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Distribution of iron oxide in different size fractions of Kusmunda coals, Korba coalfield

The variation of iron oxide in different size consists of a bulk coal sample from Kusmunda area, Korba coalfield has been studied in details. The +25 mm material representing 54.9 per cent of the bulk coal retains 47.2 per cent of total iron oxide in bulk coal ash inclusion of -0.5 mm fines increases iron oxide to 61.1 per cent of the bulk coal ash. Incorporating 25-13mm, 13-6mm,6-3 mm and 3-0.5 mm finer coals further increases iron oxide in the constituted samples to 69.4, 81.9 and 87.3 per cent of total oxide in bulk coal ash. This results in depletion of iron oxide in coal ash of finer constituted samples which now analyze 38.9, 30.6, 18.1 and 12.5 per cent iron oxide of the bulk coal ash respectively.

Keywords: *Ash constituents, iron oxide.*

Introduction

Power generation for serving the needs of a township or a localized utility point has become obsolete as the concept of developing a massive generation facility in a limited area, serving as power hub for distribution of power through national grids has gradually taken shape. We have now Korba, Singrauli, Talcher and many more power hubs generating power for major part of our country. This avoids transportation bottleneck on rail tracks for transportation of coal to long distances and with more efficient mega power plants with improved conversion efficiencies, cost of generation per unit of electricity has improved. But this has also resulted in massive production and accumulation of ash coming out of power plants posing safe handling and storage problems for this extremely hazardous material. To appreciate the bulk of ash production utilizing our high ash coals, let us consider total ash generated in a year when 10 million tonnes of coal is combusted in power plants in and around Korba, Bilaspur and Raigarh regions in a year when the amount of ash generated would be around 4.2 million tonnes and about 1.26 lac tonnes of iron oxides per annum. This may be annual production target of some raw material in a small country. Again coal ash is known to contain almost all the elements of periodic table in oxide or other chemical forms, some in major proportions while others in trace or minor quantities. The major constituents of ash include silica SiO_2, alumina Al_2O_3, ferric oxide Fe_2O_3, lime CaO and magnesia MgO. Oxides of titanium TiO_2, manganese Mn_3O_4, phosphorous P_2O_5, potassium K_2O and sodium. Na_2O are present in minor quantities while As, Zn, Sb, Bi, Hg, Ni, Cu, Co are present in trace quantities, some of these come out in gaseous form in flue gases. Thus considering the chemical constituents of ash, this bulk of industrial hazard can be gainfully exploited for its chemical values adding value to combustion of coal for power generation.

Again since we fractionate coals on the basis of size and/or density to obtain a desired ash coal for a given plant appliance while the remaining coal produce serves as fuel for some other industry, we need to identify which product will have ash more concentrated for a given ash constituent for its gainful isolation before the residual material is processed for remaining constituents in a composite plan.

Now in our context, we have a large infrastructure for production of sponge iron in close proximity of our power hubs in Chhattisgarh and Odisha region. Since coal ash has around 2-4 per cent of ferric oxide and the industrial waste from aluminium plants in these states is also having large iron oxide content, the ash and red mud can be looked upon as a source of ferric oxide for our sponge iron plants if only we have a large chemical out fit to isolate major and minor ash constituents.

The present studies are devoted to follow distribution pattern of iron as ferric oxide, an important constituent of coal ash on fractionating a bulk coal sample from Kusmunda colliery, Korba coalfield in different size fractions.

Experimental particulars

A bulk coal sample has been drawn from the Kusmunda area, Korba coalfield. After proper mixing, a definite quantity of sample has been transported to CIMFR laboratory, Bilaspur. The bulk coal sample was made to pass through 100 mm screen, manually crushing any plus 100 mm material left on the screen. Subsequently the minus 100 mm material was put on 25mm screen and material retained on the screen was

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separated as 100-25 mm size fraction. Following the same scheme, remaining minus 25 mm material was passed through 13 mm screen to obtain 25-13 mm size fraction. Using 13mm, 6 mm, 3mm, and 0.5mm screens similarly 13-6mm, 6-3mm, 3-0.5mm and -0.5mm were separated. Individual size fractions were weighed and crushed to prepare x 72 mesh laboratory samples as per BIS: 436, (Part 1/ Section 1) - 1964 and BIS: 436, (Part 2/ Section 2) - 1976 for characterization studies. Again by mixing proportionate weights of x 72 mesh laboratory samples an overall sample was obtained to represent the original bulk sample in quality and property parameters. Constituted broad size fractions were also prepared using proportionate weights of related size fractions. The samples were subjected to characterization studies including chemical analysis of coal ash.

For the characterization studies methodologies as contained in Indian Standard specifications BIS: 1350 Part I, 1984 second revision, have been followed. Chemical analysis of coal was done following specifications as contained in BIS 1355-1984 and using analytical grade reagents. .

Results and discussion

Results of characterization studies have been presented in Table 1. The moisture in coal being dependent on ambient laboratory conditions, the results have been recast on dry basis to avoid any variation on account of weather conditions or otherwise.

TABLE 1: CHARACTERIZATION STUDY OF DIFFERENT SIZE FRACTIONS AND BULK SAMPLES

Size fraction	Weight%	Dry ash%	Ash as % of mass of size consist	Ash as per cent of total ash in bulk coal
100-25 mm	54.9	40.4	22.18	61.10 %
25-13 mm	8.8	35.3	3.10	8.54 %
13-6 mm	13.1	32.4	4.24	11.68 %
6-3 mm	6.2	26.4	1.64	4.52 %
3-0.5 mm	10.1	26.3	2.66	7.33 %
-0.5 mm	6.9	35.9	2.48	6.83 %
Bulk coal	100.0	36.3	36.30	100 %

The results of screen analysis reveal that in 100 tonnes of coal produced, 100-25mm size contributed 54.9 tonnes, 25-13mm size contributed 8.8 tonnes, 13-6mm size 13.1 tonnes, 6-3mm size 6.2 tonnes, 3-0.5mm size 10.1 tonnes and the rest 6.9 tonnes were contributed by -0.5mm fines..

The 100-25mm size fraction analyses 40.4 ash dry, this is higher than analyzed by any other size material as also the bulk coal sample. The fraction retains 22.18 part of the total bulk coal ash amounting to 61.1 per cent of the total ash

The 25-13 mm size material analyses 35.3 per cent ash, near similar to ash (35.9 %) found for minus 0.5 mm size fraction. This represents 3.10 part or 8.54 per cent of the total ash in the bulk coal sample.

The ash in 6-3mm and 3-0.5mm size fractions has been found to be lowest with 26.4 and 26.3 per cent respectively representing 1.64 and 2.66 part or 4.52 and 7.33 per cent of total coal ash.

The 13-6 mm size fraction analyses 32.4 per cent ash forming 4.24 parts or 11.68 per cent of the bulk coal ash. The minus 0.5 mm fines have retained 2.48 parts amounting to 6.83 per cent of the bulk coal ash. Thus from 100-25mm size to 3-0.5mm size, ash percentage is found decreasing while in -0.5mm, the finest size coals, the ash percentage is increased by about 10 units from that for 3-0.5mm size. In bulk coal, the ash per cent is 36.3 which is nearer to the ash of -0.5mm fines.

The coal ash for individual size consists as also the constituted bulk coal samples were subjected to ash analysis. The results in respect of iron oxide content in these samples have been summarized in Table 2 in terms of per cent of ash.

TABLE 2: IRON OXIDE DISTRIBUTION IN DIFFERENT SIZE FRACTIONS, KUSMUNDA COALS, KORBA CF

Size fraction (mm)	Wt%	Ash dry%	Fe_2O_3%
100-25	54.9	40.4	1.55
25-13	8.8	35.3	2.01
13-6	13.1	32.4	2.19
6-3	6.2	26.4	2.53
3-0.5	10.1	26.3	3.32
-0.5	6.9	35.9	4.03
Bulk sample	100	36.3	1.99

It is seen that iron oxide per cent for ash samples of different size fractions as also the bulk coal ash ranges between 1.55 and 4.03 per cent.

The 6-3 mm and 3-0.5 mm fractions analyze 2.53 and 3.32 per cent iron oxide while the 100-25 mm large coal ash analyzes 1.55 per cent iron oxide and -0.5mm fine size analyzes 4.03 per cent Iron oxide.

Table 3 presents retention of iron oxide in different size fractions in terms of mass.

TABLE 3: DISTRIBUTION OF IRON OXIDE IN DIFFERENT SIZE FRACTIONS

Size fraction	Wt (in tonnes)	Iron oxide in tonnes	Iron oxide as % of mass of size consist	Iron oxide as part of iron oxide in bulk coal
100-25 mm	54.9	0.34	0.63	47.3
25-13 mm	8.8	0.06	0.71	8.7
13-6 mm	13.1	0.09	0.71	12.9
6-3 mm	6.2	0.04	0.67	5.8
3-0.5 mm	10.1	0.09	0.87	12.2
-0.5 mm	6.9	0.10	1.45	13.1
Bulk coal	100.0	0.72	0.72	100

From Table 3 it can be seen that 100 tonnes of the bulk coal contains 0.72 tonnes iron oxide in its ash. Of this 0.34 tonnes iron oxide is present in 100-25mm, 0.06 tonnes iron oxide in 25-13mm, 0.09 tonnes in 13-6mm and 3-0.5mm each and 0.10 tonnes iron oxide is present in -0.5mm size material.

It is discernible that the iron oxide contained in individual size consists is essentially related to weight contribution of these size fractions in the bulk coal sample and their ash percentage. As the 100-25mm size consist represents 54.9 per cent of the bulk coal sample and has higher ash content as well, the quantum of iron oxide produced on its combustion is also pretty high. It is found to be 0.34 tonnes from combustion of 54.9 tonnes of the size consist. This represents 47.3 per cent of total iron oxide of the bulk coal sample and 0.63 per cent of the weight of size consist burnt.

The 25-13 mm material represents 8.8 per cent of the bulk coal and analyses 35.3 per cent ash. 8.8 tonnes of this material on combustion would generate 0.06 tonnes of iron oxide which is 8.7 per cent of total iron oxide of the bulk coal sample and 0.71 per cent of the mass of the size consist.

The 13-6 mm size material forms 13.1 per cent of the bulk coal and analyses 32.4 per cent ash. The iron oxide produced on combustion of 13.1 tonnes of this material would be 0.09 tonnes representing 12.91 per cent of total Iron oxide of bulk coal sample and 0.71 per cent mass of the size consist.

The 6-3 mm size consist represents 6.2 per cent of the bulk coal sample and is found to analyze 26.4 per cent ash., the iron oxide produced on its combustion would be 0.04 tonnes This represents 5.8 per cent of total iron oxide of the bulk coal sample and 0.67 per cent of the size consist burnt.

The 3-0.5 mm size consist represents 10.1 per cent of the bulk coal sample and analyses 26.3 per cent ash. Iron oxide produced would be 0.09 tonnes from combustion of 10.1 tonnes of the size consist. This would be 12.2 per cent of total iron oxide of the bulk coal sample and 0.87 per cent of the size consist burnt.

The minus 0.5 mm fines representing 6.9 per cent of the bulk coal sample analyses 36.3 per cent ash. 0.10 tonnes of iron oxide would be produced from combustion of 6.9 tonnes of the size consist. This represents 13.1 per cent of total iron oxide of the bulk coal sample and 1.45 per cent of the size consist burnt.

Thus the lower size fractions are found to retain comparatively higher proportions of total iron oxide.

Distribution of iron oxide in constituted coal samples

In order to obtain coal dispatches for specific industries, it is generally advisable to screen the total coal produced of the mine on one or two screens only. The effect of this exercise can be perceived on reconstituted samples as discussed below.

By mixing of proportionate weights of different size fractions, some new constituted samples have been obtained as +25mm and -25mm, +13mm and -13mm, +6mm and -6mm, +3mm and -3mm, and +0.5mm and-0.5 mm size. These samples were subjected to characterization studies and ash analysis to follow distribution pattern of iron oxide silica. The results are presented in Tables 4 and 5.

TABLE 4: RESULTS OF CHARACTERIZATIONS OF CONSTITUTED SAMPLES, KUSMUNDA COALS

Size fraction (mm)	Wt%	Ash dry%	Fe_2O_3%
+25 mm	54.9	40.4	1.55
-25 mm	45.1	31.3	2.76
+13 mm	63.7	39.7	1.58
-13 mm	36.3	30.3	3.00
+6 mm	76.8	38.4	1.66
-6 mm	23.2	29.2	3.54
+3 mm	83.0	37.5	1.70
-3 mm	17.0	30.2	3.90
+0.5 mm	93.1	36.3	1.83
-0.5 mm	6.9	35.9	4.44
100-0 mm	100	36.3	1.99

TABLE 5: DISTRIBUTION OF IRON OXIDE Fe_2O_3 IN DIFFERENT CONSTITUTED SIZE FRACTIONS

Size fraction	Wt % (in tonnes)	Iron oxide in tonnes	Iron oxide as % of mass of size consist	Iron oxide as part of iron oxide in bulk coal
+25 mm	54.9	0.34	0.63	47.3
-25 mm	45.1	0.38	0.84	52.7
+13 mm	63.7	0.40	0.64	55.6
-13 mm	36.3	0.32	0.87	44.4
+6 mm	76.8	0.49	0.65	68.1
-6 mm	23.2	0.23	0.96	31.9
+3 mm	83.0	0.54	0.65	75.0
-3 mm	17.0	0.18	1.07	25.0
+0.5 mm	93.1	0.63	0.68	87.5
-0.5 mm	6.9	0.09	1.36	12.5

The results immediately show that the coarser size consists +25 and +13 mm material analyses ash in the range of 40 per cent and represent major chunk of coal production at 54.9 and 63.7 per cent level. The +6, +3 and +0.5 mm material also analyzes higher ash in the range of 36.3-38.4 per cent.

All the finer sizes, the -25, -13, -6, and -3 mm size consists analyze nearly 10 units lower in ash as compared to their coarser counterparts. The +0.5 and -0.5 mm material, however, have practically similar ash, closer to the bulk coal but still about 4 units lower that the +25 and +13 mm material.

The iron oxide per cent in all the plus or coarser size constituted samples has been within 1.55-1.83 % of ash, nearly 2-3 units lower than the finer constituted samples which range between 2.76-4.44 % of ash.

Retention of iron oxide in different constituted samples in terms of total iron oxide present in bulk coal ash has been given below for ease of appreciation.

As we include more and finer sizes in the constituted samples, the amount of iron oxide in ash generated on combustion of the constituted sample goes on increasing. Thus on combustion of 54.9 tonnes of +25 mm material, iron oxide in coal ash generated would amount to 0.34 tonnes, this is 47.3 part of the iron oxide in the bulk coal sample and forms 0.63 per cent of the mass of size consists combusted. Corresponding -25 mm material retains 0.38 tonnes of iron oxide which would be 52.7 parts of total iron oxide in bulk coal and 0.84 per cent of the mass of the size consist. Similarly, +13 mm material retains 0.40 tonnes of iron oxide which constitutes 55.6 per cent of total iron oxide of the bulk coal and 0.64 per cent of the mass of size consist. The -13 mm constituted sample retains 0.32 tonnes of iron oxide forming 44.4% of the total iron oxide of the bulk sample and 0.87 per cent by weight of the size consist. The +6mm constituted sample has retained 0.49 tonnes of iron oxide constituting 68.1 parts of iron oxide in the bulk coal. This is 0.65 per cent of the mass of the size consist.

The iron oxide retained in -6 mm material is 0.23 tonnes, which would be 31.9 parts of the total iron oxide in bulk coal sample and 0.96 per cent of the mass of the size consist. Similarly +3 mm material retains 0.54 tonnes of iron oxide representing 75.0 parts of iron oxide in the bulk coal sample and forming 0.65 per cent by weight of the size consist. The +0.5 mm constituted sample retains 0.63 tonnes of iron oxide which would be 87.5 parts of the iron oxide in the bulk coal and forms 0.68 per cent mass of the size consist. The remaining -0.5 mm fines have 0.09 tonnes of iron oxide representing 12.5 parts of the bulk coal iron oxide and 1.36 per cent of mass of the size consist.

From quality results of different size fractions and constituted samples it is seen that the +25 mm coarse coal and -0.5 mm fines have pretty high ash and their inclusion in finer constituted samples has adversely affected the quality of such coals while the incorporation of -0.5 mm fines in coarser coals only helps reduce the effect of presence of high ash +25 mm coals.

The effect of addition of 6.9 tonnes of -0.5 fines in the coarser material would reduce the ash burden in resultant excluding -0.5 mm finer constituted samples without having any adverse effect on the quality of coarser coals. The results of the exercise have been compiled in Tables 6 and 7.

It is seen that the coarser constituted samples on inclusion of -0.5 mm fines still maintain their ash levels near similar to what they had when the -0.5 fines were not added.

However, the corresponding finer constituted samples have rather improved in quality with decrease in their ash by 1 to 3 units. The iron oxide as per cent of ash is higher in the finer or minus constituted samples as compared to the corresponding coarser plus constituted samples.

TABLE 6: RESULTS OF CHARACTERIZATION OF CONSTITUTED SAMPLES, KUSMUNDA COALS

Size fraction (mm)	Wt%	Ash dry%	Fe_2O_3%
+25 incl. (-0.5)	61.8	39.9	1.78
-25 excl. (-0.5)	38.2	30.4	2.41
+13 incl. (-0.5)	70.6	39.4	1.80
-13 excl. (-0.5)	29.4	29.0	2.58
+6 incl. (-0.5)	83.7	38.3	1.84
-6 excl. (-0.5)	16.3	26.2	3.04
Bulk sample	100	36.3	1.99

TABLE 7: DISTRIBUTION OF IRON OXIDE IN DIFFERENT RECONSTITUTED SIZE FRACTIONS

Size fraction	Wt % (in tonnes)	Iron oxide in tonnes	Iron oxide as % of mass of size consist	Iron oxide as part of iron oxide in bulk coal
(+25 incl.-0.5 mm)	61.8	0.44	0.72	61.1
(-25 excl.-0.5 mm)	38.2	0.28	0.73	38.9
(+13 incl.-0.5 mm)	70.6	0.50	0.72	69.4
(-13 excl.-0.5 mm)	29.4	0.22	0.74	30.6
(+6 incl.-0.5 mm)	83.7	0.59	0.71	81.9
(-6 excl.-0.5 mm)	16.3	0.13	0.76	18.1
(+3 incl.-0.5 mm)	89.9	0.63	0.71	87.5
(-3 excl.-0.5 mm)	10.1	0.09	0.82	12.5

As the -0.5mm size is included in coarser size, the contribution of iron oxide is increased in plus sizes while decreased in minus sizes. In (+25 incl. -0.5mm) size, 0.44 tonnes iron oxide is present leaving 0.28 tonnes iron oxide retained in (-25 mm excl. -0.5mm) size. This represents 61.1 part of total iron oxide of the bulk coal and 0.72 per cent weight of the size consist.

In the same pattern, (+13 incl.-0.5mm) size is found to contain 0.50 tonnes of iron oxide representing 69.4 per cent of the bulk coal iron oxide and 0.72 per cent of the mass of the size consist.

The (+6 incl. -0.5mm) mm material retains 0.59 tonnes of Iron oxide forming 81.9 part of the total iron oxide of the bulk sample and 0.71 per cent mass of the size consists.

The (+3 incl. -0.5mm) has retained 0.63 tonnes of total iron oxide representing and 87.5 parts of iron oxide in bulk coal and 0.71 per cent of the mass of the size consist.

The finer minus constituted samples excluding the contribution of -0.5 mm fines have retained comparatively lower iron oxide in their ash. In (-25 excl -0.5mm) size, 0.28 tonnes iron oxide is present. This represents 38.9 parts of total iron oxide of the bulk coal and 0.73 per cent weight of the size consist.

Similarly the (-13 excl.-0.5mm) size constituted sample is found to contain 0.22 tonnes of iron oxide representing 30.6

per cent of the bulk coal iron oxide and 0.74 per cent of the mass of the size consist.

The (-6 incl. -0.5mm) mm material retains 0.13 tonnes of iron oxide forming 18.1 parts of the total iron oxide of the bulk sample and 0.76 per cent mass of the size consists.

The (-3 excl. -0.5mm)sample has retained 0.09 tonnes of total iron oxide representing 12.5 parts of iron oxide in bulk coal and 0.82 per cent of the mass of the size consist.

Summary

Large amount of ash is generated in regions of power hubs needing careful handling and storage. Since coal ash is known to contain a number of major and minor ash constituents of commercial significance the huge tonnage of ash generated in our plants can be treated as source material for some commercially important constituents.

To evaluate the movement and distribution pattern of iron oxide with different sizes fractions and constituted samples a bulk coal sample from Kusmunda area, Korba coalfield has been taken for study.

Different size fractions were obtained following standard specifications following BIS: 436, (Part 1/ Section 1) - 1964 and BIS: 436, (Part 2/ Section 2) - 1976 for characterization studies and chemical analysis of ash as per BIS: 1350 Part I, 1984 (2nd revision) and BIS: 1355- 1984.

The isolated size factions differ in their mass representation in the bulk coal, the 100-25 mm coarser size forming the major chunk representing 54.9 per cent of the mass of coal production.

The bulk coal sample analyzed 36.3 per cent ash. Of different size fractions, the 100-25mm size material analyzed 40.4 per cent ash suggesting shade higher concentration of ash forming mineral in the coarser coals. The 6-3mm and 3-0.5mm sizes have analyzed nearly 10 units lower ash than the bulk sample.

The 13-6mm material has analyzed 32.4 per cent ash while 25-13 mm material and minus 0.5mm fines have ash near similar to the bulk coal.

Iron oxide as per cent of ash has been nearly same and varies within 2 units amongst different size fractions.

In terms of iron oxide retained in different size fractions as part of total iron oxide in the bulk coal sample, and as per cent of mass of the size consist, the distribution pattern changes according to the weights and ash content of the size consists..

The total iron oxide in the present bulk coal sample from Kusmunda area is 0.72 tonnes. Of this, 0.34 tonnes iron oxide is present in 100-25mm, 0.06 tonnes iron oxide in 25-13mm, 0.09 tonnes in 13-6mm, 0.04 tonnes in 6-3mm, 0.09 tonnes in 3-0.5mm and 0.10 tonnes iron oxide is present in -0.5mm size materials. These form 47.2, 8.7, 12.9, 5.8, 12.2 and 13.1 per cent of the total iron oxide. In terms of the mass of the size consist, these amounts to 0.63, 0.71, 0.71, 0.67, 0.87 and 1.45 per cent of the mass.

In commercial practice, coals are screened on one or two screens only to obtain desired quality production for coal utilization. The conditions can be simulated in the laboratory by mixing proportionate weights of specific size fractions to constitute required quality product.

Distribution of ash and iron oxide in such constituted samples shows that on inclusion of finer sizes, their cumulative iron oxide concentrations increases from 47.3 to 87.5 per cent of the total iron oxide in higher sizes and decreases in sizes from 52.8 to 12.5 per cent.

Out of 0.72 tonnes of total iron oxide in the bulk coal sample, the +25mm size contains 0.34 tonnes and -25mm size contains 0.38 tonnes iron oxide. This constitutes 47.2 and 52.8 per cent of the total iron oxide respectively and represents 0.63 and 0.84 per cent mass of the size consists. In the +13mm, +6mm, +3mm, and +0.5mm size constituted samples , 0.40, 0.49, 0.54 tonnes and 0.63 tonnes iron oxide has respectively been retained while the corresponding -13mm, -6mm, -3mm and -0.5mm size consists have 0.32, 0.23, 0.18 and 0.09 tonnes iron oxide respectively.

The minus 0.5 has comparatively higher ash and therefore contributes larger dosage of iron oxide in the finer (minus size) reconstituted samples. On inclusion of the -0.5 mm fines with coarser reconstituted samples, the quality of the product will not be affected adversely while the finer reconstituted samples will show sizeable improvement in their quality.

Thus when -0.5mm material is mixed in different coarser reconstituted samples, the Iron oxide contribution would be 0.44, 0.50, 0.59 and 0.63 tonnes respectively in +25 mm, +13mm, +6 mm and + 3mm constituted samples.

The corresponding -25, -13, -6 and -3 mm size consists on removal of the -0.5 mm fines have now 0.28, 0.22, 0.13 and 0.09 tonnes of iron oxide retained in them. The retentions of total iron oxide increases from 61.1 parts to 87.5 parts of iron oxide in the bulk coal for the coarser size samples while for the finer size reconstituted samples the retention decreases from 38.9 to 12.5 parts for corresponding reconstituted samples.

Conclusion

In coal ash generated on combustion of 100 tonnes of bulk coal from Kusmunda area, Korba coalfield, the amount of iron as ferric oxide is found to be 0.72 tonnes. Of this, the +25 mm size consists retains 0.34 tonnes of iron oxide in its ash forming 47.2 per cent of total iron oxide of the bulk coal ash. Inclusion of -0.5 mm fines further increases iron oxide in the constituted sample (+25 mm incl. -0.5 mm) to 0.44 tones or 61.1 per cent of total oxide in bulk coal ash. Further addition of 25-13 mm, 13-6 mm, 6-3 mm and 3-0.5 mm finer sizes in the

constituted sample increases iron oxide to 69.4, 81.9 and 87.3 per cent. This results in the corresponding finer constituted samples -25 mm,-13mm,-6mm and -3 mm (without contribution of -0.5 mm fines in them) poorer in iron oxide which would now be 38.9, 30.6, 18.1 and 12.5 per cent of oxide in the bulk coal ash respectively.

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References

1. Sarkar, G. G.: "An introduction to Coal Preparation Practice."
2. BIS 436 (Part I, 1964): Sampling of coal.
3. Tsai, S. C. (1982): "Fundamentals of Coal Beneficiation and Utilization" Elsevier Scientific Publishing Company, Amsterdam-Oxford-New York, 1982.
4. BIS 1350 (Part I), 1984: Proximate analysis.
5. Vlado, Valkovic (1983): "Trace Elements in Coal," Vol-II, CRC Press, 1983.
6. BIS 1355, 1984: Methods of determination of the chemical composition of the ash of coal and coke.
7. Unpublished Annual reports of Central Fuel Research Institute, Bilaspur Unit.
8. Cooper, Bernard R. and Ellingson, William A. (1984): "The Science and Technology of Coal and Coal Utilization," 1984, Plenum Press, New York.
9. Sarkar, Samir (1990): Second edition, Orient Longman Limited, Bombay, 1990.
10. Tripathy, Prem S. and Mukherjee, S. N. (1997): "Perspectives Of bulk use of fly ash," CFRI Golden Jubilee Monograph, Allied Publishers Limited 1997.

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