CHAPTER 1

INTRODUCTION AND RESEARCH DESIGN
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1.1 MINERALS AND MAGNESITE

1.1.1. MINERALS - NATURAL AND NATIONAL WEALTH

All minerals are natural resources. They can neither be produced nor manufactured. They are mined from mother earth. All mineral resources are the properties of the Government. Hence, they cannot be mined by any body without the knowledge and approval of the Government.

The industry which mines mineral ores is called the mining industry. The mining industry plays a very important role as a foreign exchange earner, contributes directly and indirectly to national income and employment, is a source of governmental revenue, and makes significant impact on other sectors of economies such as transportation, construction and manufacturing.

Magnesite is a mineral. It is a rare and scarce mineral. Only a very few countries like Australia, Brazil, China, India, Korea, USSR, etc., are blessed with this kind of natural wealth.

1.1.2. MAGNESITE - THE MINERAL

Most of the metals occur as their compounds associated with sandy matter and other impurities in the
earth's crust. The various compounds of metals which occur in nature and are obtained by mining are called minerals. A mineral may be a single compound or a complex mixture. Magnesite is a mineral which is a complex mixture of iron (Fe), silicon (SiO₂), calcium (CaO), magnesium (Mg), carbon dioxide (CO₂), etc.

1.1.3. MAGNESITE - A SOURCE FOR MAGNESIUM

Magnesium is the eighth abundant element in the earth's crust and is widely distributed in a variety of minerals. The commercially important magnesium minerals are magnesite (MgCO₃), brucite (Mg(OH)₂), and dolomite (CaMg(CO₃)₂). Magnesite is the principal magnesium mineral with an ideal chemical composition. The primary constituent of magnesite constitutes 2.08% of the earth's crust.

Magnesite is the carbonate of magnesium (MgCO₃). When pure, it contains 52.4% carbon dioxide (CO₂) and 47.6% magnesium oxide (MgO). But pure magnesite is rarely found in nature. It is usually associated with small percentages of calcium, silicon, iron and aluminium, totals going to 10%.
1.1.4 MAGNESITE - RESERVES AND PRODUCTION

The world magnesite reserve has been estimated as 2,800 million tonnes \(^7\). The total recoverable reserve of magnesite in India, as on 1.1.1985 is 222 m.t. \(^8\). As for as the production of magnesite mineral is concerned, the world production in 1987 was 12.3 m.t. \(^9\), whereas the Indian production of magnesite in the same year was 0.43 m.t. (4,29,222 tonnes) \(^10\).

1.1.5 MAJOR USES OF MAGNESITE

There are four important uses of magnesite, viz, (i) as a refractory, (ii) in the manufacture of a special cement called 'sorel cement', (iii) for the extraction of magnesium metal, and (iv) for making salts of magnesium \(^11\).

Though magnesite is an important source of magnesium metal, the major consumption of this mineral goes into the manufacture of basic refractory bricks \(^12\).

1.1.6 MAGNESITE AND INDUSTRIAL SECTOR

Magnesite plays a vital role in the industry as it is the basic raw material for high grade refractories used in iron and steel, cement and other high temperature process industries. High melting point and relative chemical
inertness render it particularly suitable for this purpose. Magnesite is also used for other minor purposes in the manufacture of sorel cement, magnesium sulphate, pulp and paper, glass, rubber, fertilizer, chemicals, animal feed, pharmaceuticals etc.,

1.1.7 DEMAND ESTIMATION FOR MAGNESITE

The report of the VIII Five Year Plan of India has estimated the demand for raw magnesite as 4,93,000 tonnes for 1990 - 91, 6,22,000 tonnes for 1997 - 98, and 8,32,000 tonnes around 2000 AD (annual basis) \(^{13}\). This clearly shows that the demand for raw magnesite in India is on the increase. But the actual production is only around 5,00,000 tonnes per annum. The raw magnesite production in India was 4,29,222 t. in 1986, 5,07,908 t. in 1988 and 4,79,530 t. in 1989 (Indian Minerals Year Books).

1.1.8 CHANGES IN THE USER INDUSTRY

It is well known that changes in the steel making practices over the past decades may have massive implication in the refractory industries, both in terms of quality and quantity of metal used \(^{14}\). The open-hearth steel making process is being gradually replaced by basic oxygen processes such as LD, LD-AC, Kaldo process etc., The high operating temperatures of these process have increased the demand for
high quality basic refractories with low iron content. Hence it is expected that there may be major demand for magnesite with refractive characteristics. Thus conservation and proper utilisation of magnesite deposits have become a primary concern of the future industrial growth of India.

1.1.9 NECESSITY FOR BETTER UTILISATION OF MAGNESITE

The demand for high quality magnesite is increasing year by year. But the recoverable reserves of magnesite particularly the refractory grade are fast dwindling. At the same time, so far, no other large deposit of high grade magnesite have been located. Therefore, maximum efforts are very much required in planning the development of the existing magnesite deposits and making optimum utilisation of the same.

1.1.10 POSITION OF INDIAN MAGNESITE INDUSTRY

Indian magnesite industry is a labour intensive and an underdeveloped one. Compared to the total mining sector of the country, it is a very small industry, as its contribution to national income from the mining sector is as little as 0.25%.

"A carpenter should have access to modern tools to double his production. This individual contribution to national wealth may be negligible, but when the efforts of
such individuals are put together, they will be enormous" (Dr. V.C. Kulanthaisamy, Vice-Chancellor, IGNOU, The Hindu, 27.7.91, P.3). Thus, though the contribution of the magnesite industry to the national income is small, such a small industry cannot be neglected. Knowing the importance of this industry, the Government of India have declared magnesite as a 'Specified Mineral' and thus it is a major economic mineral.

1.1.11. NEED FOR THIS STUDY

Though magnesite is an important mineral, the magnesite producers themselves did not strive for their development. Even if some works have been made in this field, all of them are on the mineral side only, i.e. on the geological aspects of the mineral. Attention has not been given so far on the management and development aspects of this industry. Hence, this report, A STUDY OF THE WORKING AND MANAGEMENT OF INDIAN MAGNESITE INDUSTRY focuses its attention on the management and development of this industry. It is a macro level study and this report is a guide to the top management.
1.2. IMPORTANCE OF THE STUDY

1.2.1 QUALITIES OF MINERALS

Mineral resources have certain characteristics which are unique to them. Minerals have fixed locations, fixed quantity and fixed quality and these peculiarities lead to some of the most challenging problems of the mineral industry. Magnesite being a mineral has the same phenomena.

1.2.2 MAGNESITE - AN INEVITABLE ELEMENT FOR MAN-KIND

The involvement of magnesite in every day human life cannot be over exaggerated. Human beings require the three essentials, viz, food, cloth and shelter. Magnesite finds its place, directly or indirectly, in these items.

Magnesite is used in the field of agriculture through fertilizer and pesticide. Needless to mention that all agricultural produce are used for the benefit of mankind. Steel is an item which is directly linked with these essentials. Steel industry depends on magnesite industry for refractory bricks. Without the use of these bricks, steel industry cannot supply the major input of iron and steel for the manufacture of many items such as agricultural implements, tractors, textile machinery, building construction materials etc. In short, steel is used to manufacture an item as small as a pin and also an item as big
as the giant machines which are all inseparable from human life. In the absence of the steel industry, the development of human life and also the country will be a big question.

Magnesite is also used in the pharmaceutical industry. Today, there is hardly any person without consuming medicines. Thus the association of magnesite with human life cannot be separated.

1.2.3. MAGNASITE AND STEEL INDUSTRY

Magnesite industry is the steel input industry. This is because, if the refractory bricks made from magnesite are not used in the steel industry for furnace lining, there will be no steel industry at all. The Iron ore must be heated to more than 1800°C to get the material iron from the ore. Hence, the furnace used for burning iron ore must withstand heat exceeding 1800°C. For this purpose, the furnaces are given an inner lining with the magnesite bricks. Hence, when changes take place in the technology in steel industry, corresponding changes must also take place in the magnesite industry.

"The actual tonnage of refractories consumed per tonne of steel melted are far less than in the past. For instance, in Japan and U.K. refractory consumption of today's magnesiacarbon refractories in basic oxygen steel making is around 1.6 kgs per tonne of steel melted compared to 5.5
kgs per tonne of the tar bonded doloma lining in use in the early 1970's (and 20 kgs per tonned before that) 19 This clearly shows that only if the Indian magnesite industry resorts to high quality research at a very high speed, it can join the race of world technological development.

1.2.4 : MAGNESITE - A SCARCE MINERAL

Magnesite is a very scarce material. 20 Such a scarce material must be very effectively and judiciously used. Wastage of this mineral must be brought to the minimum level if not to zero.

Magnesite is available in only 22 countries of the world and India is one among them. 21 In India, it is available only in a few places, the major occurrences being in Salem (Tamilnadu) and the Himalayan Belt (Uttar Pradesh). Such a prestigious mineral must be very carefully handled.

1.2.5 : MAGNESITE - AN IMPORT SUBSTITUTION PRODUCT:

The use of magnesite is increasing year by year. 22 The demand for magnesite has increased considerably over the past two decades. 23

Even after having imposed restrictions on the export of high quality magnesite, the Indian production of high grade magnesite is not sufficient to meet the requirements of the steel industry and this has necessitated the import of high purity magnesia.
The import of high purity magnesia in the past have been erratic. However, with the increase in the demand for basic refractories, the imports will rise further. The significant increase in domestic production would act as a significant import substitution measure and improve our self-sufficiency and reserve conservation.

1.2.6 : MAGNESITE AND BENEFICIATION

As it has been mentioned already, the refractory requirements of steel industry move from the ordinary basic bricks to high purity magnesia bricks. There is thus a vital necessity to step up the production of high quality low silica magnesia to ensure the quantum of refractory magnesite supplies to steel industry. But only around 60% of the total Indian magnesite production is of higher quality (ie. refractory grade).

Hence, if the Indian magnesite industry takes steps for the optimum utilisation of domestic reserves by some method of beneficiation, India may meet the demands of the steel industry thereby avoiding the import of high purity magnesia and also possess surplus in high quality magnesia. This one step improvement in the industry will have double benefits, namely, (i) curtail the foreign exchange required for the import of high grade magnesia, and (ii) fetch foreign exchange through the export of surplus high grade magnesia.
Resorting to beneficiation of the entire production of magnesite is absolutely necessary. Even if the beneficiation project requires heavy investment, it is worth going in for it. Sooner it is done, better it is in the country's interest. 27

1.2.7: MAGNESITE - A CONTRIBUTER TO EMPLOYMENT

Labour is abundantly available in India but at the same time, unemployment is also very high. As magnesite industry is a labour intensive one, it provides employment to many people, directly and indirectly. The per day average direct employment in the Indian Magnesite industry is around 7000. 28 Expansion of the activities of this industry will accelerate employment opportunities. Thus, the magnesite industry provides a solution in solving the unemployment problem of our country.

1.2.8: NEED FOR THE REVIEW OF THE INDUSTRY

Under these circumstances, the real status of the industry must be reviewed and based on the findings, wherever possible, steps must be taken to increase the all-round efficiency. The major purpose of this study is the same and hence this study is important.
1.3 REVIEW OF PREVIOUS WORKS

1.3.1 NEED FOR THE REVIEW

To know what research works have been done in this magnesite field, at which point we stand in the development of the industry and from which point we have to start with, the various previous works done in this industry were reviewed. The review reveals the following contributions.

1.3.2 WORKS ABOUT CHALK - HILLS

The credit of discovery of magnesite deposits goes to Heyne (1814). Official interests, however, was accrossed only in 1825. Reports on the investigation of the magnesite deposit of the Chalk Hills, (Salem, Tamil Nadu), area date back to New Bold (1836) and Benza (1842).

King and Foote (1864) mapped three parts of the Salem district and descried the origin of the Chalk Hills deposits and other occurances in Salem and Trichy districts of Tamil Nadu.

Subsequently Sir Thomas Holland (1892 - 1900) discussed the origin of the Chalk Hills. Middle Miss (1896) carried out a detailed survey of the Chalk Hills and gave some quantitative data with a map of the area.
Other geologists engaged in this work in the 18th and early 19th centuries are Lacroix (1889), Davis (1909), Burlton (1912) and Vineyaka Rao (1929).

M.K.N. Aiyengar (1940, '42,'53,'64) gave a detailed account of magnesite occurrences of Tamil Nadu in general and the Chalk Hills in particular. In these reports, he has also dealt with the classification, origin and uses of the magnesite.

Crookshank (1942), Krishnan and Aiyengar (1943), and Krishan (1947) discussed the economic aspects of the magnesite deposits. Krishnamoorthy (1956 - 61) described the geology of Salem magnesite. A report on the petrology of the ultra basic body of the Chalk Hills is given by Moorthy (1969).

Patil (1971 -72) examined the ore occurrences of Periyar District. Badrinarayanan (1972-73) conducted an examination of magnesite deposits in Nammakal taluk of Salem district.

The magnesite occurrences of Coimbatore and Nilgris districts were first reported by Gopalakrishnan and Sankaran (1972). Srinivachari and Venkatesh identified the other areas in these districts. The magnesite occurrences of these districts were re-examined by Bhalla (1979).

Subramanian (1974) gave a list of unique occurrences of magnesite in Narivalam and Vandalore areas of Trinelveli district.
Srinivashari (1977-78) visited the various minor occurrences of magnesite in Tamil Nadu and on a cursory study grouped various occurrences on the basis of size and economic potentiality.

The Geological Survey of India (GSI) formulated a Five year programme for reassessment of magnesite deposits of Tamil Nadu (1985). On this basis, the surface geological work was carried out by the GSI in the Chalk Hills and Sirapalli area and regional drilling was undertaken with a view to find out the depth persistence of ore mineralisation in the Chalk Hills area.

1.3.3. WORKS ABOUT HIMALAYAN BELT

Mukthinath (1949), Nautiyal (1953), Agarwal and Singh (1960) studied the origion of the Himalayan magnesite. They are of the opinion that the Himalayan magnesite is of secondary origin formed by replacement of dolomite by magnesia rich hydothermal solutions. These solutions are thought to have been derived from the basic intrusions in the region.

Mukthinath and G.L. Wakhaloo (1962) have given a comprehensive account of the magnesite occurrences in Almora a district of Uttar Pradesh.

Mishera and Valdiya (1961) proposed the theory of primary precipitation of the Himalayan magnesite. Latter on
Valdiya (1968) proposed the theory of contemporaneous replacement of earlier formed carbonate assemblages.

Negi (1976) is of the view that formation of Himalayan magnesite was by two processes, the diagenetic replacement of pre-existing carbonate sediments as well as primary precipitation due to the favourable conditions created by algae.

1.3.4 WORKS BY GSI AND STATE DEPARTMENT OF MINING AND GEOLOGY

The GSI attached to the Government of India, conducts field experiments to trace the occurrence of magnesite in the country. The Department of Mining and Geology of each State government explores the economic viability of this mineral. These works are being continuously carried out by these agencies.

1.3.5 MINOR RESEARCH WORKS

Apart from these works, minor research works such as (i) increasing the fuel efficiency of furnace oil (used for burning), (ii) waste recovery, (iii) efficient design of the kiln, (iv) increasing the efficiency in mining methods, etc., have been done by various individual units in the industry.
Thus the literatures available about this industry tell that all the works have been done on the geological and technical aspects and on unique aspects of the major functions of the industry. No comprehensive study has been carried out so far about the industry as a whole and this is what this report aims at.

1.4 SCOPE OF THE STUDY

1.4.1 MAJOR FUNCTIONS OF THE INDIAN MAGNESITE INDUSTRY


1.4.2 CLASSIFICATION OF THE FUNCTIONS

These functions may be classified into technical and non-technical. Technical functions are mining, production, maintenance, quality assurance, and research and development. The non-technical functions are materials management, marketing, financial management, and personnel and industrial relations.
1.4.3 SUBJECT OF THE STUDY

The review of previous works reveal that many research works have been undertaken on the geological and technical sides of the industry. There is no evidence regarding research on the management of the non-technical functions of this industry. Hence, the scope of this study covers the major non-technical functions such as materials, marketing, finance, and personnel and industrial relations. Each of these functions is studied in depth as to its present state of affair, problems faced, and the ways and means for its efficient performance.

1.5 LIMITATIONS OF THE STUDY

The following facts have limited the scope of the study:

(i) Two of the sample units are members of large industrial houses. These large houses maintain records and prepare annual reports for the large undertaking (group company) as a whole. As a result, data, exclusively relating to the individual units of the sample are not available for the purpose of the study.

(ii) Reluctance on the part of the management and some executives to disclose some material facts has limited the scope of the study.
(iii) Synthetic magnesia is not produced presently in India. (It is understood that a private sector company has a proposal to produce synthetic magnesia at Vishakapatnam, Andhra Pradesh; but the project has not yet come into implementations). The consideration of the synthetic magnesia is beyond the scope of the study.

(iv) Different sources of data due to different figures of production, sales, exports, etc., of magnesite. Under this circumstance, the latest figures available from the Indian Government’s publications have been used in this report.

(v) As the researcher is a non-technical professional, the technical and geological aspects of the industry have not been considered in depth.

1.6 THE PERIOD OF THE STUDY

Magnesite production was started in Salem (Tamil Nadu) first in 1890. Thereafter the industry developed slowly.

The ages of the units of the industry vary considerably from 14 to 100 years. A major unit was added to the industry in 1979. Based on the availability of records, the study covers the period after its inclusion to the industry. Thus a ten year period from 1981-82 to 1990-91 has been considered in this study.
1.7 OBJECTIVES OF THE STUDY

This research study has been carried out with the following objectives:

1. To assess the status of the magnesite industry in the international scenario.

2. To analyse the status of the Indian magnesite industry.

3. To evaluate the status and progress of the sample units.

4. To study the operational problems (relating to mining, processing, maintenance, quality assurance, research and development) of the Indian magnesite industry.

5. To identify the practices prevailing in the Indian magnesite industry relating to materials purchasing and control, marketing, finance, personnel and industrial relations and environmental aspects.

6. To identify the common problems faced by the Indian magnesite industry.

7. To offer suggestions on the basis of findings.
1.8. SAMPLING

1.8.1 WORKING MAGNESITE MINES IN INDIA

As on 1.1.1990, mining lease has been granted for 28 magnesite mines. Of these, 21 mines are in operation. The names of various working magnesite mines in India are given in Table:1.1.

TABLE : 1.1 WORKING MAGNESITE MINES IN INDIA AS ON 1.1.90.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>State</th>
<th>District</th>
<th>Owner of the Mine</th>
<th>Name of the mine</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Karnataka</td>
<td>Mysore</td>
<td>TISCO</td>
<td>Dodkanya</td>
</tr>
<tr>
<td>2</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Mysore Minerals Ltd.,</td>
<td>Karya</td>
</tr>
<tr>
<td>3</td>
<td>Rajasthan</td>
<td>Ajmer</td>
<td>Babulal</td>
<td>Chotigman</td>
</tr>
<tr>
<td>4</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Chhan Magri</td>
</tr>
<tr>
<td>5</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Laxmi Bhandar</td>
</tr>
<tr>
<td>6</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Ganesh Bhandar</td>
</tr>
<tr>
<td>7</td>
<td>Tamilnadu</td>
<td>Salem</td>
<td>Tamilnadu Magnesite Ltd.</td>
<td>Arasu</td>
</tr>
<tr>
<td>8</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Dalmia Magnesite corp.</td>
<td>Chettichavadi</td>
</tr>
<tr>
<td>9</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Seerapalli</td>
</tr>
<tr>
<td>10</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Burn Standard Company Ltd.</td>
<td>Burns</td>
</tr>
<tr>
<td>11</td>
<td>&quot;</td>
<td>&quot;</td>
<td>K.G. Munisamy Chetty</td>
<td>Ramakrishna</td>
</tr>
</tbody>
</table>
Table 1.1 shows that those 21 working magnesite mines are owned by 15 companies. Hence, the universe of this study consists of these 15 units.
1.8.3 SAMPLING PROCEDURE

To study the universe, we have to select the appropriate sample. Goode and Hatt point out: "A sample not only needs to be representative, it needs also to be adequate. A sample is adequate when it is of sufficient size to allow confidence in the stability of its characteristics".

To reflect the views of Goode and Hatt and to select the sample scientifically it was decided to get some basic information about each of these units regarding their capital, mining and production capacities, range of products, sales turn-over, employment details, etc. For this purpose a questionnaire was prepared (Refer Appendix 1.1) and copies of the same were sent to the various constituents of the universe.

1.8.4 CLASSIFICATION OF THE MEMBER UNITS OF THE UNIVERSE

The informations recieved through the filled-in questionnaires show that these 15 units may be broadly grouped into two, viz, (i) units with captive mines, and (ii) units with free mines.

A unit is said to have captive mine if it uses the raw magnesite mined from its own mine(s) in its production unit to get dead-burned magnesite (DBM), caustic calcined magnesite (CCM), ramming mass, refractory bricks, etc. There
are six such units and they are: (i) Tamilnadu Magnesite Ltd., Salem, (ii) Dalmia Magnesite Corporation, Salem, (iii) Burn Standard Company Ltd., Salem, (iv) Almora Magnesite Ltd., Almora, (v) Orissa Industries Ltd., Pithoragarh, and (vi) TISCO, Mysore.

A unit is said to have free mine if it mines magnesite mineral from its own mine(s) and sells the raw magnesite as such. The other nine units of the universe are of this kind.

1.8.5 SAMPLING TECHNIQUE

Sample represents the whole population. Selection of the sample must be adjusted in accordance with the object of the enquiry so that no significant item may be ignored. In this study, the universe itself is very small (only 15 units) and further the units are heterogeneous in nature. Hence, 'Judgement sampling' technique is taught to be the appropriate sampling technique for this study. "The basic assumption behind judgement sampling is that with the exercise of good judgement and appropriate strategy one can hand pick the cases to be included in the sample and thus develop samples that are satisfactory to ones research needs" 31.

Further, 'under this method (judgement sampling) the researcher uses his expertise in selecting units that are
representative of the target population or that are most relevent to the issue under study’ 32.

Having those use in mind, the sample size and the sample units to be tipical of the population were selected.

1.8.6 SAMPLE SELECTION STRATEGY

Considering the two sets of mines, it may be noted that mining activities are common to both sets. The additional functions performed in the captive mine units are the processing activities performed in the factory to get different magnesite products. Hence, the study of the various functions of the captive mine units will cover the functions of the free mine units also. This means that the free mine units may be omitted from their inclusion in the sample and the captive mine units alone may be considered for deciding the sample units.

1.8.7 SELECTION OF SAMPLE UNITS

As it has been already pointed out, there are six captive mine units, the details of which are given in Table:1.2
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Unit</th>
<th>Production of raw magnesite in 1988 (tonnes)</th>
<th>Cumulative production of raw magnesite in 1988 (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Tamilnadu Magnesite Ltd, Salem.</td>
<td>1,38,773</td>
<td>1,38,773</td>
</tr>
<tr>
<td>2.</td>
<td>Dalmia Magnesite Corpn. Salem.</td>
<td>1,29,611</td>
<td>2,68,384</td>
</tr>
<tr>
<td>4.</td>
<td>Almora Magnesite Ltd., Almora</td>
<td>59,820</td>
<td>4,11,767</td>
</tr>
<tr>
<td>5.</td>
<td>Orissa Industries Ltd., Pithoragarh.</td>
<td>11,426</td>
<td>4,23,193</td>
</tr>
<tr>
<td>6.</td>
<td>TISCO, Mysore</td>
<td>9,022</td>
<td>4,32,215</td>
</tr>
</tbody>
</table>


The total Indian magnesite production in 1988 was 5,07,908 tonnes. The production of raw magnesite by the captive mines alone in 1988 was 4,32,215 t., which is 85% of the total Indian production.

The production of raw magnesite by the free mines is only 15% of the industry’s total production. Hence, it can be justified that a study of the various functions of these captive mine units shall give a clear picture about the whole Indian magnesite industry.
N.B.: The raw magnesite production of each of the unit of the universe is in the same ratio over the past (Indian Minerals Year Books, 1981 - 1991, IBM, Nagpur).

A perusal of the raw magnesite production by the individual units of the captive mines in 1988 shows that Orissa Industries Ltd., and TISCO have produced 11,426 and 9,022 tonnes respectively. Compared to the total raw magnesite production by the captive mine units, the production of these two units is only 4.7% which is considerably small. Hence, even if these two units are removed from the purview of sample selection, it will not degrade the sample, because the other four captive mine units account for more than 80% of the total Indian magnesite production. Thus it can again be justified that a study of these four captive mine units will be representative of the universe.

Further, of the 15 magnesite producing units, four are in the public sector, one is in the joint sector and the remaining ten are in the private sector. Two of the four public sector units have captive mines. The joint sector unit also has captive mine. Of the ten private sector units, three have captive mines. Of the three private sector units with captive mines, one unit contributes nearly 30% of the total raw magnesite production whereas the other two units contribute only around 4.7% of the total production.
Hence, if we include the two public sector units, one joint sector unit and the major private sector unit (all with captive mines), the sample will be a representative of the public, joint and private sector units. This is how the sample has been selected.

The sample size is 27% of the universe and the sample units are (i) Tamilnadu Magnesite Ltd., Salem, (ii) Dalmia Magnesite Corporation, Salem, (iii) Burn Standard Company Ltd.; Salem, and (iv) Almora Magnesite Ltd., Almora. The profile of each sample unit is given in Appendix: 1.2. Hence, we can be sure that the sample units are the typical representative of the universe.

Thus, the method of 'judgement sampling ' is adopted to determine the sample size and to select the sample units.

1.9 METHODOLOGY AND TOOLS

1.9.1 DATA COLLECTION

To get an overview about the magnesite in general and to make an in depth study of the working of the sample units in particular, both primary and secondary data were collected as explained below.

1.9.2 PRIMARY DATA

(i) Information was collected through a questionnaire (Appendix 1.1) To define the universe and to decide the sample of the study;
(ii) To make an in depth study of the sample units, an interview guide (Appendix 1.3) was used, because a guide may aid in: (a) focusing attention on salient points in the industry, (b) securing comparable data in different interviews, and (c) gathering the same range of items in the analysis of data;

(iii) Field observation were made in the mining and factory sites;

(iv) Personal discussions were held with outsiders and experts in the field of mining and refractory, related agencies such as Indian Bureau of Mines, Government Departments of Mining and Geology, Research and Development organisations, materials and equipment suppliers, major consumers of magnesite products, etc.,

1.9.3  SECONDARY DATA

(i) Books on geology, chemistry, metallurgy, and economic minerals were referred to get an overview of the magnesite mineral and the magnesite industry;

(ii) Books on mining, production techniques, process management, etc., were referred to determine and list the various functions carried out in the magnesite industry;

(iii) Books, journals, papers presented in seminars and conferences and reports relating to mineral in general and magnesite in particular were used to assess the state of affair of the world and Indian magnesite industry.
1.9.4 DATA COLLECTION TOOLS

Questionnaires, interview guide, interview schedule, field observations and personal discussions were used as tools for collection of primary data.

Books, journals, reports, year - books, seminar papers, etc., were used as tools to collect secondary data.

1.10 REPORT LAY-OUT

This report contains eleven chapters as detailed below:

Chapter one gives an introduction to the study along with the 'research design'.

Chapter two deals with the fundamentals of magnesite such as its chemistry, formation, occurrences, properties and uses.

Chapter three gives an account of international scenario of magnesite industry.

Chapter four tells about the status of the Indian magnesite industry and its contribution to the national economy.

Chapter five explains the various operational functions performed in the Indian magnesite industry.

Chapter six deals with the procedures involved in procuring and controlling the materials used in the industry.
Chapter seven deals with the marketing practices prevailing in the industry.

Chapter eight deals with the finance functions such as sources and uses, investment practices, working capital management, ratio analyses, costing methods, etc.

Chapter nine deals with the personnel practices relating to manpower planning, selection, training and development, rating of employees, employee compensation, motivational measures, employer-employee relations, etc.

Chapter ten makes an analysis of the study. It analyses the industry as a whole and the performance of the sample units. It also makes a reference relating to the impact of the industry on the environment and health. A summary of findings is also included in this chapter.

Chapter eleven offers some suggestions based on the findings along with conclusion.

The appendixes give the questionniner, profile of sample units, interview guide, and other related tables and informations.
REFERENCES


10. ibid, P.136.


24. ibid, P.181.


29. ibid, P.139.


