BENEFICIATION OF BEACH SANDS

THE beach sands from Tamil Nadu, Kerala and Maharastra coasts contain a variety of minerals used for different industries. Monazite is the most important radio-active mineral that is recovered from the beach sands. Other minerals are rutile, garnet, sillimanite, ilmenite, quartz etc.

Sands from Ratnagiri coast in Maharastra, and Manavalakurchi in Tamil Nadu were tested for concentration.

A. BEACH SANDS FROM RATNAGIRI—MAHARASTRA

Sample No. 1

The sample was received from M/s. Saiga & Co., Bombay and analysed as follows :

Mineral	*Wt. %*
Ilmenite	87.7
Quartz	10.3
Magnetite	1.5
Others	0.5
	100.0

The sample was almost of 100 mesh size and the examination of the sized products indicated that bulk of the quartz was distributed in −100+150 mesh portions while the ilmenite was present in the −150 mesh portion.

Magnetic separation of the sand (3 stages) produced a combined magnetic concentrate (stage 1+2) containing 99.6% ilmenite with 95.2% distribution. The third magnetic portion contained 95.2% ilmenite but most of it was segregated in the finer portion of the product. When the Mag. 3 product was sized and subjected to magnetic separation, and when the magnetic concentrate was combined with ilmenite concentrate, the product contained 99.4% ilmenite with 97.8% distribution.

Magnetic separation tests were conducted with the +200 mesh portion of the sand. The −150 +200 mesh portion of the magnetic concentrate contained 99.4% ilmenite. When this product was combined with the —200 mesh portion, the combined concentrate contained 99.0% ilmenite with 93.6% distribution. Removal of magnetite from the ilmenite concentrate will further improve the grade and recovery.

Straight tabling of the beach sand produced a concentrate containing 98.6% ilmenite with 90.9% distribution. Magnetic separation of the table middling yielded a further concentrate containing 91.0% ilmenite with an additional 5.3% distribution. The combined table and magnetic concentrates contained 98.5% ilmenite with 94.1% distribution.

Sample No. 2

The sample was received from M/s. Tayeballi Dawoodbhai, Bombay for beneficiation. Mineralogical composition of the sample was as follows :

Mineral	*Wt. %*
Ilmenite	94.9
Magnetite	1.2
Quartz	1.8
Altered grains	0.4
Limonite	1.3
Others	0.4
	100.0

The sample analysed 49.98% TiO_2 2.98% SiO_2 and 1.15% Al_2O_3. Examination of the sized products of the beach sand indicated that —200 mesh

fines constituting 80.1% of the sample contained 98.4% ilmenite analysing 52.11% TiO_2 with 83.1% distribution of ilmenite.

Two stage magnetic separation of the sand after removing the magnetite, produced a magnetic conc.1. with 98.8% ilmenite and conc. 2 with 86.8% ilmenite in it. The —200 mesh fines of both the concentrates respectively contained 99.5% and 95.5% ilmenite in them.

Tabling tests produced a concentrate containing 98.9% ilmenite with 86.2% distribution in it. When the table middlings were also combined, the product contained 98.1% ilmenite with 98.5% distribution.

Humphrey's spiral test followed by tabling of the spiral tails produced a combined concentrate containing 98.5 ilmenite (52.16% TiO_2) with 92.0% distribution. Removal of the magnetite from the concentrate would further improve the grade of the concentrate.

B. MANAVALAKURCHI BEACH SAND

The sample was received through the Atomic Minerals Division from M/s. Travancore Minerals Ltd., for separation of various minerals and to develop a flowsheet for the treatment of the same. Complete mineralogical composition of the sand sample was as follows :

Mineral	*Wt. %*
Ilmenite	62.3
Leucoxene	4.3
Garnet	4.2
Monazite	10.7
Zircon	10.8
Rutile	1.8
Ferro—Magnesium Minerals	0.8
Quartz + Sillimanite	4.5
+28 mesh shells etc.	0.6
Total :	100.0

Examination of the various sized products revealed the maximum segregation of ilmenite in the —35+200 portion while garnet was found mostly in the +48 mesh portions. Bulk of the monazite was present in the —150 mesh portion and that of zircon in the —65+200 mesh portions. Quartz was segregated in the coarsest and finest portions.

Low intensity magnetic separation with a crossbelt type magnetic separator yielded a Mag. I. Concentrate containing 99.0% ilmenite and a Mag. II conc. containing 88.2% ilmenite and 11.1 garnet in it. The Mag. 2 concentrate was subjected to high intensity separation where in the ilmenite and garnet were separated. The conducting portion contained 99.3% ilmenite while the non-conducting portion contained 95% garnet and 5% ilmenite in it. The non-magnetic tailing from the crossbelt magnetic separator was further treated in a roll type high intensity magnetic separator to recover the residual and altered garnet and ilmenite as magnetic concentrate, which was further treated in the high intensity separator for the separation of garnet and ilmenite from the magnetic concentrate.

Monazite from the Mag. 2 conc. portions was primarily concentrated by removing all the highly magnetic minerals followed by screening to discard the gangue minerals, and then tabling. The monazite concentrate thus obtained was 97% pure with 90% distribution.

Rutile, quartz and sillimanite which were all present in the non-magnetic portion after removal of the residual ilmenite and garnet was subjected to tabling where in the quartz and sillimanite were rejected as table tails. The concentrate containing rutile and zircon was subjected to high tension separation with two cleanings, where the zircon was collected as non-conducting and rutile as conducting portions which were respectively 90%, and 97% pure.

Detailed flowsheet for the complete treatment and separation of the mineral was submitted.

NOTE : All the weight % of the minerals are given on the basis of grain counts under microscope.

C. GUJARAT BEACH SANDS

The sample was received from The Director of the State Mining and Geology, Department for the

recovery of ilmenite. The sample had the following chemical analysis.

Constituent	*Assay %*
Total Fe	4.46
FeO	1.72
TiO_2	1.19
CaO	22.34
Al_2O_3	8.60
SiO_2	30.00
LOI	11.89

The sample was basically composed of quartz and fossiliferous carbonates. The metallic minerals found in the sand were ilmenite was found in the octahedral cleavage planes of magnetite. The non-metallic minerals observed were sphene, zircon, monazite, tourmaline, apatite, rutile etc.

Magnetic separation tests yielded a magnetic concentrate composed of interlocked silica and metallic minerals like magnetite, hematite etc. Free metallic grains were rare. Gravity concentration also yielded similarly interlocked heavy concentrate.

High tension separation tests yielded a conducting concentrate assaying 2.2% TiO_2 and 36.56% SiO_2 with 10.5% TiO_2 distribution in it.

Test results indicated that it was difficult to concentrate ilmenite from the sample.

D. KERALA BEACH SAND

1. Purification of zircon concentrate

The zircon concentrate was received from M/s. Hindustan Sanitary Ware & Industrial Ltd., for purification. The concentrate was produced from the Kerala beach sands and analysed as follows :

Constituent	*Assay %*
ZrO_2	65.65
SiO_2	32.20
Al_2O_3	1.12
TiO_2	0.003
Fe	0.22
Fe (Sol.)	0.023
Rare Oxides & P	Trace.

The sample contained some altered ilmenite, monazite, sillimanite etc. upto about 2% by weight.

Chemical analysis of the closely sized portions indicated that Fe & Al_2O_3 contents were maximum in the portions coarser than 100 mesh.

High intensity separation tests yielded a non-conducting concentrate analysing 0.17% Fe and 0.75% Al_2O_3 in it with 51.7% yield. Similar test conducted with table concentrate yielded a concentrate assaying 0.10% Fe and 1.16% Al_2O_3 with 46.5% yield.

High tension separation tests with —65 mesh and —100 mesh fines followed by cleaning of the middling and non-conducting portions produced concentrates respectively assaying 0.15% Fe and 0.51% Al_2O_3 with 59.0% yield and 0.14% Fe and 0.42% Al_2O_3 with 55.2% yield.

2. Beneficiation of Rutile

A sample of rutile concentrate was received from M/s Travancore Minerals Ltd., Quilon for the reduction of iron content. The sample had the following chemical analysis:

Constituent	*Assay %*
TiO_2	95.06
Fe_2O_3	1.50
SiO_2	3.70

Examination of the sample under microscope indicated presence of Leucoxene and ilmenite which contribute iron and small amounts of sillimanite, zircon and garnets.

Chemical analysis of the sized fractions of the sample indicated that the iron content was decreased with fineness and TiO_2 content increased.

High intensity magnetic separation of the sample produced a non-magnetic concentrate assaying 95.2% TiO_2 and 0.78% Fe_2O_3 with 98.1% TiO_2 distribution. Similar test with the sized samples yielded a combined concentrate assaying 95.1% TiO_2 and 0.95% Fe_2O_3 with 98.3% TiO_2 distribution in it. Reduction roast and magnetic separation tests did not produce any encouraging results.

References

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2. Concentration of ilmenite sand from udi and Reel villages, Ratnagiri Coast. NML/IR/34/54— N N Subramanyan. D S Krishnaswamy & P I A Narayanan.

3. Pilot plant studies on concentration of economic minerals from Manavalakurchi beach sand. NML/IR/301/64—N Chakravorty, K N Rakshit & P I A Narayanan.

4. Beneficiation of a beach sand sample from Gujarat. NML/IR/637/71—N Chakravorty & G P Mathur.

5. Reduction of iron content in a rutile sample from Travancore Minerals—Quilon. NML IR No. 217/61. By S. K. Banerjee & P. I. A. Narayanan.

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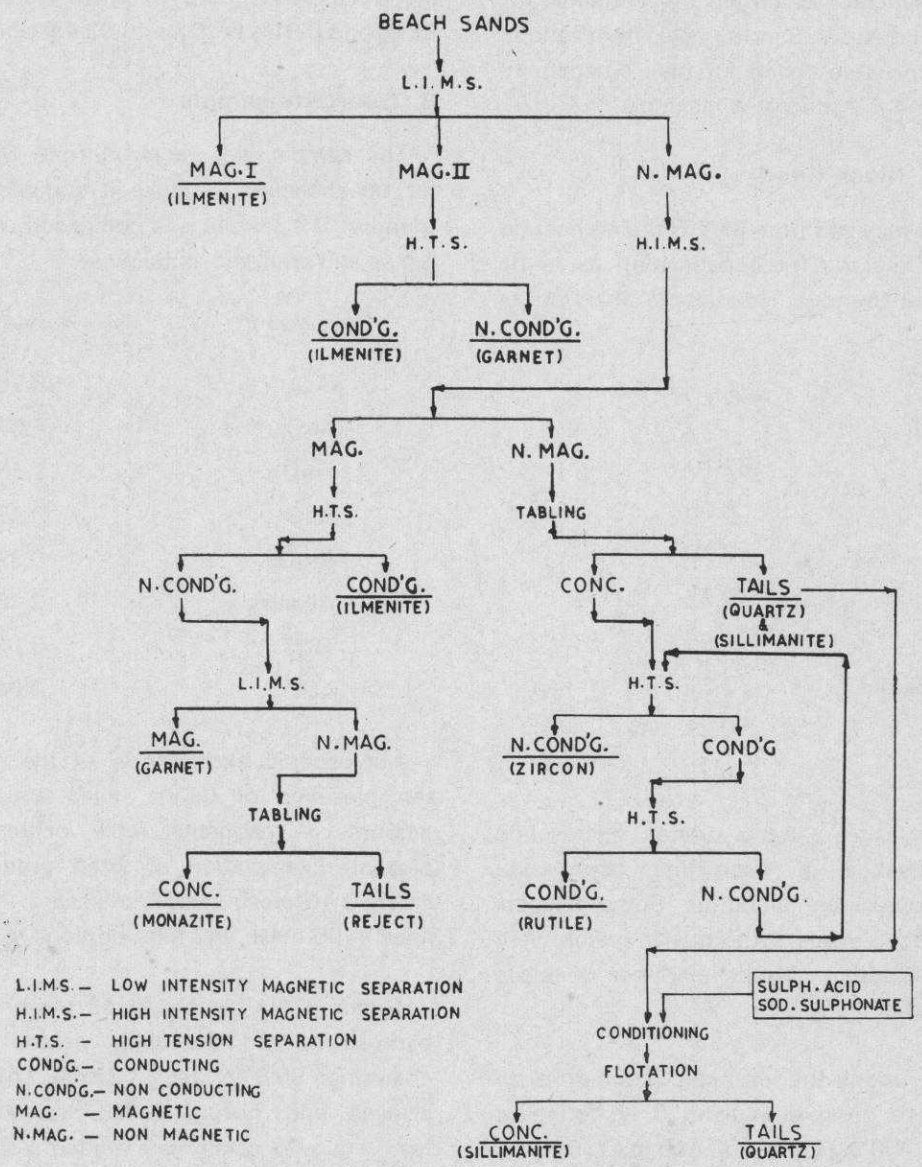

Fig. 4.1 General Flow Sheet for Treatment of Beach Sands