

BENEFICIATION OF FOUNDRY & GLASS MAKING SANDS

SANDS basically contain SiO_2 with varying amounts of impurities like feldspars, which contribute alkalies and rendering them useless for foundry work and iron bearing minerals which are objectionable for glass and ceramic industries. Sand samples from various parts of the country were tested for their amenability for use in the foundries and glass making.

A Swarnarekha River Sand

The sample was received from M/s Tata Engineering and Locomotive Co. Ltd., for beneficiation as to be useful in their steel foundry. The sample analysed as follows:

<i>Constituent</i>	<i>Assay %</i>
SiO_2	82.10
Al_2O_3	8.05
Fe_2O_3	2.76
CaO	0.97
MgO	0.96
Alkalies(oxides)	3.21
TiO_2	0.29
LOI	0.73

Examination of the sample under microscope revealed the presence of microcline, and soda plagioclase in appreciable amounts. Some feldspars were altered to kaolin while some quartz grains were stained with iron oxides. Minor quantities of micas were also observed.

Flotation tests under the optimum conditions of 16.5% —200 mesh grind employing 5 kg/tonne of Hydrofluoric acid, 1.0 kg/tonne of Armac D, 0.5 kg/tonne of fuel oil and 0.08 Kg/tonne of pine oil—after removing the ferruginous float, a silica tailing analysing 96.14% SiO_2 , 0.77% Al_2O_3 and 1.06% Fe_2O_3 with 73.7% SiO_2 distribution in it.

Washing the sample with acid followed by fatty acid flotation for the separation of ferruginous minerals followed by the flotation of feldspar with Armac D, the silica concentrate analysed 95.35% SiO_2 , 1.32% Al_2O_3 and 0.91% Fe_2O_3 with 63.4% silica distribution.

B Quartzite sample

The sample was received from M/s TELCO Ltd., for beneficiation to make it suitable for use in the foundry. The sample was composed of 125 to 150 mm lumps and analysed as follows:

<i>Constituent</i>	<i>Assay %</i>
SiO_2	88.76
Al_2O_3	4.37
Fe_2O_3	1.46
CaO	0.43
MgO	0.39
Alkalies	2.45
TiO_2	0.14
LOI	0.64

Microscopic examination of the sample indicated the presence of quartz, mica and feldspars. Minor amounts of magnetite, rutile, ochre, clay were also present. Examination of sized products from stage crushed 10 mesh sample indicated the segregation of mica at 65 mesh and finer portions.

Grinding the sample to 48 mesh size followed by hydrosizing and desliming yielded a sand sample analysing 95.67% SiO_2 , 2.14% Al_2O_3 and 1.14% alkalies and having a PCE value 1720°C. Similar test with a 28 mesh feed yielded a sand product analysing 95.26% SiO_2 , 1.81% Al_2O_3 and 1.03% alkalies having a PCE value of 1720°C. Hydroclassification conducted with 35 mesh material did not yield encouraging results.

C Talahari Silica Sands

Two samples were received from M/s TELCO for beneficiation.

No. 1

This was designated as 'silica sand' and was sent for the study of grain distribution and to determine the PCE value of the same. The sample analysed 96.94% SiO₂ with a PCE value of 1730°C.

No. 2

This was designated as 'off-grade' silica sand containing some clayey matter. After washing and desliming the sample analysed 97.38% SiO₂ with 1740°C PCE value.

D Sand sample from M/s ACC

The sample was to be treated so as to get about 57.0% SiO₂ which is similar to clay sample that is used in the cement industry.

Microscopic examination of the sample indicated the presence of quartz, felspar, micas, calcite, kyanite, andalusite, sillimanite, iron oxides and opaques, tourmaline, amphibole garnet etc. The sample analysed as follows:

Constituent	Assay %
SiO ₂	70.10
Al ₂ O ₃	11.50
Fe ₂ O ₃	3.70
CaO	7.05
MgO	1.97
Alkalies	2.40
LOI at 950°C	3.50

By flotation, it was observed to be possible to remove about 30% by Wt. of quartz after which the sample would assay 57.1% SiO₂, 16.4% Al₂O₃ and 10.0% CaO with 3.4% alkalies in it.

E Reclamation of used foundry sand

A sample of used foundry sand was received from M/s Bharat Electric Steel Co. Ltd., Calcutta, to find out the possibilities for the reclamation of sand. The sample was found partly in lumps due to the binders used for moulding and also contained some tramp iron in it.

After hand picking of the tramp iron pieces, the sample was tumbled with water in a concrete mixer

where in all the lumps were broken and then treated in a laboratory hydroclassifier. By this treatment all the sand was collected in the three spigots and the clayey matter was removed with water. This treatment yielded 60.4% of the total feed. The slime losses may be reduced by use of additional spigots in the classifier.

F Sand sample from Ennore District

A beach sand sample was received for the production of —30+50 mesh (ASTM equivalent of—28+48 Tyler) sized sand for use in the foundries.

The sand was composed of quartz, felspars, zircon, sillimanite, ilmenite, monazite etc. Screen analysis of the sand indicated that 79.3% of it was of required size.

Mechanical screening operation in a double deck vibrating screen provided with 28 and 48 mesh screens was not satisfactory as the fines blinded the screens.

Screening on 28 mesh screen followed by tabling of the —28 mesh fines produced 68.3% yield of —28+48 mesh sized product with 5.6% of —48 mesh fines.

Treatment of the sand directly on shaking table yielded a medium grind product of 59.5% containing 4.4% of +28 mesh portion and 7.9% of —48 mesh fines in it.

G Quartzite from Chaibasa

Three quartzite samples were received from Sri Lakshmi Prasad Sahoo of Chaibasa for the production of glass grade/foundry grade sands. It was suggested that the quartzites must be wet ground to 14 mesh top size and screened on 35, 100 and 150 mesh screens. Each of the sized portion must be tested for the quality.

Sample No. 1

The sample was marked A(ASS) and was coloured yellowish to brown and consisted of 400 mm to 12 mm lumps. The sample analysed as follows :

Constituent	Assay %
SiO ₂	94.44
Al ₂ O ₃	2.26
CaO	0.15
MgO	0.41
Alkalies as chlorides	1.46
TiO ₂	Trace
Fe ₂ O ₃	0.87
LOI	0.89

Microscopic examination revealed the presence of quartz and all types feldspars. Some of the feldspars were found to be altered to kaolin and sericite. Ferruginous coating was present on some grains. Quartz was liberated at 100 mesh.

Grinding tests with —10 mesh ground sample indicated that 1 Min of grinding time was enough to pass all the sample through 14 mesh screen with 19.4% —150 mesh fines in it. Sizing of the —14 mesh ground sample in hydroclassifier rejected 12.5% by weight as slimes and the sand analysed 96.34% SiO₂ and 0.58% Fe₂O₃ with 90% SiO₂ distribution in it. Magnetic separation of the sand product for the elimination of iron oxides yielded a non-magnetic product assaying 98.10% SiO₂ sand 0.30% Fe₂O₃, and the sand can be used in the glass industry for making ordinary glass.

Sample No. 2

The sample was marked 'B' (ASQ) and had the following analysis.

Constituent	Assay %
SiO ₂	92.48
Al ₂ O ₃	4.10
CaO	0.22
MgO	0.63
Alkalies as chlorides	1.56
TiO ₂	Trace
Fe ₂ O ₃	0.56
LOI	1.24

This sample was similar to sample A in mineralogical composition and nature with only more of weathered feldspars. Stage crushed 10 mesh sample contained 16.1% of —150 mesh fines.

After 1½ minutes grinding in the mill the whole of —10 mesh material passed through 14 mesh screen with 24.2% of —150 mesh fines in it. Hydroclassification of the —14 mesh sample rejected 15.4% of the feed as slimes and the sand analysed 96.32% SiO₂ and 0.34% Fe₂O₃ with 88.0% SiO₂ distribution in it. On magnetic separation, the non-magnetic portion analysed 97.53% SiO₂ 0.17% Fe₂O₃, which may be used in the manufacture of ordinary glass.

Sample No. 3

The sample was marked C (KTBJ) and analysed as follows :

Constituent	Assay %
SiO ₂	88.91
Al ₂ O ₃	7.45
CaO	0.27
MgO	0.96
Alkalies as chlorides	1.39
TiO ₂	Trace.
Fe ₂ O ₃	0.53
LOI	1.29

The analysis of the samples A, B & C indicated the gradual decrease in the silica content and the mineralogical examination revealed the gradual increase in quantity of altered feldspar.

Stage crushed —10 mesh sample contained 14.7% of —150 mesh fines and after 1 minute of grinding, the whole sample passed through 14 mesh containing 22.2% of —150 mesh fines.

Hydroclassification of —14 mesh sand rejected 14.2% of the feed as slime and the sand analysed 90.0% SiO₂ and 0.67% Fe₂O₃. Magnetic separation of this product showed a nominal increase of 1% SiO₂ only. This sand cannot be used in the glass manufacture, but may be used as 'C' grade foundry sand on further grinding.

H Jamuna River Sand

The sample was received from National Building Organisation for the removal of mica so as to make it useful for the civil constructions purpose. The sample was of —28 mesh size having grey colour and analysed as follows :

Constituent	Assay %
SiO ₂	84.00
Al ₂ O ₃	6.83
Fe ₂ O ₃	2.28
TiO ₂	0.39
CaO	1.15
MgO	1.18
Alkali chlorides	1.64
LOI	2.38

Examination of the sand under microscope indicated the presence of feldspars, amphiboles, pyroxenes, and micas in association with quartz.

Heavy liquid separation conducted in a specially designed separation column indicated that about 30% of the sand consisted of micaceous minerals and may be separated only by flotation.

Flotation tests employing 0.6 kg/tonne of Aero-mine 3037 (cationic collector) at pH 3.0 removed 84.0% of the totally flaky minerals from the sand. Similar test conducted with a washed and deslimed feed produced a tailing sand containing only 0.84% of mica minerals by weight with 71.2% yield. Use of sulphonates has slightly improved the yield.

I Maganpur Glass Sand

The quartz sample was received from M/s. Indo-Asahi Glass Co. Ltd., Hazaribagh for the reduction of iron content and producing a sized product. The sample analysed as follows :

<i>Constituent</i>	<i>Assay %</i>
SiO ₂	99.22
Al ₂ O ₃	0.41
Fe ₂ O ₃	0.17
Na ₂ O	0.01
K ₂ O	0.03

As such the Fe₂O₃ content of the sample was to be reduced to below 0.05% and the ground product must have a size distribution of 85% of -48 + 80 mesh, and 15% of -80 + 150 mesh with 5% tolerance of on the +48 mesh and -150 mesh each.

Mineralogical examination of the sample indicated the predominance of quartz and minor amounts of feldspars, chlorite, opaques, clay and ferruginous matter was found as coating over the grains.

Stage crushed 28 mesh sample contained 4.4% of +28 mesh, 87.5% of -20 + 150 mesh and 8.1% -150 mesh fines. The -28 + 150 mesh portion analysed 0.163% Fe₂O₃ which on high intensity

magnetic separation yielded a non-magnetic portion assaying 0.061% Fe₂O₃.

Washing at 64 mm size reduced the Fe₂O₃ content of the lump to 0.11% and this on crushing to 28 mesh followed by sizing produced a -28 + 150 mesh portion assaying 0.08% Fe₂O₃. Magnetic separation of this product further reduced the Fe₂O₃ content to 0.057%.

Dry grinding and wet grinding tests conducted in the Lab. Rod Mill, followed by hydrosizing respectively yielded -28 + 150 mesh portions of 61.2% analysing 0.18% Fe₂O₃ and 67.6% analysing 0.21% Fe₂O₃ respectively. Dry grinding in a porcelain pebble mill yielded 24.1% of -28 + 150 mesh portion analysing 0.064% Fe₂O₃. Test results indicated the contamination of iron when ground in the rod Mill. Acid leaching with N.HCl for 60 mts. reduced the Fe₂O₃ content of the sand to 0.007%.

References

1. Concentration of Swarnarekha Silica sand for Steel foundry purposes (NML/IR/44/54). By G P Mathur & P I A Narayanan.
2. Beneficiation of quartzite to make it suitable for foundry moulding purposes. (NML/IR/48/54). By N N Subramanyam & P I A Narayanan.
3. Desliming of Taljahari Silica sand (NML/IR/51/55). By G P Mathur & P I A Narayanan.
4. Preliminary report on the possibility of beneficiating a sand sample from the Associated Cement Companies Ltd., (NML/IR/109/57) By P I A Narayanan & M S Chopra.
5. Pilot Plant studies on reclamation of used foundry sand from M/s Bharat Electric Steel Co. Ltd., Calcutta. (NML/IR/161/59). By S K Banerjee & P I A Narayanan.
6. Production of sized fraction from a quartz sand sample from Ennore Dist., Tamil Nadu. (NML/IR/344/65). By N Chakravorty, G S Ramakrishna Rao, G P Mathur & P I A Narayanan.
7. Production of sized sand for foundry and glass making from quartzite sands from Chaibasa, Singhbhum Dist., Bihar (NML/IR/349/65). By S K Dhar, S K Banerjee & P I A Narayanan.
8. Removal of Mica from Jamuna River sand (NML/IR/379/66) By R Ganesh, M S Chopra & P I A Narayanan.
9. Studies on reduction of iron content and production of sized sand for the Indo-Asahi Glass Co. Ltd., Hazaribagh (NML/IR/750/73). By R Ganesh & G P Mathur.