 (R) | | 2019-20 (P) | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **76078** | **8084379** | **56168** | **6073419** |
| Australia | 30712 | 3275809 | 18325 | 1962060 |
| Indonesia | 5681 | 613308 | 14289 | 1518753 |
| Malaysia | 19335 | 2106280 | 9096 | 1030308 |
| South Africa | 12237 | 1244162 | 8292 | 889071 |
| USA | 3038 | 328270 | 2624 | 308137 |
| Sri Lanka | 400 | 45981 | 1535 | 153831 |
| Ukraine | 476 | 39541 | 802 | 82718 |
| Senegal | 2916 | 292670 | 764 | 82541 |
| China | 601 | 66734 | 204 | 19765 |
| Thailand | 103 | 7897 | 104 | 10517 |
| Other countries | 579 | 63728 | 132 | 15718 |

*Figures rounded off*

**Table – 14: Imports of Zirconium & Scrap**
**(By Countries)**

| Country | 2018-19 (R) | | 2019-20 (P) | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **61** | **108309** | **41** | **97661** |
| Sweden | - | - | 4 | 33689 |
| Germany | 9 | 28919 | 4 | 2050 |
| France | - | - | 2 | 1148 |
| USA | 5 | 19585 | 1 | 9405 |
| China | 43 | 36145 | 28 | 7926 |
| UK | ++ | 827 | 1 | 5247 |
| Italy | ++ | 7670 | ++ | 3073 |
| Canada | ++ | 11 | ++ | 1767 |
| Japan | ++ | 1113 | ++ | 1716 |
| Malaysia | 2 | 5468 | 1 | 1435 |
| Other countries | 2 | 8571 | ++ | 1408 |

*Fgures rounded off*

**Table – 15: Imports of Unwrought Powders (By Countries)**

| Country | 2018-19 (R) | | 2019-20 (P) | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **1** | **6949** | **2** | **10835** |
| France | - | - | 2 | 10787 |
| China | - | - | ++ | 35 |
| UK | - | - | ++ | 14 |
| Germany | 1 | 6683 | - | - |
| Vietnam | ++ | 266 | - | - |

*Figures rounded off*

**Table – 16: Imports of Zirconium Waste & Scrap (By Countries)**

| Country | 2018-19 (R) | | 2019-20 (P) | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **60** | **101360** | **40** | **86826** |
| Sweden | - | - | 4 | 33689 |
| Germany | 8 | 22236 | 4 | 20507 |
| USA | 5 | 19585 | 1 | 9405 |
| China | 43 | 36145 | 28 | 7891 |
| UK | ++ | 827 | 1 | 5233 |
| Italy | ++ | 7670 | ++ | 3073 |
| Canada | ++ | 11 | ++ | 1767 |
| Japan | ++ | 1113 | ++ | 1716 |
| Malaysia | 2 | 5468 | 1 | 1435 |
| Austria | 2 | 8044 | ++ | 1408 |
| Other countries | ++ | 262 | ++ | 700 |

*Figures rounded off*

# FUTURE OUTLOOK

The development of digital printing of ceramic tile pattern has the potential to increase demand since higher zircon content of the base tile is required to impart aesthitically appealing product and to optimise the cost of the digital printing process.

TZ Minerals International Pty Ltd, a major industry analyst of the zircon and Titanium Mineral Sands Industry, expected global zircon demand to increase by 3% to 4% per year from 2015 to 2020.

Zircon and Zirflor are the key ingredients in ceramics, foundry and refraction and are likely to see growth path on account of Government of India's thrust for 'Housing for all'.