

Chapter Ten

SUMMARY AND RECOMMENDATIONS

Foundry Sands

Foundry sands can be broadly classified into four major groups: (1) Natural moulding sands ; (2) crude silica sands ; (3) high silica sands ; (4) special sands like zircon, sillimanite, olivine, etc. In India, the eastern region broadly comprising the industrial areas of Orissa, Bihar and West Bengal has the maximum number of good foundry sand deposits. The most important deposits in this region occur in Burdwan district in the villages of Oyaria, Barakar and Damodar ; other natural sands being used are the rock sands which occur in Ondal and sands from the beds of the rivers Amta, Hooghly and Gidni. In Bihar, the main deposits of natural sands are located in a village near Jamalpur in Monghyr district. The beds of the rivers Adjoy, Mogra, Pandua, Swarnarekha, Kharkoi and Brahmani provide abundant supplies of crude silica sands. The main sources of high silica sands are the quartzite deposits at Jamshedpur, Rajmahal sand deposits in Santhal Parganas, rock sand deposits at Raniganj, Sewliberi

TABLE 146—CLASSIFICATION OF HIGH SILICA SANDS ON THE BASIS OF MECHANICAL GRADING AND CHEMICAL ANALYSIS

SAMPLE	GRADING IN RESPECT OF GRAIN SIZE	GRADING IN RESPECT OF CHEMICAL ANALYSIS
Washed Rajkot	Widely spread	(iii)
Rajmahal	Widely spread	(ii)
Beneficiated quartzite rock	IV*	(ii)
Allahabad	Widely spread	(i)
Madras silica	Widely spread	(ii)
Hyderabad	Widely spread	(ii)
Vengurla	Widely spread	(ii)
Ratnagiri	Widely spread	(ii)
Snow white silica	III*	(ii)
Durgapur	I*	(ii)

* 70% or more retained on 20-30-40 (I), 40-50-70 (III), and 50-70-100 (IV) of U.S. sieves.

(i) Over 98% (ii) Above 95-98% (iii) Above 90-95%

TABLE 147—SUMMARY OF TEST RESULTS AND RECOMMENDATIONS

SL. No.	SAMPLE	CHEMICAL ANALYSIS, %							FINENESS CHARACTERISTICS	RECOMMENDATIONS
		SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Alkalies	L.O.I.		
Natural Moulding Sands										
WESTERN REGION										
1.	Londha Sand 1	80.2	3.2	8.6	—	—	2.0	4.3	Fine; mostly subangular; grains retained on 50, 70, 100 & 140 sieves; G.F. No., 93.2; A.F.S. clay, 26.8%	Useful for cast iron jobs after incorporating sharp silica sand
2.	Londha Sand 2	80.8	3.3	7.6	—	—	2.4	4.3	Medium; mostly subangular; grains retained on 40, 50, 70, 100 & 140 sieves; G.F. No., 66.2; A.F.S. clay, 16.8%	Useful for cast iron jobs after incorporating sharp silica sand
3.	Bhavnagar 1	57.9	16.1	11.2	6.8	—	4.1	5.5	Fine; mostly subangular; grains retained on 100, 140 & 200 sieves; G.F. No., 99.5; A.F.S. clay, 26.6%	Useful for light cast iron jobs after admixture with sharp silica sand
4.	Bhavnagar 2	52.1	16.0	12.9	2.5	3.4	—	10.6	Fine; wide distribution, G.F. No., 92.6; A.F.S. clay, 29.3%	Useful for cast iron jobs after suitable admixture
5.	Bhavnagar 2A	81.3	7.4	2.7	2.8	1.2	1.6	2.6	Fine; subangular to round grains retained on 100, 140, 200 & 270 sieves; G.F. No., 126.4; A.F.S. clay, 6.2%	Useful for cast iron jobs after suitable admixture
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SL. No.	SAMPLE	CHEMICAL ANALYSIS, %							FINENESS CHARACTERISTICS	RECOMMENDATIONS
		SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Alkalies	L.O.I.		
6.	Bhavnagar 2B	75.5	9.9	3.7	1.7	2.1	2.0	3.6	Fine; mostly subangular to rounded grains retained on 100, 140 & 200 sieves; G.F. No., 101.7; A.F.S. clay, 13.1%	Useful for cast iron jobs after suitable admixture
7.	Bhavnagar 3	57.9	11.9	10.6	3.2	2.1	5.0	—	Fine; subangular to rounded grains retained on 100, 140 & 200 sieves; G.F. No., 93.3; A.F.S. clay, 25%	Unsuitable for grey iron castings—may be used for non-ferrous jobs
8.	Bhavnagar 4	65.5	12.5	9.5	—	—	3.4	5.3	Fine; subangular grains retained on 140, 200 & 270 sieves; G.F. No., 144.1; A.F.S. clay, 24%	Useful for cast iron jobs after admixture with silica sand useful for green and dry sand moulds for brass bronze and aluminium
9.	Goriali	81.8	9.0	1.3	—	—	4.9	1.3	Fine; mostly subangular grains retained on 70, 100, 140 & 200 sieves; G.F. No., 96.3; A.F.S. clay, 6%	Useful for cast iron jobs after suitable admixture
10.	Jayadi	82.0	9.4	3.4	—	—	2.0	2.4	Fine; mostly subangular grains retained on 70, 100 & 140 sieves; G.F. No., 80.1; A.F.S. clay, 11.2%	Useful for cast iron jobs after admixture with a high silica sand
11.	Rajkot	81.2	6.1	4.0	—	—	2.7	3.5	Angular to subangular grains retained on 30, 40, 50, 70 & 100 sieves; G.F. No., 67.2; A.F.S. clay, 19.15%	Unsuitable for grey iron castings

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SL. No.	SAMPLE	CHEMICAL ANALYSIS, %						FINENESS CHARACTERISTICS	RECOMMENDATIONS	
		SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Alkalies L.O.I.			
12.	Rajkot (after washing)	93.2	2.2	1.7	—	—	—		Useful as a high silica sand for cast iron and steel castings after blending with suitable binders	
13.	Jubbulpore yellow	85.0	5.5	2.0	2.0	—	—	3.5	Mostly subangular to rounded retained on 20, 30, 40 & 50 sieves; G.F. No., 38; A.F.S. clay, 6.4%	
14.	Jubbulpore white	80.5	6.3	1.2	4.4	—	—	5.6	Subangular to rounded retained on 40, 50, 70, 100 sieves; G.F. No., 72.2; A.F.S. clay, 8.5%	
15.	Kanpur	70.8	13.6	4.7	1.6	1.6	3.9	3.3	Fine; mostly subangular grains; G.F. No., 45.7; A.F.S. clay, 13%	
SOUTHERN REGION										
16.	Guntur	71.2	12.2	—	6.0	—	1.7	2.0	5.7	Medium to fine; mostly subangular, wide distribution; G.F. No., 45.7; A.F.S. clay, 13%
17.	Secunderabad	76.0	10.5	2.5	—	1.0	—	3.9	4.5	Mostly angular to subangular; A.F.S. clay, 14.2%
										Suitable for grey iron and non-ferrous casting both by green and dry sand practice
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SL. No.	SAMPLE	CHEMICAL ANALYSIS, %							FINENESS CHARACTERISTICS	RECOMMENDATIONS	
		SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	Alkalies L.O.I.			
18.	Balamrai	69.5	15.5	4.5	—	1.0	—	1.5	6.5	Medium fine angular to subangular; wide distribution; G.F. No., 78	Suitable for grey iron and non-ferrous foundry work after suitable admixture with a sharp silica sand
EASTERN REGION											
19.	Oyaria	78.1	49.5	3.0	—	1.3	—	5.2	2.3	G.F. No., 30; A.F.S. clay, 11.6%	Unsuitable for steel foundries; useful for cast iron jobs but suitable mould dressings should be applied
20.	Damodar	83.0	12.0	12.0	—	—	—	—	—	Medium fine; angular to subangular retained on 50, 70, 100 & 140 sieves; G.F. No., 73; A.F.S. clay, 11.5%	Useful for green and dry sand moulding of cast iron
21.	Barakar	—	—	—	—	—	—	—	—	Wide distribution retained on 40, 50, 70 & 100 sieves; G.F. No., 72 A.F.S. clay, 11.3%	Useful for light and medium grey iron castings

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SL. No.	SAMPLE	CHEMICAL ANALYSIS, %						FINENESS CHARACTERISTICS	RECOMMENDATIONS	
		SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Alkalies L.O.I.			
Crude Silica Sands										
<i>NORTHERN REGION</i>										
22.	Hardwar sand	89.4	4.1	2.0	—	—	1.4	1.2	Medium fine; retained on 50, 70 & 100 sieves; G.F. No., 57; A.F.S. clay, 1%	Washing to remove the fines and floating to remove the mica and ferromagnesian minerals suggested to improve the refractoriness of the sand to make it suitable for ferrous casting
<i>EASTERN REGION</i>										
23.	Brahmani BT-9/2	82.0	8.5	3.0	1.9	—	3.0	—	Fine; subangular to rounded retained on 50, 70 & 100 sieves; G.F. No., 52.4; A.F.S. clay, 0.4%	Useful for grey iron casting after blending with suitable binder—upgrading by suitable ore-dressing methods so as to increase silica content and improve refractoriness is suggested to make it suitable for light and medium steel casting
24.	Brahmani BT-10	82.5	9.3	1.3	2.0	—	—	—	Subangular to rounded retained on 50, 70 & 100 sieves; G.F. No., 53.7; A.F.S. clay, 0.5%	do.
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SL. No.	SAMPLE	CHEMICAL ANALYSIS, %							FINENESS CHARACTERISTICS	RECOMMENDATIONS
		SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Alkalies	L.O.I.		
25.	Brahmani K-5	83.4	7.1	2.8	2.9	—	3.0	—	Medium; subangular to rounded retained on 30, 40 & 50 sieves; G.F. No., 33.9; A.F.S. clay, 0.4%	do.
26.	Brahmani K-10	77.5	10.2	2.7	3.5	—	4.3	—	Medium; subangular to rounded retained on 50, 70, 100 & 140 sieves; G.F. No., 67.1; A.F.S. clay, 3.2%	Useful for grey iron casting after blending with suitable binder—upgrading by suitable ore-dressing methods so as to increase silica content and improve refractoriness is suggested to make it suitable for light and medium steel casting
27.	Brahmani S-5	83.8	8.3	1.8	1.7	—	3.1	—	Medium; mostly subangular retained on 20, 30, 40, 50 & 70 sieves; G.F. No., 36.6; A.F.S. clay, 0.2%	do.
28.	Brahmani S-10	84.8	6.4	2.2	1.7	—	3.6	—	Medium; mostly subangular retained on 20, 30, 40, 50 & 70 sieves; G.F. No., 36.3; A.F.S. clay, 0.4%	do.
29.	Gidni sand	82.5	5.0	2.7	1.5	—	3.0	1.5	Medium coarse; mostly angular to subangular retained on 12, 20, 30, 40 & 50 sieves; G.F. No., 23.5; A.F.S. clay, 5.7%	With suitable mould dressing it may be employed for light grey iron castings
30.	Adjoy River	81.2	9.5	2.1	2.0	—	2.9	—	Medium fine; mostly subangular to rounded retained on 40, 50, 70, 100 & 140 sieves; G.F. No., 57.6; A.F.S. clay, 1.4%	Unsuitable for steel moulding; may be used for cast iron jobs after bonding with 5% bentonite

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SL. No.	SAMPLE	CHEMICAL ANALYSIS, %							FINENESS CHARACTERISTICS	RECOMMENDATIONS
		SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Alkalies	L.O.I.		
31.	Mogra	85.0	9.0	—	1.0	1.0	2.0	—	Mostly subangular retained on 40 & 50 sieves	Useful for cast iron and non-ferrous jobs; admixture with a fine grained sand suggested for light castings
SOUTHERN REGION										
32.	Yadgiri	77.5	12.4	—	1.3	—	6.5	1.0	Medium to fine; mostly subangular retained on 50, 70, 100 & 140 sieves; G.F. No., 73.7; A.F.S. clay, 3.2%	Useful for non-ferrous job; requires blending with sharp high silica sand for cast iron work
High Silica Sands										
EASTERN REGION										
33.	Rajmahal	97.9	0.8	0.6	—	—	—	—	Medium; mostly subangular rounded retained on 40, 50 & 100 sieves; G.F. No., 46; A.F.S. clay, 1%	Suitable for steel castings
34.	Beneficiated quartzite	95.6	2.1	—	—	—	1.9	—	Medium fine; angular grains mainly in composite form retained on 50, 70 and 100 sieves; G.F. No., 55	Satisfactory for steel foundry practice; requires larger amounts of binders; surface friability should be borne in mind
35.	Durgapur	98.0	—	—	—	—	—	—	Coarse; subangular to rounded grains retained on 20, 30 & 40 sieves; G.F. No., 38.1; A.F.S. clay, 0.6%	Suitable for light steel castings, precaution to be taken while crushing the quartzite rock
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SL. No.	SAMPLE	CHEMICAL ANALYSIS, %					FINENESS CHARACTERISTICS	RECOMMENDATIONS
		SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO Alkalies L.O.I.		
NORTHERN REGION								
36.	Jubbulpore	87.2	3.0	1.3	2.6	— 1.1 4.0	Subangular to rounded retained on 20, 30, 40, 50 & 70 sieves; G.F. No., 53.1; A.F.S. clay, 5.1%	Suitable for dry sand moulding of steel castings particularly for medium and heavy jobs
37.	Allahabad	98.1	0.8	—	—	—	Fine; subangular to rounded, retained on 50, 70, 100 & 140 sieves; G.F. No., 50.1; A.F.S. clay, 1.9%	Suitable for light and medium steel castings but requires thorough washing to reduce the fines and to improve the grading
SOUTHERN REGION								
38.	Madras	97.1	1.2	—	—	—	Medium coarse; subangular to rounded retained on 20, 30, 40 & 50 sieves; G.F. No., 26.4	Suitable for medium and heavy steel castings; surface coating or mould wash is necessary
39.	Hyderabad	97.5	1.1	—	—	—	Mostly subangular retained on 40, 50, 70 & 100 sieves; G.F. No., 54.9; A.F.S. clay, 3%	Useful for grey iron and steel castings both in green and dry sand moulds
WESTERN REGION								
40.	Vengurla	97.0	1.7	—	—	—	Medium coarse; compound grains with wide distribution; G.F. No., 41.2; A.F.S. clay, 1%	Suitable for light and medium steel castings subject to confirmation under actual plant trials
41.	Ramagiri	96.8	2.3	—	—	—	Medium; subangular to rounded retained on 40, 50 & 70 sieves; G.F. No., 40.4; A.F.S. clay, 0.7%	Suitable for light and medium steel castings subject to confirmation under actual plant trials
42.	Snow white silica	96.5	0.9	—	—	1.1	Medium; subangular to rounded retained on 40, 50 & 70 sieves; G.F. No., 41.3; A.F.S. clay, 0.5%	Suitable for light steel castings, precaution to be taken while crushing the quartzite rock

boulder sand, Kudia boulder sand and oriental boulder sand at Kumardhubi. Sand resources of other regions are yet to be systematically surveyed.

Natural sands from different parts of the country (supplied by the users) and synthetic sand mixtures were studied in the National Metallurgical Laboratory in respect of fineness characteristics (including size distribution of the sand grade, grain fineness number, A.F.S. clay grade), chemical and petrological composition and moulding and casting characteristics. For examining their high temperature properties, fusion points and approximate sintering ranges were determined.

The silica sands which have been studied have been classified on the basis of mechanical grading and chemical analysis in accordance with the draft Indian Standards Specification (Table 146).

The results of tests on all the sands and bonding clays and recommendations for their use are presented in Table 147.

Bonding Clays

A study of the different samples of indigenous bentonites, supplied by *Messrs Tata Locomotive & Engineering Co. Ltd.*, Tatanagar and from Bihar, has shown that the latter can be employed in the proportion of 5 per cent by weight of sand for synthetic sand mixtures for use in grey iron and steel foundries. If knocked out sands were also incorporated in the sand mixture in major proportion as generally practised in mechanized foundries using circulatory sand systems, 3 per cent addition of the bentonites might be sufficient to maintain the strength of the sand mixture at the requisite level. The sand mixtures can be worked around 3 per cent in order to obtain the optimum combination of strength and permeability.