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Scope for beneficiation of heavy minerals in the state of Odisha, India

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Introduction

Beach sand minerals are placer deposit minerals which essentially consist of heavy minerals such as ilmenite, leucoxene, rutile, zircon, sillimanite, garnet, monazite etc. The beach and inland sand deposits exhibit a considerable variation in mineralogy depending on the location.

In India the highest concentration of total heavy minerals in beach sand is found in the Chavara deposits (~50% – 80%THM) and Manavalakurichi deposits (~39%THM) contain 2% to 6% zircon concentration. The Chatrapur deposit (20%–22%THM) contains 0.2% to 0.4% zircon.

The west coast of India particularly the states Kerala and Tamil Nadu own beach mineral producing plants: namely, IREL Chavara, Kerala Minerals and Metals Ltd (KMML), IREL Manavalakuruchi, VV Minerals and Beach Sand Minerals. In contrast to this the southeastern coast of India has only three beach sand plants: namely IREL Chatrapur, Trimex India Pvt. Limited and Trans World Garnet. Trans World Garnet plant produces only garnet minerals. Although the southeastern coast of India possess large tonnage resources of industrial minerals with a long coastline of 1460km (Odisha and Andhra Pradesh), the scope to exploit the resources is limited. In view of this, an attempt has been made to highlight the advantages and thereby study and recommend beneficiation plants on deposits of southeastern coast of India.

Researchers focussed on the beach and inland deposits of India. Ilmenite-rich major beach and dune sand deposits occur in the coastal stretches of Kerala (Chavara), Tamil Nadu (Manavalakurichi, Midalam, Vayakallur), Andhra Pradesh (Kakinada, Pentakota, Bhimunipatnam, Konada-Kandivalasa-Mukumpeta-Bendicreek-Donkuru), Odisha (Sanaeka-Sangi-Gopalpur, Chatrapur, Bajarkot, Satpara and Puri) and Maharastra (Kalbadevi, Newre and Malgund).[1]

Investigators collected sample from Kontiagarh placer deposit in the Ganjam district, Odisha, India to study the heavy mineral deposits in this area. His team found that the average heavy mineral content in the beach and dunes vary from 9.38% to 24.2%.[2]

Many authors have studied the heavy mineral deposits of Odisha, but no literature is found related to heavy mineral deposits of Konark-Ramachandi coast and their recovery.[3–8]

As a study, beach and dune sand samples were collected along Konark to Ramchandi coastal stretch, Puri district, Odisha, India (Lat.17°49'–22°34'N and Long.81°29'-87°29'E) and Ganjam coast, Odisha, India (Lat 19°15'–19°30' N and long 84°45'–85°15'E). The Geographical location of sampling areas is shown in Figure 1.

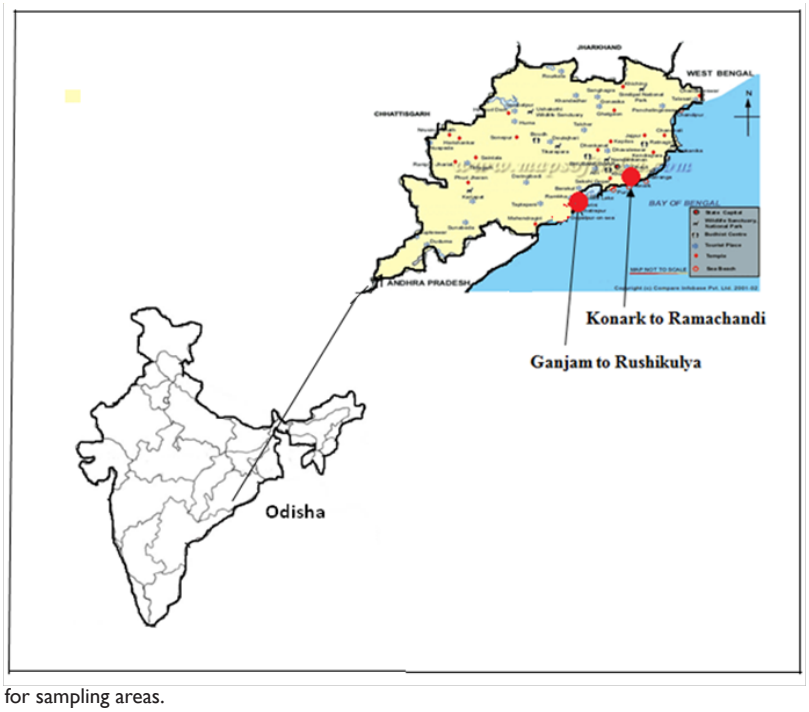

Figure 1 Geographical location for sampling areas.

The physical characterization such as bulk density, true density, porosity, angle of repose, size analysis, sink-float analysis were done for all samples. The true density value for beach sand samples varies from 2.88g/cm^3 to 2.9g/cm^3 and for dune sands it varies from 2.76g/cm^3 to 2.8 g/cm^3. The THM content of beach sand samples vary from 16.8% to 18.2% and for dune sand THM varies from 9.9% to 12.3%. It is observed that the true density and THM content of beach sand samples is higher than dune sand samples. The data also indicate that with increase in THM content, the true density value increases. This is because the heavy minerals possess high specific gravity value; hence with increase in amount of heavies the specific gravity or true density of that sample also increases. Figure 2 shows the Geomorphologic features and mineral concentration at study areas.

Figure 2 Geomorphologic features and mineral concentration at different beach of present study areas.

The modal analysis of THM of Konark-Ramachandi composite bulk sample shows that it contains 44.12% limonite, 31.5% garnet, 19.94% sillimanite, 0.96% zircon, 0.9% rutile, 0.66%monazite and 1.92% of other minerals. The modal analysis for THM of Ganjam-Rushikulya sample shows that it contains 27.05% ilmenite, 30.3% garnet, 36.5% sillimanite, 1.32% zircon, 3.16% rutile, 1.28% monazite and 0.39% of other minerals.

After physical characterization of the individual samples, a composite sample was prepared for recovery of individual heavy minerals. The composite bulk sample with 14.6% THM is subjected to mineral separator to assess its amenability to the recovery of heavy minerals. Detail material balance for recovery of total heavy minerals from this composite bulk sample by using mineral separator is given in Figure 3. The flow sheet shows a five stage mineral separator studies.

The concentrate obtained in each stage has been subjected to the next stage mineral separator. The final concentrate obtained contain 86.3% grade with a yield of 11.8% and recovery 69.8% respectively. The tailings obtained in the last two stages of mineral separator can be subjected to recirculation (as they contain higher THM value close to the THM content of feed to second stage mineral separator). The recalculated feed is 4.7% by weight with a grade of 20.5% THM. The tailings obtained in the first three stages of mineral separator operation are rejected as final tailings which show 83.5% weight and 4.1% grade Figure 4.

As these deposits respond positively towards beneficiation of heavy minerals in laboratory scale using mineral separator, hence large scale beneficiation of heavy minerals can be attempted on these deposits for flow sheet development.

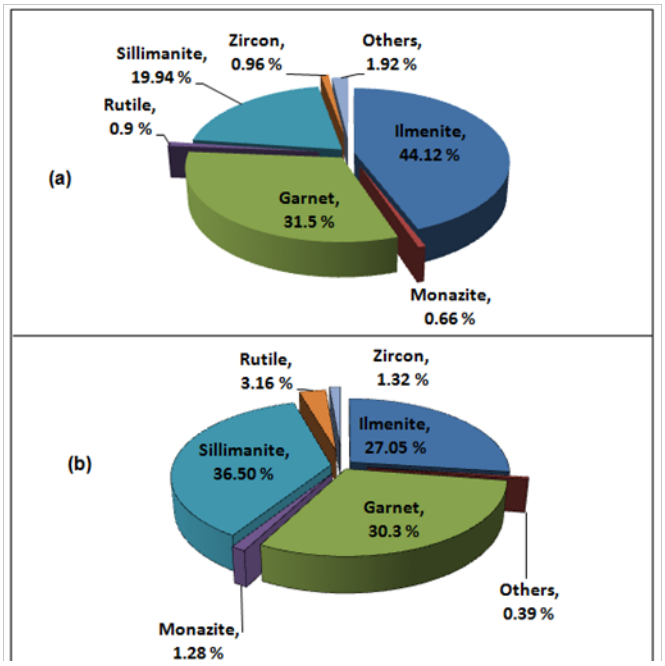

Figure 3 Modal analyses of THM of composite samples A)Konark-Ramachandi coastal stretch, b) Ganjam-Rushikulya coastal stretch.

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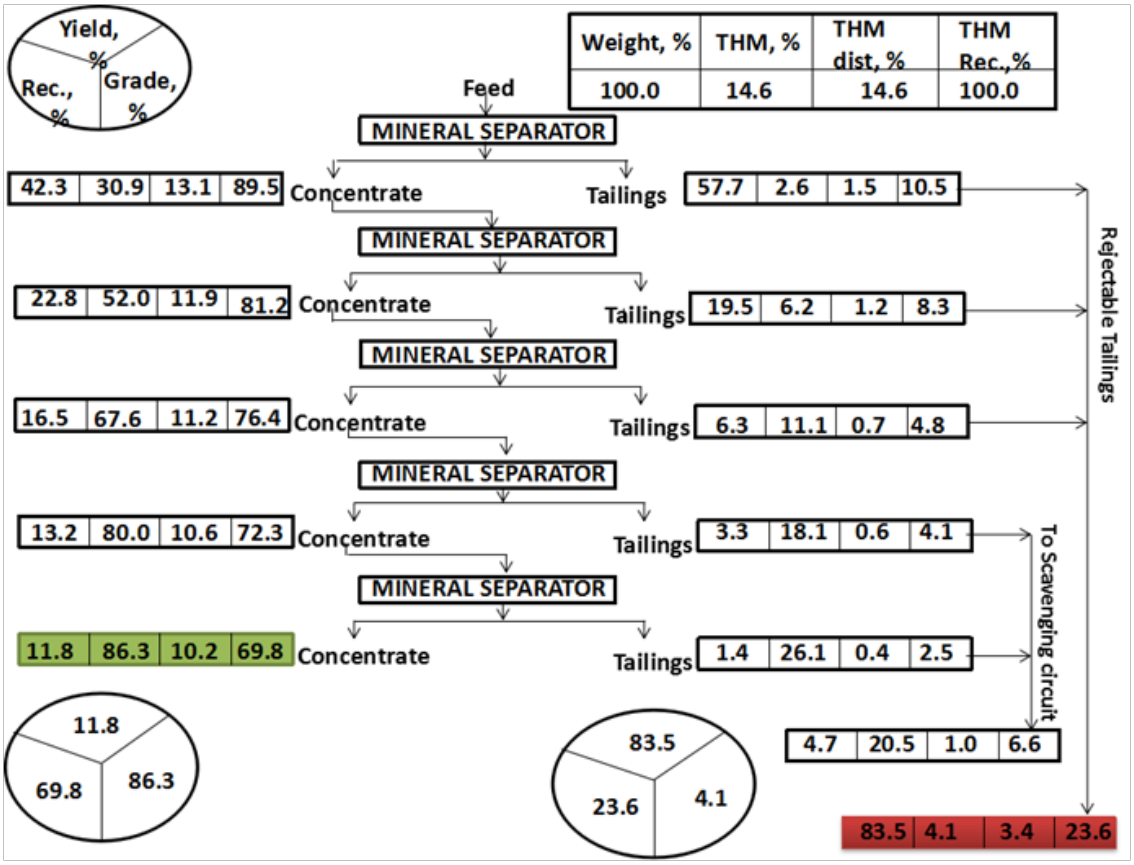

Figure 4 Flow sheet with material balance on recovery of total heavy minerals from composite sample beach –dune sand using mineral separator.

Acknowledgments

None.

Conflict of interest

The author declares that there is no conflict interest.

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