A REVIEW ON SAND MINING IN COASTAL AREAS OF KERALA

A. SANDEEP KUMAR[1], BAPSON STANLY[2], M. C. YESHWANTH ASHOK[3], NANDITHA KURIAN[4], NITHA MATHEW[5]

[1]Assistant professor, [2, 3, 4, 5] B. Tech, final year students,
Department of Mining Engineering,
Godavari Institute of Engineering and Technology (A), Rajahmahendravaram, Andhra Pradesh, India

Abstract **-** Mining is extremely vital in today's world, as demand for metals and minerals continues to rise. Sand mining is a method of extracting sand, usually through an open pit. Sand is mined from beaches, inland dunes, and ocean and river beds, among other places. Sand contains a variety of valuable minerals, including rutile, ilmenite, and zircon, which contain the industrially useful elements titanium and zirconium. These minerals are frequently found in combination with regular sand. There are several firms in India that deal with sand mining and mineral extraction, and one of the well-known sand mining firms is KMML (Kerala Minerals and Metals Ltd). KMML is a titanium dioxide production firm in Kollam, Kerala, India. This research entails a thorough investigation of KMML's sand mining methods. It includes the extraction method, the technology used, and the principal minerals extracted from beach sand mining. Environmental implications, social and economic difficulties, and natural resource depletion due to sand mining techniques in and near KMML mining locations, such as Alappad, are the focus of the project. The mining processes and machinery is studied and the scope for improvement of the sand mining industry is being investigated.

Index terms**: Sand mining, beach sand, rutile, ilmenite, zircon, KMML, environmental impacts**

1. INTRODUCTION

Sand is a loose granular substance that forms as a result of rock erosion. Beaches, riverbeds, and deserts are all typical places to find it. Many industrially valuable minerals, such as monazite, rutile, and ilmenite, can be recovered from sand. Sand mining is the process of extracting sand from beaches, inlet dunes, and ocean and river beds, primarily through an open pit. Beach sand mining has made a substantial contribution to India's mineral resources. In Kerala, beach sand mining is utilised to collect rutile, ilmenite, and zirconium. The mining methods of Kerala Minerals and Metal Ltd (KMML), Kollam, were the focus of this investigation. KMML is focused on beach sand mining in the coastal parts of Kerala's Kollam districts. This project covers mineral extraction, machinery, minerals obtained from beach sand mining, the relevance of sand mining, and its impact on the region's environmental, social, and economic elements. The dangers and difficulties of sand mining, as well as measures for limiting environmental repercussions, are investigated. The future of the beach sand mining sector, as well as clearance and financial difficulties, are also investigated.

Fig.1: Beach sand

1. 1. Importance of sand mining

Sand is one of the world's most widely used natural resources. It has become a critical component in numerous industries, including the construction industry. Sand obtained from sand mining can be used in a variety of ways. Some of them include:

- Concrete
- Moulding
- Sandbags
- Lime sand brick
- Drainage
- Filters
- Fertilizer fillers
- Highways and road traction
- Golf courses
- Sands for construction and paving
- Beaches
- Paved Roads
- Volleyball courts
- Arena flooring
- Land reclamation
- Fracking
- Sandboxes in playgrounds
- Glass
- Paint
- Petroleum Fracking
- Mortar

1. 2. Minerals obtained from beach sand mining

Ilmenite and rutile are two economically important minerals found in beach sand. Leucoxene, monazite, zircon, garnet, and sillimanite are examples of minerals obtained from beach sand. These minerals are called beach sand minerals

(BSM). These minerals are used in atomic energy as well as other sectors. The table below lists some of the minerals' industrial applications.

Table. 1: Beach sand minerals and their uses.

Name of mineral	**Industrial use**
Ilmenite, Rutile Leucoxene:	Titanium pigment, Desalination plant, Welding rod flux, Aircrafts, Titanium metal production
Zircon	Cladding material for nuclear fuel, Pigments for ceramic, Refractories Zirconium metal production
Monazite	Source for thorium and REEs. Thorium is used as a fuel in nuclear power programs and REE has use in hi-tech applications.
Garnet:	Abrasives, Water filtration industries Artificial building stones
Sillimanite	Refractories

Mainly obtained products from beach sand mining by KMML are;

- Titanium Dioxide Pigment (Rutile)
- Magnesium Chloride
- Nano Titanium Dioxide Pigment (Rutile)
- Titanium Tetra Chloride
- Ilmenite
- Monazite
- Sillimanite
- Zircon
- Leucoxene
- Rutile
- Titanium Sponge

1. 3. Impacts of sand mining

Some of the main impacts are;

- Environmental impacts
- Social impacts
- Economic impacts

Environmental impact:

The loss of sand in the streambed along coastal areas causes rivers and estuaries to deepen, as well as the enlargement of river mouths and coastal inlets. There's a danger that saltwater water from the neighboring sea will sweep in. and mining may have an impact on the nearby groundwater system. Sand mining affects aquatic habitat, resulting in decreased fisheries productivity, biodiversity, and recreational value.

Social impacts:

In several places, sand mining has resulted in the full devastation of beaches and adjacent ecosystems, as well as severe damage to coastal protection and tourism. Even after kilometers of beach have been stripped of sand, mining continues in some locations, limiting the possibility of a tourism-based economy. Beach sand mining has a detrimental societal impact due to the loss of coastal aesthetics. Poverty, corruption and Un regularity developments are some of the local issues that arise as a result of sand mining.

Economic impacts:

Various sand mining industries employ a vast number of people, both skilled and unskilled. It aids in the development of the economy and the creation of jobs. Infrastructure and the supply of society's vital raw materials.

1. 4. Strategies to limit environmental impacts

To protect the environment, the government has issued an order prohibiting sand mining without first obtaining sufficient environmental approval. To reduce the environmental impact of sand mining, scientists apply scientific mining techniques and environmentally friendly management approaches. The Indian government has created a mining surveillance system (MSS) to help state governments monitor illegal mining activities by utilizing space technology. “Sustainable sand mining management guidelines 2016” has been announced by the Ministry of Environment, Forestry, and Climate Change. Environmental impact assessment (EIA) and strategic environment assessment (SEA) are two techniques used to assure environmental sustainability. Some other methods to ensure protection of environment are;

- Strictly follows the environment protection rules and regulations
- Manage and continually improve the processes and activity
- Prevent pollution by controlling the impacts on land, air and water.
- Optimize the use of resources

1. 5. Risk and Challenges

Illegal and unscientific sand mining is one of the most significant concerns facing the sand mining business. Because sand is in such great demand in construction, sand mining is an extremely profitable enterprise. Illegal extraction thrives as a result of this. Sand mining has sparked a variety of demonstrations and movements. Protests against sand mining by members of the DMDK and PMK near Vaipar, Madurai, as well as the protest at Abhipur village, Panjab, are examples. Another major anti-sand mining protest took occurred in Alappad, Kerala. In response to sand mining, other environmental movements have sprung up. The sand mining sector also has to contend with the sand mafia. The supreme court has ruled that sand mining cannot take place without the authority of the central government. But it hasn't actually succeeded; instead, a number of strange deaths of people who tried to stand up to the sand mafia have occurred.

1. 6. Clearance issues

To conduct out sand mining operations, environmental approval is required. Authorities examine potential environmental implications during the environmental clearance procedure. Complicated clearance processes can put mine owners under a lot of financial stress. The mine owner is responsible for obtaining all approvals and adhering to the terms of the clearance letter. The production of a District Survey Report (DSR) is the first stage before a mining lease is granted, according to the "sustainable sand mining standards, 2016." A six-monthly environmental clearance report must be posted on the Ministry of Environment, Forestry, and Climate Change's website.

2. LITERATURE REVIEW

Sekhar L.K and Jayadev S.K (2003): In the study, the researchers try to comprehend the situation prevailing in the 17-km stretch of state-owned land from Valiyazhikkal to Thottappilly in Alappuzha district, which is leased to Kerala Rare Earths and Minerals Limited (KREML), a joint sector company, to conduct mineral sand mining. The study also attempts to quantify the severity of the social, environmental, and health risks that could arise from a profit-driven company's indiscriminate mining activity.

P. R. Arun et. al (2006): The present paper deals with the impact of sand mining on the physical and biological environments of river systems of Kerala. A few suggestions are made to improve the overall environmental condition of Kerala's River basins.

Sreedharan et. al (2011): The demand for construction grade sand is increasing in many parts of the world due to rapid economic development and subsequent growth of building activities. This, in many of the occasions, has resulted in indiscriminate mining of sand from instream and floodplain areas leading to severe damages to the river basin environment. The case is rather alarming in the small catchment rivers like those draining the southwestern coast of India due to limited sand resources in their alluvial reaches. Therefore, a scientific assessment is a prerequisite in formulating management strategies in the sand mining-hit areas.

M. Naveen Saviour (2012): This article discusses the direct and indirect impacts due to soil and sand mining to the environment in Indian regions. Pollution of the water is evident by the coloration of water which is mostly seen in the rivers and streams in the mining area varying from brownish to reddish orange.

Binoy Aliyas Mattamana et. al (2013): The indiscriminate and unscientific sand mining has become a serious environmental threat to the river systems of Kerala. The present study focuses on the determination of sand inflow in different stretches of the Periyar River and thereby optimizing the sand removal by considering several socio- economic and topographical features.

Shaji J and Dr. R Anilkumar (2014): The study conducted in the Neyyar river basin shows that indiscriminate and illegal sand mining has created many problems in the environmental setting and water quality of the river basin. In the basinal area, it has created certain negative impacts on land use, landscape and land stability. Apart from these impacts on physical environment of the river basin, it has also contributed many adverse impacts on the socio- economic wellbeing of the area.

3. METHODS

There are different types of sand mining such as mining in beach areas and inland mining. Beach sand is usually collected by open cast method, along the seashore, beach washings are collected to a depth of 30 cm. After this, the mined-out area is brought to its previous height by deposition of minerals due to wave and tidal actions. An excavator or Toyo pumps are used to move sand from the beach's inland portions without drilling or blasting. The minerals processing mainly consist of 4 steps;

- Reduction and leaching of raw ilmenite to titanium dioxide
- Ilmenite Beneficiation
- Regeneration of spent HCl
- Beneficiated ilmenite is converted to titanium dioxide.

Beach washing refers to the sand that is washed onto the beach by the waves every day. These are the raw ingredients used by KMML to create its goods. The manufacturing facility at KMML includes the following units;

- **Mineral separation (MS) unit**

Mining KMML's block no. 3 is used to collect raw sand. The mineral makeup of raw sand varies. Low-grade sand is sent to pre-concentration units for primary upgradation, whereas rich sand is carried directly to the mineral separation unit. For the separation of precious minerals from raw sand, plants such as a wet mill, a dryer, a dry mill, a rutile recovery plant, and a zircon-sillimanite plant were erected. The mineral-rich sands collected from captive beaches are first transported to the Mineral Separation Unit (MS Unit), where Ilmenite, Rutile, Leucoxene, Monazite, Sillimanite, and other minerals are separated from the beach sand.

- **Acid regeneration plant**

The spent leach liquor from the pre-concentrator is treated in the spray roaster, which uses burning oil to heat the liquid spray entering the furnace. Metal oxides and hydrochloric acid are formed as the wasted liquor decomposes. The vapour of hydrochloric acid is cooled in the pre-concentrator before being absorbed in the wash liquid.

- **Oxygen plant**

This plant produces oxygen that is 99.98 percent pure. The Oxygen Plant takes in air, purifies it, liquefies it, and separates it into oxygen and nitrogen, which is then used. In addition to this plant, we have a PSA (Pressure swing adsorption) oxygen plant that produces 300 NM3/hr of oxygen with a purity of 95% to 96%.

- **Ilmenite beneficiation plant**

Raw Ilmenite (RI) with a Titanium Dioxide level of 58-60% is beneficiated to a Titanium Dioxide content of 90 percent. The Pigment Production Plant uses beneficiated Ilmenite (BI) as its starting material. In the Roaster, high

temperatures are applied to the ferric oxide in the RI. The Fe_2O_3 is converted to a form that can be leached, called FEO. The cooled reduced ilmenite (ReI) is then delivered to digesters, where it is leached using 18–20 percent hydrochloric acid. The spent leach liquor is collected and placed in storage tanks. After washing and filtration, the leached Ilmenite is harvested to produce beneficiated Ilmenite.

- **Pigment production plant**

The mineral separation unit delivers raw ilmenite to the titanium producing facility for further processing. The ilmenite beneficiation complex, which includes a regeneration plant, pigment manufacturing plant, oxygen plant, and other facilities, processes ilmenite in stages.The KMML Titanium dioxide facility is the world's first fully integrated Titanium dioxide factory. Titanium Dioxide is primarily obtained from the ocean.

- **Utility section**

The Boiler Plant is part of the Utility Section of our Manufacturing Facility. There are two main boilers and one packaged boiler to choose from. At an air compressor station, there is a water treatment and DM plant.

Ilmenite, Rutile, Leucoxene, Monazite, Sillimanite, and other minerals are separated from beach sand by the Mineral Separation Unit (MS Unit) of KMML. For mineral separation from sand, the MS Unit uses Gravitational, Magnetic, and High-Tension Electrostatic Techniques. The titanium dioxide pigment unit, on the other hand, is where the titanium dioxide is made. KMML is India's first and only chloride-process manufacturer of Rutile Grade Titanium dioxide. Raw Ilmenite is chemically processed to remove impurities like iron, resulting in a pure, white colour.By

treating titanium ores with chlorine gas, the chloride process creates TiO_2. To complete the recovery of Titanium Tetrachloride, the chlorides of contaminant metals are eliminated by several procedures.

It is then distilled to obtain pure Titanium Tetra Chloride in liquid form, which is then stored in storage tanks. In the Oxidation Plant, Titanium Tetrachloride is vaporised, preheated, then oxidised with oxygen to produce raw Titanium Dioxide at a high temperature.The Pigment Production Plant's raw ingredient is Beneficiated Ilmenite (BI). In the Chlorination Plant, BI from the Ilmenite Beneficiation Plant is chlorinated to produce Titanium Tetra Chloride (Tickle). In a fluidized bed chlorinator, chlorine combines with titanium dioxide and other metallic oxide impurities in BI in the presence of petroleum coke at a temperature of 9000 degree celcius to form chlorides of titanium and other impurities metal.In the Pigment Surface Treatment & Finishing Plant, the raw Titanium Dioxide is classed and surface treated with various chemicals, filtered and washed to remove salts, then transferred to the dryer and finally to the micronizer. Then, the titanium dioxide pigment is packaged.

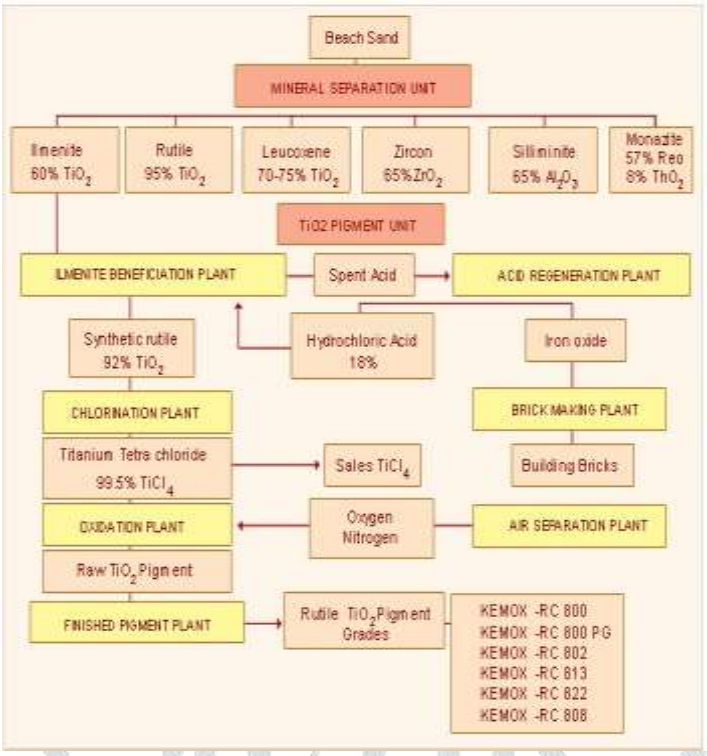

Fig.2: Conversion process of ilmenite to TiO2

4. CONCLUSION

Sand is one of the most consumed natural resources on earth. A number of economically important minerals are obtained from beach sand. The study shows that the use of beach sand minerals for titanium sponge production can contribute greatly towards the development of the country's economy. Also through this study it is understood that illegal mining and sand mafia are some of the main threats faced by the mining industry. By making stricter rules and ensuring that these rules are followed, can help to reduce the problems and losses caused by illegal mining. By strictly following the rules, the negative environmental and social impacts caused by sand mining can also be reduced tremendously. The advent of technology has opened up a slew of new opportunities and approaches for improving the sand mining sector in Kerala. With the aid of automation, robotics, the internet, artificial intelligence, and other technology, the sand mining industry has a possibility to improve in the future.

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Author state that the research was conducted according to ethical standards

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CONFLICT OF INTEREST

None declare

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