Mineral Resources & Industries in Goa

The State of Goa is a tiny emerald land on the west coast of the Indian Peninsula. The rich and varied mineral resources of the State have contributed handsomely towards the development and industrialization of the State. The landscape is mostly hilly forming part of the Western Ghats. The altitude varies from sea level to a maximum of 1700 metres above mean sea level. The territory is gifted with warm tropical climate and annual rainfall of 350 to 450 cms. during the monsoon seasons -June to October. The main rivers Mandovi and Zuari both flowing into the Arabian sea are navigable by barges used for transporting the ore.

The State of Goa is endowed with Mineral Resources. Iron ore, Manganese ore, Bauxite are minerals of economic importance. Besides there are minor minerals like Basalt, Laterite stones and rubbles, River sand, Murrum etc., which are in great demand as construction material. This industry is labour intensive and provides work to large number of people.

Mining in Goa today is synonymous with iron ore mining. Exploration for Iron ore started at the beginning of the 20th Century. Present day mining resumed in 1947 which marks the beginning of modern day mining and export of iron ore. The exports have steadily increased from 4,36,400 tonnes of iron ore in 1951 to 35 million tonnes in 2008-09. The Goan iron ore is exported to China, Japan, Taiwan, South Korea and Eastern European Countries.

Iron ore mining in Goa is completely in the private sector. The Iron ore deposits are distributed over the Northern, Southern and Central Blocks of Goa. The Northern Block deposits are richer both in terms of quality and quantity of the ore, as compared to the Southern and Central Blocks.

Infrastructure wise Goa has an advantage over other exporting regions in the countries in view of its being endowed with a deep sea port and waterways that crisscross the territory facilitating barge transport. The two rivers Mandovi and Zuari have proved to be a boon to the working industry as they provide cheap river transport. These two rivers and the Mormugao Harbour are nature’s gift and are natural resources of Goa.

The Bauxite Mines are situated in South Goa over an area of 1263.678 HA. with estimated reserves of 70 million tons. These are metallurgical grade bauxite which can also be used for various applications such as cement, alumina chemicals, etc. The mines are situated also in the close proximity of two major ports, viz. Marmugoa Port and Betul Port.

It has the following Minor Minerals reserves Basalt, Laterite, River sand, Laterite-Rubble, Laterite-boulders, Pebble, Murrum and Lime Shell. The Major Minerals reserves are Bauxite, Iron ore, Manganese ore etc.

Iron Ore – Major Mineral

- The Goan economy is heavily dependent on the iron ore industry in so far as the major share of the regional income from the mineral industry and its allied activities like transport and trade is concerned. The spurt in iron ore industry has started in 1955 subsequent to India’s economic embargo.

- Iron ore mining in Goa is completely in the private sector. Iron ore reserves in Goa are variously estimated to be around 1000 million tonnes. The Iron ore deposits in Goa are fines oriented. Around 80% of the deposits are fines and the rest lumps. Another peculiarity of Goan iron ore deposits is that the lumpy ore is of lower grade than the powdery ore. The iron ore deposits are distributed over the northern, southern and central blocks of Goa. The northern block deposits are richer both in terms of quantity and quality of the ore. All the large mines which produce over one million tonnes are situated in the northern block. The mines in the other two blocks are of medium size or small ones.
• Infrastructure wise, Goa has an advantage over other exporting regions in the country in view of its being endowed with a deep seaport and waterways that criss-cross the territory facilitating barge transport. Additionally most of the mines are located in close proximity to either of the two rivers Mandovi and Zuari. The average road linkage from the mine to the river loading points is around 30 km. Most of the mines are within 15 km. of the river loading points. The ore is loaded on to the barges mechanically and transported either to the ports mechanized ore berth or to the transhippers.

• The Goan Iron ore is export oriented. The present average annual export of iron ore from Goa is around 30 million tonnes.

**Bauxite /Aluminous Laterite – Major Mineral**

• The term bauxite is applied to the ores containing not less than 45-50% Al₂O₃ and not more than 20% Fe₂O₃ and 3-5% combined silica. It consists chiefly of hydrated aluminium oxides like gibbsite, bohemite, and diaspore. The impurities are silica, clay, silt, iron hydroxide and titania. It is formed in tropical and subtropical latitudes under good drainage conditions.

• The Goa bauxite falls in the group of inter tropical bauxite deposits and are associated with laterites derived from metamorphic rocks.

• The bauxite genesis occurs from silica, Alumina, and iron rich rocks; when silica is removed leading to enrichment of Al₂O₃ and Fe₂O₃ whereby silica values coming down from 40% to about 2-3%

• The rock formations generally found in Goa include quartzite and quartz-sericite schist, quartz-chlorite schist, metavolcanics, conglomerates, limestone, phylites, banded ferruginous quartzite, granitic gneisses and various basic and ultrabasic intrusives, etc. belonging to Precambrian. Deccan Trap lava flows are seen in the upper reaches of the ghats along the North Eastern border of Goa All these rocks are covered by laterites which assume up to 15m thickness near the coast. The laterite have been classified (Gokul, 1974) as:
  - Pink ferruginous laterite
  - Limonitic laterite
  - Aluminous laterite
  - Bauxitic laterite

The last one is pale pink to flesh red in colour whereas bauxite shows flesh red, cream and white colours.

The bauxite deposits can be grouped geographically into the following directiones as marked by GSI. Following are the well-known areas of bauxite occurrences in Goa as marked by GSI.

• North Goa deposits which include the area of Chapora river, Mopa area, Pernem area, Morgim area, Dargalim, Ibrampur and Korgaon areas.
• Central Goa deposits, which include Dabolim, Verna, Canua, Raia, Quessolim and Sancoale.
• South Goa deposits which include the hily area of southwest Quepem, south of Chauri, Betul area and Polem - Loliem-Galgibaga area.
• Minor scattered occurrences of aluminous laterite / lateritic bauxite occurrences of purely local incidence all over the lateritic terrain comprising Batim-Porvorim, Carmolim, Colvale, Taleigao-Bambolim and Calangute area.

In addition to the above, laterites cappings are noticeable practically in the whole of Goa, and they offer a promising exploration target for locating bauxite deposits.
Manganese – Major Mineral

- The manganese deposits of Goa are of Lateritoid type. Geographically the manganese deposits are more concentrated in the southern parts of Goa.

- The manganese ore deposits of Goa occur as lensoid concordant bodies within the pink shales and phyllites and the associated quartzite’s. The deposits generally occur at the edge of a plateau or ridge from where the slope suddenly falls. Manganese deposits are also noticed on the small humps and elevations along the slope of hill and on some mounds and knolls. Very rarely or perhaps never does the manganese deposit occur at the top of a plateau or ridge. This characteristic topographic control for manganese ore concentration could be seen at all places. Many of the humps on the slope of the hills and small low mounds and knolls on which the manganese deposits forms minor anticlinal or domal structures. The concentration of ore is maximum at the core or apex and dwindles down on both the sides along the slopes. The lengths of the individual deposit vary from 20 m to 500 m and the widths from 15 m to 60 m.

- The depth of concentration into the hill varies from about 15 m to 60 m. When the quarry working is pushed gradually into the hill, the concentration of ore decreases and ultimately vanishes into the altered country rock.

- The Goan manganese ores contains some iron, increasing as the manganese content decreases. Iron ores also contain a certain amount of manganese.

- The Goan manganese ores are generally poor in grade with manganese content varying from 30 to 45%. But at places the grade increases to 58-60% manganese. There are some thin concentrations of 2 to 3 m thick zones of black iron and ferruginous manganese ore in some deposits above the manganese ore.

- The concentration and enrichment of ores are maximum at and near the surface, dwindling down with depth. The big boulders and even a crude bedded nature of the ores at the upper zones give place to smaller boulders and nodules.

Basalt – Minor Mineral

- The entire state of Goa except a narrow patch in the North Eastern corner is covered by the rocks of Dharwar Super group of pre-cambrian age.

- In general the basic intrusive like Dolerite & gabbro and acid intrusive like mat greywacke, met basalt, granite, Granite gneiss etc. are included.

- North Eastern corner of the State is covered by Deccan traps and represented by Basalt rock.

- Wide outcrops of the rocks are in Pernem, Sattari, Salcete, Sanguem and Quepem Talukas.

- These rocks are used in concrete works, as a road metal and Railway ballast after crushing to required size. Though they vary from Granite gneiss to Met greywacke, they are grouped together and locally called as Basalt Metal.

- The above rocks are quarried by using blasting operations and the boulders obtained are crushed to the required sizes.
Sand – Minor Mineral

- Sand is available mainly in three forms in the State of Goa. They are Ordinary sand, Silica sand & Beach sand.

- Ordinary sand is brought by the river originating in general from Western Ghats and flows towards West & joins Arabian Sea.

- The process of weathering helps deposition of sand.

- Sand is collected mainly from the river Mandovi, Zuari, Terekhol, Chapora & its tributaries.

- On upstream the sand is collected manually, screened and supplied directly.

- Where the water column is more the sand extraction is done with the help of canoes and bucket attached to bamboos.

- Sand is used in making concrete in construction activity.

Laterite – Minor Mineral

- Nearly two third of the area of Goa is covered by a mantle of laterite ranging in thickness from a couple of meters to over 25 mts.

- Maximum thickness of laterite is observed along the coast in the west and minimum along the Ghat section in the East.

- The laterites in Goa are generally formed from Quartz-chlorite-Amphibole Schist, Pink ferruginous phyllite, Schistose met basalt & Met greywacke.

- The laterite in Goa is used in construction activity as laterite boulders and laterite stones (Locally called as "chira").

- The laterite stones are used in construction activity because of their peculiar nature of being soft while cutting and becomes hard after use.

- Earlier the extraction of laterite was being carried by manual method.

- Now the same has seen replaced by machinery, normally Power Tiller fitted with Laterite Cutting Blades.

River Pebbles – Minor Mineral

- River Pebbles are formed due to abrasion & rolling of fragmented parent rock during transportation in Streams/Rivers from the uphills.

- These Pebbles are deposited along the river bed wherever possible flat places are available.

- The same are collected manually, transported by tipper trucks and used mainly in foundation/footing, construction activities.