

I. INTRODUCTION

The minerals and the metals are integrally associated with the development of human culture and growth of the society. Minerals are essential component of Nation's material and economic base. They contribute to industrialization and form an important infrastructure for the development of the country. However, conservation of these non-renewable assets is absolutely essential in view of the rapid industrialization and consumption of minerals. Attempts should be aimed to use the resources wisely and efficiently for complete utilization of the components with no waste. Ignoring the awareness in respect of mineral resources, environmental issues have come into prominence and the aspect of conservation and safe guarding the environment can be managed by making proper use of the mined materials, wasting the least, reclamation, restoration, afforestation and creation of better environment for better habitat.

Resource wise, India is well endowed with large variety of rich mineral resources amounting 120 million tonnes in 2002. India produced as many as 64 minerals, consisting 4 fuel minerals, 10 metallic minerals and 50 non-metallic (industrial minerals) in 2003-04. India's ranking in 2002-03 in world production was 2nd in barytes, chromite and talc/steatite/pyrophyllite, 3rd in coal & lignite, 4th in iron ore and kyanite/sillimanite/andalusite, 6th in bauxite and 7th in manganese ore. However, with rapid expansion of mineral based industries, high grade ores are preferentially being consumed resulting with fast depletion of the same and the country is gradually leading to depend upon low grade and complex ores.

Mineral beneficiation is a process to separate the economic minerals from the waste rock gangue. The difference of properties between the value minerals and the undesired minerals determine the method of separation. This aspect of separation of minerals and upgrading the useful values suitable for down stream processing, assume greater significance in the context of low grade and complex ore deposits. Recovery of metal values from these resources of low tenor is associated with generation of more and more quantities of waste and greater load on efficient management of these wastes and protection of environment. The mineral engineers are thus confronted with the work of finding efficient, innovative and cost effective process and equipment for solving these problems faced by mineral industries.

Mineral processing involves a number of unit operations starting with the run of mine (ROM) ore as the initial raw material. Traditionally the scope of mineral processing is limited to liberation of individual mineral phases and their separation from each other without altering the identity of any mineral constituents. Mineral processing is the field of study that starts after mining and ends before extraction of metals for metallic ores. Before separation of the individual minerals, an intimate knowledge of the mineralogical composition of the ore, their mode of association, complexity, texture and size are essential to know the optimum size of liberation. The study of mineralogy helps processing personnel in acquiring this knowledge. The liberation of valuable minerals from the gangue is accomplished by comminution i.e., the process of size reduction to the desired size. Actual separation is then effected

by utilizing the difference in physical and other properties of value minerals and the gangue viz., size, shape, color, specific gravity, magnetic property, electrical conductivity, radioactivity, specific surface property like affinity or repulsion towards water etc. Technology is accordingly developed to create the suitable process conditions for separation. Often the surface properties are modified to create a greater difference of a specific property for the value mineral and gangue.

For low grade and complex ores, the mineral processing steps are generally carried out in 'wet' condition i.e. using water as a medium. This is obviously for a number of reasons either demanded by the process including requirement of liberation or for ease and efficiency of handling & separation or other aspects. Whatever be the reasons, the concentrates produced in fine sizes and in pulp condition need to be dewatered, dried and again agglomerated into a suitable lump form for ease of handling for subsequent treatment for metal extraction.

With the above introduction, somewhat details of mineralogical aspects, beneficiation, de-watering and agglomeration are presented in the following pages.