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MINOR MINERALS

30.7 DUNITE & PYROXENITE

(ADVANCE RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

Indira Bhavan, Civil Lines,
NAGPUR – 440 001

PHONE/FAX NO. (0712) 2565471
PBX : (0712) 2562649, 2560544, 2560648
E-MAIL : cme@ibm.gov.in
Website: www.ibm.gov.in

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30-7 Dunite & Pyroxenite

Dunite is a monomineralic ultrabasic rock that consists of more or less pure olivine. Dunite typically contains 36 to 42% MgO and 36 to 39% SiO_2. Olivine is a commercial source of magnesia combined with silica that is mainly used in metallurgy, fertilizer, etc. Pyroxenite is also an ultrabasic rock that consists of pyroxenes, i.e., predominantly ferromagnesian minerals other than olivine. There is a rising trend in use of dunite and pyroxenite in sintering and as a fluxing agent in blast furnace in place of dolomite.

RESERVES/RESOURCES

In India, occurrences of dunite are reported in association with other ultrabasic rocks in chrysotile-bearing areas of Jharkhand and Karnataka; chromite-bearing areas in Odisha, Karnataka, Jharkhand & Nagaland; and magnesite-bearing areas in Karnataka & Tamil Nadu. As per the NMI database, based on UNFC system, the total reserves/resources of dunite in the country as on 1.4.2015 has been estimated at about 187.82 million tonnes of which 12.77 million tonnes constitute Reserves (about 10.85 million tonnes Proved Reserves and 1.92 million tonnes Probable Reserves) and 175.05 million tonnes Remaining Resources. Dunite resources are located mainly in Tamil Nadu (65%) and Karnataka (17%). The remaining 18% resources are in Jharkhand (9%), Odisha (6%) and Nagaland (3%). Reserves/Resources of dunite are furnished in Table-1.

The occurrences and production of pyroxenite are reported from Jajpur district in Odisha and Singhbhum (East) district in Jharkhand. However, no production data is available.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'Dunite & Pyroxenite' have been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. Production data for 'dunite & pyroxenite' is presently not available. However, 49,634 tonnes of dunite production was reported during the year 2019-20 as compared to that 25,031 tonnes produced last year i.e. 2018-19 predominantly by Karnataka state.

USES & SPECIFICATIONS

Dunite and pyroxenite are preferred as flux to dolomite as a source of MgO in sintering and also in Iron & Steel Industry. Main benefits of olivine over dolomite in slag conditioning are higher MgO content, no requirement of preheat treatment, low LOI, reduced energy consumption, lower coke consumption, reduced slag volume and lower CO_2 emissions. Presence of higher amount of silica in dolomite leads to lower sinter basicity (i.e. CaO/SiO_2) at around 2.5 than 3.5 of dolomite and the phases in sinter change to those having better reducibility. The net result is a reduction in the resistance of the cohesive zone to gas flow in the blast furnace leading to drop in fuel rate and higher productivity. In addition, the magnesium silicates do not call for calcination (unlike the carbonates) and thus lowers energy requirement in the blast furnace.

Olivine helps to condition the slag as well as to control the basicity through reduction of alkali recirculation. Its higher reaction temperature reduces low temperature breakdown and swelling of burden, thus, maintaining permeability and reducing coke consumption. Olivine could be added directly to the blast furnace charge as lump (10 to 40 mm), sinter feed (3 to 6 mm), or mixed with low silica iron ore fines and pressed into pellets.When lump is added

Table – 1 : Reserves/Resources of Dunite as on 1.4.2015
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
All India : Total	**10848**	**18**	**1901**	**12768**	**436**	**1925**	**108887**	**25202**	**1087**	**23832**	**13680**	**175049**	**187818**
By Grades													
Grade - I	4969	-	984	5953	264	-	37910	24516	780	11464	2328	77263	83216
Grade-II	5535	-	917	6452	172	1351	70976	686	307	7268	11352	92113	98565
Unclassified	345	18	-	363	-	574	-	-	-	5100	-	5674	6037
By States													
Jharkhand	123	-	262	385	264	-	448	607	780	6121	8637	16857	17242
Karnataka	3074	18	189	3282	-	-	34	23909	-	4606	-	28549	31831
Odisha	308	-	-	308	172	1925	6215	686	307	2531	-	11837	12145
Tamil Nadu	7343	-	1450	8793	-	-	102190	-	-	5773	5044	113007	121800
Nagaland	-	-	-	-	-	-	-	-	-	4800	-	4800	4800

Figures rounded off.

directly to the furnace, olivine can replace limestone partly and dolomite flux in the reduction of iron ore. In comparison with dolomite, olivine has higher MgO content (requires less material for a given MgO level), amenable MgO: SiO_2 ratio (allows MgO levels to be raised without changing the basicity of the slag) and lower LOI, i.e., 0.3-0.7% (conserves the energy required to drive off unwanted carbon dioxide). As a sinter feed, olivine reduces the sintering temperature as much as100°C, thus, producing harder sinter which in turn generates less fines. Olivine is added directly to the iron ore as flux during the production of pellets so that the fluxed pellets swell less, reduce more quickly and have narrower melting range. However, on the other side, high silica content in olivine restricts its use in low silica iron ores because high silica content creates excessive slag formation in the furnace.

Dunite is well-suited as a refractory material due to its low and uniform coefficient of thermal expansion. Besides, dunite exhibits properties, such as, good resistance to thermal shock; spalling and slag attack; high green strength; and resistance to metal attack. Dunite, calcined in rotary kilns at 1,650 °C increases its refractory and foundry applications. Other uses of olivine are as loose-grainshot blasting abrasive, filtration media, in mineral wool production, filler in speciality paints, asphalt, mastics and weighing agent in concrete oil production platforms. Olivine also contributes magnesia and iron as nutrients to the soil.

Olivine should contain 45 to 51% MgO, 40 to 43% SiO_2, 7 to 8% Fe_2O_3, 0.2 to 0.8% CaO and 1.8 to 2% Al_2O_3 and TiO_2, MnO, Cr_2O_3, NiO & CaO for various uses. For blast furnace use, olivine should contain 47 to 48% MgO with 10 to 40 mm lump size. For foundry use, the size should be AFS 20, 30, 60, 90, 120 and for Flour, Filler and Fertilizer grades, size recommended is up to 0.8 mm, up to 0.02 mm and less than 0.1 mm, respectively.

As per the end-use grade classification, the reserves of 'fresh' and 'weathered' dunite have been classified as Gr. I and Gr. II, respectively. However, recommendations to assign chemical specification to these grade based on the experience of Tata Steel Ltd and GSI have been incorporated.

FUTURE OUTLOOK

The importance of dunite as a fluxing agent is increasing in the low silica iron ores. It is also used as a refractory material. India has adequate resources of dunite and pyroxenite to meet all its future industrial applications. With increasing need to augment steel production, requirement of fluxes as well as refractories are bound to increase and India is self-sufficient as far as these minerals are concerned.