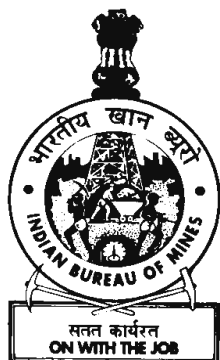


RESEARCH & DEVELOPMENT



Indian Minerals Yearbook 2015

(Part- I : GENERAL REVIEWS)

54th Edition

RESEARCH & DEVELOPMENT

(FINAL RELEASE)

**GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES**

Indira Bhavan, Civil Lines,
NAGPUR – 440 102

PHONE/FAX NO. +91712 – 2565471, 2562216

PBX : +917 12 - 2562649, 2560544, 2560648

E-MAIL : cme@ibm.gov.in

Website: www.ibm.gov.in

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5 Research & Development

The Science and Technology (S&T) programmes of the Ministry of Mines, Government of India, cover the disciplines of Geology, Exploration, Mining, Bioleaching, Beneficiation, Rock Mechanics, Ground Control and Non-ferrous Metallurgy and Environmental issues related to Mining and Metallurgy. A meeting was held on 04.12.2014 by Project Evaluation and Review Committee (PERC). Based on Committee's scrutiny report, Standing Scientific Advisory Group (SSAG) considered and recommended Grant-in-Aid under S & T programme of the Ministry of Mines. The SSAG approved Eleven project proposals for Grant-in-Aid under the S&T Programme and recommended extension of project period up to 31st March 2015 for five on-going projects.

The highlights of work carried out during 2014-15 by IBM relating to mineral beneficiation and mining & environment are given below:

BENEFICIATION

CHROMITE

Bench Scale beneficiation studies on a low grade Chromite (Feed) sample from M/s Misrilall Mines (P) Ltd, Saruabil, Distt Jajpur, Odisha -
A low grade Chromite (Feed) sample from M/s Misrilall Mines (P) Ltd, Saruabil Distt Jajpur,

Odisha collected under Regional Mining Geological Studies and conducting bench scale beneficiation studies at Modern Mineral Processing Laboratory and Pilot Plant, IBM, Nagpur to confirm the grade and recovery of the operating plant and further expedite the possibilities of improving them and minimising the tailing losses of valuables, if possible. The aim of the investigation was to produce a chromite concentrate suitable for industrial use and to reduce Cr₂O₃ content below 10% in the tailings.

The as received sample assayed 34.87% Cr₂O₃, 15.73% Fe, 8.23% Al₂O₃, 23.34% SiO₂, 0.24% CaO, 8.31% MgO, 0.24% TiO₂ and 2.39% LOI. By adopting beneficiation route of wet sieving of as received sample followed by tabling of -50 +325 mesh sieve fraction followed by dry high intensity magnetic separation of table middling and multi gravity separation of -325 mesh sieve fraction yielded the composite concentrate assayed 54.29% Cr₂O₃, 12.79% Fe, 10.72% Al₂O₃, 8.83% SiO₂, 0.20% CaO, 7.10% MgO, 0.34% TiO₂ and 47.33% LOI with 83.6% Cr₂O₃ recovery (wt% yield 53.0).

A chromite concentrate with a higher grade as well as recovery could be obtained and the tailing losses could also be minimised to 6.66% Cr₂O₃.

GOLD ORE

Beneficiation studies on a Gold ore sample from Togo, for M/s VSR Trading Limited, Hyderabad-

A Gold ore sample from Togo, (Africa) was sent by M/s VSR Trading Limited, Hyderabad for beneficiation studies at RODL, IBM, Bengaluru.

The objectives of the investigations were to (i) Carry out detailed chemical analysis and mineralogical studies and (ii) to recover gold by ore dressing techniques with maximum recovery.

The as received sample assayed 18.88 ppm Au, 10.69 ppm Ag, 83.31% SiO₂, 4.63% Al₂O₃, 3.90% Fe₂O₃, 1.25% LOI, 0.14% MgO, 1.69% CaO and 0.27% Na₂O.

By adopting tabling process, the table conc. assayed 142.21 ppm Au with 42.2% recovery (Wt% yield is 5.3).

The pre-concentrate of the ore by tabling followed by cyanide leaching tests on table rejects ground to minus 200 mesh resulted in 95.2% gold recovery with residue assaying 0.83 g/t gold.

Direct cyanidation on ground original sample at minus 200 mesh size, resulted 94.3% gold recovery. Leach residue assayed 1 g/t Au.

IRON ORE

1) Bench Scale Beneficiation Studies on a Low-grade ROM Iron Ore Sample from Shahgarh Area, Distt Sagar, M.P. for M/s S.V. Modi Mines, Shahgarh, Distt Sagar, Madhya Pradesh - A low-grade ROM iron ore sample was received from M/s S.V. Modi Mines, Shahgarh, Distt Sagar, M.P.,

for bench scale beneficiation studies at the Modern Mineral Processing Laboratory & Pilot Plant, Indian Bureau of Mines, Nagpur. The objective of the study was to explore the possibility of obtaining value added product for its better marketability.

The ROM sample assayed Fe (T) - 43.66%, SiO₂ - 21.71%, Al₂O₃ - 6.66%, TiO₂ - 0.51%, CaO - 0.68%, MgO - 0.50%, P - 0.14%, Mn - 0.14% and LOI - 5.75%.

The major iron minerals are goethite/limonite and haematite. Quartz is the major gangue mineral with subordinate amount of clay, very minor amount of mica (muscovite, biotite) and trace amount of pyroxene (diopside), carbonate (calcite) and talc.

It is inferred from the beneficiation studies carried out that the sample can yield only a blendable grade (over 55% Fe) iron ore concentrate. By adopting beneficiation process viz. screening of ROM ore to three size fraction of -80+40/50 mm, -40/50+18 mm and -18 mm. The screen oversize (+40/50 mm) is resorted to hand picking of heavy iron ore lumps rejecting quartz. The intermediate screen size of +18 mm is reduced to all -18 mm size. The entire -18 mm (inclusive of screen undersize of -18 mm) is then screened over 5 mm size and screen undersize is rejected. The -18+5 mm size fraction is then processed deploying Jig (air/water) to obtain jig concentrate rejecting lighter gangue as jig tails.

RESEARCH & DEVELOPMENT

The evolved process route of beneficiation could produce a composite iron ore lump (-80+40/50 mm and -18+5 mm) concentrate assaying 55-58% Fe(T), 3.7-4.1% Al_2O_3 , 7.90-8.20% SiO_2 & 4.10-4.26% LOI with iron recovery of 43 to 47% (%wt. yield 42-47).

The blendable grade lumpy concentrate produced from a very low-grade ROM iron ore may find its use in DRI production.

2) Beneficiation studies on an Iron Ore sample from Jabalpur, Madhya Pradesh for M/s Gulf Ispat Limited, Jabalpur - An Iron ore sample from Jabalpur mines, Madhya Pradesh was sent by M/s Gulf Ispat Limited, Jabalpur for beneficiation studies at the RODL, IBM, Bengaluru. The objectives of the investigation were to (i) Carry out chemical analysis and mineralogical studies & (ii) upgrade the ore to +60% Fe(T) by ore dressing techniques with maximum Fe(T) recovery.

The as received sample assayed 46.20% Fe(T), 22.02% SiO_2 , 5.33% Al_2O_3 , 2.36% LOI, 0.064% CaO, 0.07% MgO, 1.30% Mn, 0.10% P and 0.52% TiO_2 .

By adopting tabling process on -48 mesh size obtained table concentrate. The wet high intensity magnetic separation process carried out on (i) table middling and tails & (ii) mixed minus 100 mesh, obtained magnetic and non magnetic product. The table concentrate and both magnetic

concentrate were combined to get combined concentrate assaying 60.38% Fe(T), 5.61% SiO_2 , 3.14% Al_2O_3 , 1.32% Mn, 0.06% P and 0.45% TiO_2 with 85.6% Fe(T) recovery (Wt.% yield 65.3).

The iron ore sample was upgraded from 46.20% Fe(T) to 60.38% Fe(T) with 85.6% Fe(T) recovery.

LIMESTONE

A low-grade Limestone sample from Kovaya, Distt Amreli, Gujarat of M/s UltraTech Cement Ltd - A low grade limestone sample from Kovaya, Distt Amreli, Gujarat of M/s UltraTech Cement Ltd was successfully tested on bench scale to produce a concentrate suitable for cement industry assaying 45.05% CaO, 2.22% Al_2O_3 , 1.79% Fe_2O_3 and 12.55% SiO_2 with CaO distribution of 69.0% (wt% yield 41.4). The concentrate produced was from a low grade limestone ore assaying 26.84% CaO, 6.16% Al_2O_3 , 6.55% Fe_2O_3 and 31.14% SiO_2 . The process comprised of scrubbing of the as received sample followed by screening and direct flotation of -50 mesh screened product, eliminating the grinding circuit. The +50 mesh fraction and flotation concentrate were combined. Thus a simple and cost effective flow sheet was developed.

ROCK PHOSPHATE

Bench scale beneficiation studies on a low-grade Rock Phosphate sample from Jhamarkotra, Udaipur, Rajasthan for M/s Hindustan Zinc Ltd - A low-grade Rock phosphate sample from the Jhamarkotra mines, Udaipur Distt., Rajasthan was sent by M/s Hindustan Zinc Ltd at RODL, IBM, Ajmer for bench scale beneficiation studies. The objective of the investigation were a) to produce a upgraded phosphate concentrate; b) reduce the iron, silica and alumina in the phosphate concentrate.

The as received sample assayed 10.42% P_2O_5 , 15.20% CaO, 6.62% Fe_2O_3 , 4.01% Al_2O_3 , 56.28% SiO_2 , 0.02% MgO, 0.14% Na_2O , 0.97% K_2O , 0.02% S(T), 1.12% BaO, 0.22% TiO_2 , 4.61% LOI (including Moisture 0.11%). By adopting flotation test studies, the final concentrate obtained assaying 30.03% P_2O_5 , 2.81 % Fe_2O_3 , 0.92% Al_2O_3 , 8.84% SiO_2 with 78.9% recovery (Overall Wt % yield 27.6).

The Rock phosphate concentrate generated meets the specifications for the elemental Rock phosphate-Type-1 and can be used after blending with high-grade ores, because it's ($Al_2O_3 + Fe_2O_3$) content is slightly higher.

Tailing sample from Jhamarkotra Phosphate Processing plant:

Development of Mineral Processing flow sheet to recover the phosphate mineral from a tailing sample from Jhamarkotra Phosphate Processing plant for M/s Jai Drinks Pvt. Ltd, New Delhi - A tailing sample from Jhamarkotra Phosphate Processing plant was send by M/s Jai Drinks Pvt. Ltd, New Delhi for bench scale beneficiation studies at RODL, IBM, Bengaluru. The main objective of the study was to recover the phosphate mineral from the sample which was misplaced during processing of run-of-mine and upgrade it to the level of saleable grade for different applications.

The as received sample assayed 7.86% P_2O_5 , 3.14% SiO_2 , 32.88% CaO, 13.62% MgO, 0.27% Al_2O_3 , 0.36% Fe_2O_3 , 0.56% Na_2O , 0.07% K_2O , 0.32% chlorine, 0.75% fluorine and 32.62% LOI.

By adopting floation test studies, the combined phosphate concentrate assayed 28.48% P_2O_5 with revovery of 78.0% (Wt.% yield 22.2).

Thus the process flow sheet developed is simple to operate and flexible to obtain various grade products.