BULLETIN No. 28

MICA

in

Andhra Pradesh

INDIAN BUREAU OF MINES
MINISTRY OF MINES
NAGPUR

भारत सरकार
GOVERNMENT OF INDIA
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भारतीय खान ब्यूरो
INDIAN BUREAU OF MINES

प्रशिक्षण, खनन अनुसंधान और प्रकाशन प्रभाग
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PREFACE

The present Bulletin on 'Mica in Andhra Pradesh' is the twenty-eighth in the series of bulletins brought out by Indian Bureau of Mines. In India, Bihar stands first in mica production followed by Andhra Pradesh, which contributed 46 percent of the total production of crude mica, in 1992-93. The occurrence of muscovite is predominant. Of all the known varieties of mica 'Muscovite' has the largest commercial application in electrical industry, because of its unique combination of physical, chemical, thermal and dielectric properties.

India enjoyed monopoly in the export of best quality sheet mica since the beginning of the 20th century. But in recent years India's export in the world market has declined considerably. This decline is partly due to the use of substitutes of mica and partly due to the gradual depletion in the availability of exposed pegmatites having good mica mineralisation.

Present scenario of occurrence of mica pegmatites indicates that there is ample scope of finding out concealed productive pegmatites in all the three mica fields of Bihar, Andhra Pradesh and Rajasthan.

This bulletin covers mica deposits, exploration, mining and production, mica based industries in A.P., besides, outlook and problems of mica industry in India.

It is hoped that this publication shall be useful to the producers, consumers and entrepreneurs.

NAGPUR
Date : March, 1994

(O.P. SACHDEVA)
CONTROLLER GENERAL

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Chapter-1
Introduction

1.1 General

Mica has been known in India from time immemorial. It is called 'Abhra' in Sanskrit meaning cloud. The use of mica in early times seems to have been confined to : (i) medicines; (ii) ornaments and vestures for idols; (iii) decoration; (iv) glazing of transparent medium and (v) painting bases. Abhrak and Abhra, the Indian names for mica have been mentioned in the Hindu mythologies. In the Ayurvedic system of medicine, the powders of mica such as Dhaup Abhrak and Abhra Bhasma have been used both as a general tonic as well as for curing various diseases.[1,2]

India is one of the major producers and exporters of sheet mica and various forms of mica products. Mica mining in India is over 100 years old. Production of crude mica in India by late 1950 was very high around 30,000 tonnes. It had come down to 14,173 tonnes in 1972 and has been continuously declining and touched a low level of 2,507 tonnes in 1992-93. Number of working mines has also declined from 438 in 1972 to 127 in 1992-93. The production of crude mica comes mainly from Bihar, Andhra Pradesh and Rajasthan. In India, Bihar is the largest producer and second largest producer is Andhra Pradesh.[3]

1.2 Characteristics

The characteristic of mica is that it possesses highly perfect basal cleavage due to which it can be easily and accurately split into very thin sheets or films of any specified thickness. Mica possesses the unique combination of elasticity, toughness, flexibility, transparency, resistance to heat and sudden change in temperature and high dielectric strength. It is chemically inert and stable and does not absorb water.[4]

1.3 Composition and Varieties[4,5]

Mica is a hydrous silicate of aluminium with varying amounts of potassium, sodium, calcium, magnesium and iron. In nature, there are several varieties of mica such as Muscovite or potash mica, biotite or iron magnesium mica, phlogopite magnesium mica, lepidolite, lithium mica, parafinite, sodium mica, zinnwaldite, lithium iron mica and lepidomelane iron mica. Of these, muscovite and phlogopite are of great economic importance.

Among these two, the Muscovite is of major significance and accounts for the bulk of sheet mica products in the world.

1. Muscovite [$KAl_2(AlSi_3)O_{10}(OHF)_2$] : Muscovite is a hydrated silicate of aluminium and potassium with hydroxyl and fluorine. It is a potash mica or white mica of variable chemical composition. It is a pale to almost colourless mica and named after muscovy - glass where it was used as substitute for glass. Muscovite may include flattened garnets quartz or tourmaline. Hardness: 2.25; specific gravity: 2.7 to 3. It is abundantly found in granitic pegmatites.[5] Muscovite is colourless transparent mica (with potassium) while biotite is a dark coloured translucent or opaque variety (with iron and magnesium).[3] Muscovite mica has consistent and relatively high dielectrical properties, high temperature resistance and has a low thermal conductivity. Further it can be easily split into very thin sheets, which are elastic, flexible, strong and also transparent.[2]

Biotite [$K(MgFe)_3(AlSi_3)O_{10}(OHF)_2$] : Biodite is a hydrated silicate of magnesium, iron aluminium and potassium with fluorine. It is dark coloured mica, brown and black, sometimes green, containing magnesium and iron, thin cleavage sheets show light spots, rings or halos. Hardness : 2.5 to 3; specific gravity: 2.3 to 3.1. Biotite may occur with muscovite in metamorphic rocks. It is abundant in some granites and is also common in schists and gneisses.[4,5]

Phlogopite Mica [$HMg_3(AlSi_3)O_{10}(OHF)_2$]: It is a silicate of aluminium magnesium and potassium with hydroxyl and fluorine. It is usually seen as brown flakes in crystalline dolomite and marble. Hardness : 2.5 to 3; Specific gravity : 2.78 to 2.85. It is white brown or colourless mica.[5]

All other varieties of mica do not have any commercial significance and are of academic interest.

Chapter-2

General Geology, Mode of Occurrence, Genesis and Classification

Mica occurs in many districts of Andhra Pradesh. Nellore district is the most important one popularly known as Nellore mica belt, covering Gudur, Rapur, Podalakur, Atmakur and Kavali Taluks. It extends from Ojili, 16 km south of Gudur on G.T. road to Udayagiri NNW of Nellore, covering an approximate area 2,000 sq. km (100 km x 20 Km).

2.1 Geology and Structure

The mica fields in Andhra Pradesh belong to Dharwarian formations of Archaean Age dating between 1490 and 2100 million years (based on absolute age determination of samarskite, allanite, muscovite and biotite). The general geological succession in Nellore mica belt is given as under :-

Lower Proterozoic	:	Pegmatites Granite and Granite gneiss
Archaean	:	Kandra Volcanics Schistose series

The schistose series of rocks consist chiefly of garnetiferous hornblende biotite schist and are interbanded with biotite schist, quartzite, quartz schist and amphibolites. The Kandra volcanic suite consists of hornblende schists and amphibolites, products of metamorphism of basalt, gabbro and dolerite. Massive granites of pink and gray colour and biotite gneisses occur within the rocks of the schistose series.

The rocks have a general NNW - SSE trend with westerly dip varying between 45^{o} and 80^{o}. The area is highly folded in nature, giving rise to near isoclinal folds having, in general, a southerly plunge. At some places, the pegmatites appear to be confined within the limb of the folds. The area is traversed by a number of faults and at places, shear zones have also been inferred.[6,7,8]

2.2 Shape and Size

The shape and size of Nellore pegmatites vary to a great extent. There are long narrow pegmatites thinning out on either ends or at depth. Lenticular and lensoid pegmatite bodies are also met with in this field. Pegmatites having length from a few metres to more than 100m and width from a few centimetres to as wide as 27m have been recorded. The depth of these pegmatites also varies to a great extent and a maximum depth of over 200 m has been noted.[6]

2.3 Mode of Occurrence

In the Nellore belt, the mica pegmatites are observed as emplaced along shear fractures developed in the crestal regions of the folds, along fault and foliation planes and along noses of folds developed in the country rocks viz. hornblende schist, kyanite- staurolite schist, quartzite, etc.[6]

2.4 Genesis

The mica pegmatites in this area are heterogeneously zoned and composite. In the zoned pegmatites zones may be horizontal or vertical. Generally, crystallization starts from the border and ends up at the core showing the border of crystallization of pegmatites as microcline-quartz-beryl pegmatite, plagiloclase-quartz-mica-pegmatite and quartz with beryl forming the core.

The concentration of mica is seen generally along the hanging wall and footwall contacts as well as along the periphery of quartz core. Economic concentration of mica is found within favourable structural locales and is accompanied by the presence of beryl, apatite, tourmaline, smoky-quartz and garnet.

Potash feldspar pegmatites are generally devoid of muscovite mica. Albite, oligoclase and quartz pegmatites contain muscovite mica which occurs as shoots. The concentration of mica is seen in the form of books formed by direct crystallisation from pegmatitic melt and occur in the wall zone near the contact of country rock as well as around xenoliths and cores of quartz. Muscovite probably crystallised out in hydrothermal stage following crystallization of pegmatite as fracture-filling or by replacement of felspars and

quartz. Assimilation of country rock by pegmatitic melt is also considered to have helped crystallisation of mica in course of fractional crystallisation of the assimilation products.

It is stated that pegmatite fluids brought about muscovitization and felspathization of the schists and biotitization of hornblende of the country rock to varying degrees. These, together with other wall rock alteration processes, progressed intensively along the fractures/foliations developed in the country rocks. Identification of such fractures might be helpful in locating mica deposits.[6,7]

2.5 Classification

The Nellore pegmatites may be broadly classified into (a) productive pegmatites and (b) unproductive pegmatites. The productive pegmatites occur mainly in schistose series of rocks. These are also associated with hornblende schist, as concordant, sub-concordant and rarely as discordant bodies. The mica bearing pegmatites are further classified into four groups depending on the content of mica viz. ruby mica pegmatite, green mica pegmatite, densely spotted green mica pegmatite and honey mica pegmatite.

The other type viz. unproductive pegmatite consists of mainly microcline and quartz with subordinate amounts of plagioclase. The presence of any mica in these pegmatites is only of academic importance.

Further the shape and size also play a role in classification viz. lense-shaped pegmatites, pipe shaped pegmatites, enechelon pegmatites and massive pegmatites.[6,7]

Chapter-3
Prospecting and Exploration

3.1 General

Commercial sheet mica has been mined from pegmatites and almost all conceivable studies have been made in several countries and a considerable load of literature has been produced on the different types of pegmatites, their mineralogy and genesis. The pegmatites represented the most amazing, most contradictory and most complex and at the same time interesting group of all known rocks and minerals. Though pegmatites are one of the complexities of nature, the studies over a long period have revealed that it is possible to formulate certain guidelines which could be favourably used for searching mica. Such guidelines can be grouped under structural, mineralogical, petrological and geochemical evidences.

3.2 Past Investigations

Invariably, the past over 100 years mostly witnessed locating the outcrops and developing them upto economic horizons. It was always a hit and run practice upto the independence and sometime after. Later due to obliteration of many of the outcrops and non-availability of productive pegmatites, the search for dependable methods began. IBM entered the scene by issuing directives to the mica mine owners in the mid sixties and by way of research in 1972. Issue of statutory directives for preparation of plans and sections, surface mapping of the obliterated outcrop areas, compilation of past mining histories, etc. paved the beginning for a long way for R & D activities by IBM. Later the compulsory preparation of Mining Plans for obtaining lease or renewal, etc. has activated the exploration activities.

3.2.1 INVESTIGATIONS BY GSI[9-13]

Mohan carried out investigation of 7 mines in Tummala Talupur area by mapping an area of 11.5 sq km along with underground coverage of mapping. Again Mohan and Rao A.K. undertook systematic mapping of another 350 sq km as well as plane table mapping of 1.7 sq km area in Tummala Talupur and Kalichedu areas. Several virgin and partly excavated mica pegmatites in Ammavaripalem and Tatpatri have been located during these mappings. The synclinal structure identified have led for further earmarking of areas for detailed exploration by pitting and drilling.

Unerground mapping was carried out in-Vutukur by Mohan. GSI and Osmania University had jointly taken up 200 sq km surface mapping as well as underground mapping in southeast peripheral part of the Nellore mica belt, which resulted in proving mainly of barren pegmatites.

Rao A.K. and Das J.N. covered an area of 18 sq km by surface mapping and 2.1 sq km for underground mapping in Chennur-Kondagunta block. Individual pegmatites have been studied for systematic evaluation on structural, mineralogical and petrological aspects. Geochemical surveys were also conducted to evaluate their utilization for locating concealed pegmatites. Soil samples were collected to study secondary dispersion pattern of various elements like Li, Cs, Rb, Ba, Sr, Be etc. But no positive results could be achieved. Geophysical surveys by resistivity and magnetic methods in Ammavaripalem-Tatpatri block have led to hidden pegmatites proved by drilling. Further work have to be continued for concrete results.

3.2.2 INVESTIGATION BY IBM

By virtue of statutory powers, Indian Bureau of Mines had been inspecting the mica mines for over four decades and geological studies were also conducted. The mining companies were asked to prepare geological plans, assay plans etc. and this made the beginning for further

studies in mica fields. IBM undertakes different types of gelogical studies like Regional Mineral Development Studies (RMDS), Mining Geological Studies (MGS), Mineral Reject Studies (MRS), Stoping Notice Examination, etc. Regional Mineral Development Studies were aimed at making techno-economic appraisal of a group of mines in the region. The main objectives are to define shape, size, and disposition of pegmatites by geological mapping and correlation and appraisal of resources position. It carries out a review of practice of exploration, mining, processing, etc., so as to identify gaps in exploration, reserve assessment, conservation, waste disposal, etc. and suggest remedies. Review of impact of mining activity on environment is taken note of for further work. R and D activities and scope for setting up of mineral based industries are also considered. Mining Geological Study is confined to one leasehold and the mines within it. The aspects of extent of mineralisation, mode of occurrence including controls, exploration, estimation of reserves and method of mining are studied in greater details.

So far 28 Mining Geological Studies, 4 Regional Mineral Development Studies, 2 Mineral Rejects Studies and 20 Stoping Examinations have been carried out in Nellore Mica Belt.[14]

3.3 Sequence of exploration for mica[15-18]

The general prospecting and exploration activities can be classified as preliminary and detailed.

(a) Preliminary

(1) Preparation of geological maps and sections.

(2) Pitting and trenching (2 to 3 m. maximum) to trace the extensions of pegmatites and its other dimensions.

(3) Deep pits (upto 5 to 6 m. max.) to see the productivity or otherwise.

(b) Detailed

(4) Shallow open cast working/mine development upto depths of 15 to 20 m.

(5) Underground mine development by means of vertical shafts and/or combination of a vertical shaft and an inclined shaft.

(6) Exploration for parallel/blind pegmatite by cross cutting and/or Extended Tungsten Carbide (ETC) drilling.

(7) Preparation of stope blocks.

Even to date, in some parts of mica belts in the country, the importance of preliminary exploration is not properly tested by the industry. It is quite necessary to identify clearly as to which part of the pegmatites is to be developed in detail, so as to keep the costs of exploration and development within feasible limits.

Over the long years of mining activity in A.P. almost all the pegmatite outcrops have been searched for and obliterated or developed into pits and mines. So now what is left is to search for hidden pegmatites, parallel or enechelon bodies and left over extensions of certain workings. A lot of research and field activities were going on for identifying proper methods of locating hidden pegmatites or productive bodies.

Besides the research activities, IBM also took up RMDS & MGS in all the mica fields of India. The results of research and studies were applied in some of the mines in Bihar mica field and one each in Nellore and Rajasthan mica fields and it was observed that the guidelines can be successfully applied in the search of concealed pegmatite bodies. Application of the results of research mainly in Bihar mica field could bring to light new mica mines and extended the life of existing mica mines as well. The guidelines emerging from field studies are given below :-

Favourable	Unfavourable
a) Pegmatites emplaced within schistose country rocks which suffered medium to high metamorphism.	a) Pegmatites occurring in quartzite are rare and the chance of getting mica in them is less.
b) Presence of granite and migmatite in the vicinity of a pegmatite body helps the pegmatite to be productive.	b) Pegmatites within granite or pegmatites produced by metamorphic differentiation are generally non-productive.
c) Pegmatites controlled by the noses and limbs of F_2 folds, bedding and schistosity planes and other structural planer structures are generally better mineralised.	c) Pegmatites emplaced along steep dipping joints and fractures are generally barren or poor in mineralisation.
d) Undeformed zoned pegmatites are better locales for commercial mica.	d) Deformed and unzoned pegmatites are generally barren.
Guidelines Emerging from Laboratory Studies	
a) Pegmatites undergoing complete fractional crystallisation from border inwards in a pegmatite body are well zoned and such pegmatites represent good locales for mica.	a) Absence or presence of only partially zoned units in a pegmatite indicates that the conditions were not suitable for fractional crystallisation and hence mica is absent or poor in such pegmatites.
b) Both the hanging and footwall zones of a pegmatite body may contain mica; better prevalence of mica is generally seen in the hanging wall zones. Sometimes mica occurs at the core zone contact as well. In case of high dipping pegmatite bodies, mica is generally concentrated in the upper horizon and the lower levels become barren.	b) Unzoned potash felspar rich pegmatites are devoid of mica. The potash felspar-rich intermediate zone of a zoned pegmatite is also devoid of mica. Perthite-rich zone of a pegmatite body is generally barren.
c) Most favourable mineralogical assemblage favouring concentration of mica is as under : Smoky quartz - 20 to 25%Transparent quartz - 10 to 12% Plagioclase (Oligoclase + Albite) - 40 to 50% Tourmaline - 3 to 5% Flaky muscovite - 12 to 15% Besides, the presence of flourapatite, beryl and radioactive minerals to some extent makes the pegmatite productive.	c) High content of quartz, potash, felspar and tourmaline makes the pegmatite barren.
d) The higher the intensity of wall rock alteration process, such as kaolinisation, felspathisation, sericitisation, etc. the better is the possibility of getting mica.	d) Absence or presence of a poor wall rock alteration process in a pegmatite makes the pegmatite barren.

e) Presence of plastic clay, kaolin, greisenised mica flakes, leucocratisation and cross oriented muscovite flakes in leader vein or pegmatite proper makes the pegmatite productive.

f) Presence of Pb, Ga, Sr, Be, Ba, and Mn in optimum amounts in felspar and Cu, Pb, Sn, Ga, Sr, Ba, and Mn in muscovite makes the pegmatite productive.

g) The core zone in a mica rich pegmatite body generally yields a significantly low contents of Ba and Sr; Ba/Sr ratio is also low at the core of mica rich pegmatites.

h) Chemically, pegmatites containing low SiO_2, CaO, Na_2O and K_2O with high Al_2O_3 are generally found to favour mica mineralisation.

e) Absence of plastic clay, kaolin, greisenised mica flakes, leucocratisation and cross oriented muscovite flakes in leader vein or pegmatite proper makes the pegmatite barren.

f) A high concentration of Mn, Pb and sometimes Ga without other trace elements in a pegmatite body makes it barren.

g) Pegmatites deficiencies in mica or devoid of mica show higher contents of Ba and Sr and the Ba/Sr ratio is also high at the cores of such pegmatites.

h) Pegmatites with a high concentration of K_2O and SiO_2 and low Al_2O_3 generally do not favour mica mineralisation.

Chapter-4
Deposits and Reserves

4.1 Deposits

Mica is found in the districts of Anantapur, East and West Godavari, Khammam, Krishna, Nellore, Srikakulam and Vishakhapatnam. The districtwise occurrences are given below.

4.1.1 ANANTAPUR DISTRICT

In Anantapur narrow books of much stained muscovite 2 cm to 13 cm across and associated with pegmatites have been reported from some old pits situated to the east of Siddaramapuram. Besides, old workings for mica occur near Ramasagaram and Akkampalle. The mica is associated with pegmatites. It is found as books upto 10 cms across at the former locality and at the latter place as books up to a foot across.[19] The presence of muscovite bearing pegmatites is noticed at Ramasagaram.

4.1.2 EAST GODAVARI DISTRICT

An occurrence of good quality mica is reported from Kannaram but the deposit is rather small.[20]

4.1.3 WEST GODAVARI DISTRICT

Fairly large deposits of good qualilty muscovite occur near Pochavaram Gongolu and Kancharlagudem. Muscovite and ruby coloured mica occurs near Annanagudem. The area is however, inaccessible. Occurrence of mica have also been reported from Kovvurupadu and Nandigudem. The pegmatites at none of the localities contain mica larger than 8 cms across.[19]

The excavations for mica are observed near Kovvurupadu, the Poluvaram taluk.[20]

4.1.4 KHAMMAM DISTRICT

Books of Muscovite 5 cm to 8 cm across are found in pegmatite veins in the Muchovaram Village, Madura taluk. Mica also occurs at Kallur. It has been worked in the past at Kappalbandam, Karlapadu and Bealpalle. Occurrences of dark green mica of small size are reported from Rakmanidi Hills, Tekulupalli, Tahagundi etc.[19]

Occurrences of mica are observed in pegmatites traversing the quartz-muscovite schist near Gosavidu, Kannuru, Vavilala and Kalluru in Khammam district.[20]

4.1.5 KRISHNA DISTRICT

According to M.S. Krishnan, excellent indications of workable deposits of mica are seen 1.6 km south west of Tiruvur, near Kummarkuntla, Chimpalapadu,[19] and shallow quarries for muscovite are found near Tiruvur, Lakshmipuram, Gampalagudum, etc.

4.1.6 NELLORE DISTRICT

Mica mining in the Nellore district has attained considerable importance since the first mine was opened here in 1889. Mica deposits are worked in the district within belt striking NNW-SSE for some 96 km with a width of 13 km to 16 km. The country rocks are mica-schists, biotite schists and hornblende schists. The Mica bearing country rock here is flat, unlike in Bihar and is usually covered by a mantle of soil with only rare outcrops of pegmatite veins.

The mica belt has been divided into five zones and named respectively after the towns of Gudur, Rapur, Podelokur, Atmakum and Kavali. The majority of the mines are situated along two more or less parallel lines on the eastern and western sides of the belt. The principal mines, those of

"Pallimitta" and "Tellabodu" near Saidapuram, Kalyanarama near Kalichedu, Inukurti and Lakshminarayana near Chaganam are situated on lentilcular masses or bosses of pegmaite. The pegmatites are of two types, simple and composite, one consisting of a single vein with well defined walls and the latter showing numerous branching or parallel veins with minor parting of schists. Most of the pegmatites strike parallel to the foliation planes of the enclosing schists and dip steeply or vertically. They vary in length from 30 m to several hundred metres and the width is generally upto 30 m but it may also be upto 70 m. Number of pegmatites show a central core composed of quartz like those of Bihar. As regards mineral composition, quartz, albite, orthoclase, microcline, microcline perthite and muscovite are the essential constituents. Garnet, tourmaline, apatite and beryl are common accessories. Small quantities of rare-earth minerals are occasionally found. The Sankara mine in the neighbourhood of Griddalur has yielded considerable quantities of Samarskite in the past.

The mica obtained is usually of a greenish colour, due to a trace of chromium, but a certain proportion of ruby mica is also obtained from the mines. Much of the mica is stained with oxide of iron. In the pegmatites mica occurs as books measuring upto one metre are also common. In thickness the books are generally 5 cm to 15 cm or even 25 cm. In general, large sheets are available from the mica books of Nellore than of Bihar.

Occurrence of green mica and biotite mica are reported from Narasapuram and Sripurama respectively. Mica bearing pegmatites have been reported from near Boganampadu, Narayanspura, and Chandrapadiya.

The pegmatites are scattered throughout the belt but are mostly located within the limits of Kavali, Atmakur, Rapur and Gudur taluks. The important mica pegmatites are located around Gullawalleru, Chinna Ammaluru, Chinnatruka, Lakshmipuram, Deendigam, Sripalam, Vasili, Suryapalalem, Thimmayapalem, Battulapalli, Nallapalem, Tatipatri, Prabhagiripatnam, Loderu, Marupuru, Inukurti, Degapuri, Vadlapudi, Devaravemur, Tummulatalupur or Talupur, Kalichedu, Turpupadla, Anantamadugu, Chennur, Mangalapuram, Tippamoru, Mekanuru, Voduru, Rettapalli, and Patharegunta in the Nellore district.

The distribution of mica in the pegmatites is very irregular, but usually it occurs near the hanging and foot wall sides. Where there is a central core of quartz, mica is noticed at its contact with the surrounding felspathic zone. It occurs as books, which, on a average vary from 15 cm to 30 cm across but larger books measuring 50 to 90 cm across are also found. The books are generally 5 to 10 cm thick.

The Nellore mica has a light green colour. A variety of mica locally known as "Loney mica" with shades of green and light ruby is worked in some pegmatites. The mines around Mudigadu, Kalichedu and Utukur yield a pale ruby variety comparable to Bihar ruby mica.[19,20]

4.1.7 SRIKAKULAM DISTRICT

A small occurrence of good quality mica has been recorded near Kurupam. The mica is up to 2.5 cm to 15 cm across. Small blocks of ruby mica of no economic importance occur to the SSW of Dolemba. Phlogopite mica occurs to the south of Bathilabadi.

Minor occurrence of muscovite bearing pegmatites ore reported from Kurupam, Konnaram and Majigudem villages of the Srikakulam district.[20]

4.1.8 VISHAKHAPATNAM DISTRICT

Deposits of good quality and light to deep amber coloured phlogopite mica occur near Borra, Majigudem, Kudia etc.

It occurs as irregular clusters and as pockets in dyke like or lens shaped bodies of decomposed pyroxenite. Some weathered books of muscovite upto 45 cm across are found in the dumps near an old pit at Majigudem.[19]

Muscovite is found in pegmatites in the former Mudugula Estate and attempts have been made to exploit the deposits at Sivarampuram and Garisigi. Silver grey and amber coloured phlogopite is found in the surface soil at several

localities of the Estate. The specimens are buckled, but some are clear, the largest measuring over 6 metre across.[19]

Occurrence of mica have also been reported from Kavikondla Agraharam, Kottavalasa near Bhimali, Govada, Kondasingi etc. Ruby mica in small quantity has been found near the Visakhapatnam Distillery. Mica upto about 15 cm across had been obtained from here.[19]

Minor occurrence of Phlogopite from near Borra and Muscovite mica from Kavidikundala and Govada in Vishakhapatnam district have also been noticed.[20]

4.1.9 GUNTUR DISTRICT

The presence of muscovite bearing pegmatites is noticed at Elchuru in Guntur district.[19]

4.1.10 CHITTOR DISTRICT

The presence of muscovite bearing pegmatites is noticed at Bondarevu and Golapalli in Chittor district.[19]

4.2 Reserves

Indian Bureau of Mines is entrusted with responsibility of preparation of National Mineral Inventory in order to keep the documents of Reserves/Resources of various minerals in India which is useful in planning Indian Industries and also helps Government of India to know the potentialities of minerals in India. As per the National Mineral Inventory prepared as on 1st April, 1990 by Indian Bureau of Mines in collaboration with various Geological agencies such as Geological Survey of India, Directorates of Geology and Mining of State Governments, Public Undertakings etc. The all India insitu reserves of mica, recoverable reserves, conditional resources and prospective resources etc., in all leasehold areas are given below :-

4.2.1 ALL INDIA TOTAL RESERVES[21]

	(in tonnes)
1. In situ Reserves	132,874
2. Recoverable Reserves	109,014
3. The conditional Resources	2,216
4. The Prospective Resources	1,385

The reserves calculated are all in leasehold areas and of unclassified grade.

The term, Recoverable Reserves may be defined as 'Identified Resources' with calculable tonnage of ore that would be available on mining considering the mining losses involved.

'Conditional Resources' are those, that form a part of the 'Identified Resources' that will become reserves with favourable changes of such conditions, single or combined as cost of production, selling price, technology, market, infrastructure facilities etc.

4.2.2 ANDHRA PRADESH

The total insitu and recoverable reserves are of the order of 117,218 tonnes and 93,778 tonnes respectively and they are in the leasehold areas. The total reserves are reported from the districts of Nellore and Khammam. Minor occurrences of mica are also reported from districts of Anantapur, Chittor, East Godavari, Guntur, Karimnagar, Krishna, Srikakulam and Vishakapatnam. There is no reserve figure available for these districts.

4.2.3 DISTRICTWISE ANALYSIS OF IN SITU RESERVES OF MICA IN ANDHRA PRADESH

In Nellore district, the total insitu reserves are 116,338 tonnes in the possible category and are of unclassified grade. In Khammam district the insitu reserves are of 880 tonnes in the possible category and are of unclassified grade. They are in leasehold areas.

4.2.4 DISTRICTWISE ANALYSIS OF RECOVERABLE RESERVES OF MICA IN ANDHRA PRADESH

The total recoverable reserves in the leasehold areas in district Nellore are 93,074 tonnes and in district Khammam it is 704 tonnes in the 'possible' category and are of unclassified grade.

In Vishakhapatnam district, in freehold area the insitu and recoverable reserves are of 15.24 tonnes and 10.67 tonnes respectively are of vermiculite mica.

Chapter-5
Mining, Production and Processing

5.1 Leases

As on 1.1.92 there are 154 mining leases for mica in Andhra Pradesh with a total area of 2902.1 hectares. Distribution of leases, and lease area (active and idle) in Andhra Pradesh is given in Table 5.1.

TABLE - 5.1 : DISTRIBUTION OF MICA LEASES AND LEASE AREA IN ANDHRA PRADESH AS ON 1.1.92

District	No. of leases			Lease area in hectares		
	Active	Idle	Total	Active	Idle	Total
Khammam	1	0	1	21.74	0.00	21.74
Nellore	87	54	141	1705.96	756.11	2462.07
Visakhapatnam	10	1	11	381.88	20.28	402.11
West Godavari	1	0	1	16.16	0.00	16.16
Total	**99**	**55**	**154**	**2125.76**	**776.34**	**2902.10**

5.2 Production[3]

All India production of Crude mica was 1,413 tonnes in 1972 which has been continuously declining touched a low level of 2,507 tonnes during 1992-93. Number of working mines has also declined from 438 in 1972 to 127 in 1992-93. Many of the mines have been closed, because easily available pegmatites have been worked out up to economic depth and abandoned prematurely. Presently production of Crude mica is reportedly from Andhra Pradesh, Bihar and Rajasthan.

Andhra Pradesh is the second largest producer of crude mica in India. During the period 1972 to 1993 the production fluctuated between 5,029 tonnes and 2,555 tonnes. Thereafter the production has decreased in succeeding years and has come down to 1,166 tonnes in 1992-93.

The production of crude mica in Andhra Pradesh during the five years period from 1988-89 to 1992-93 is given in table No. 5.2.

TABLE - 5.2 : PRODUCTION OF CRUDE MICA AND MICA SCRAP IN ANDHRA PRADESH , 1988-89 TO 1992-93

(Quantity in tonnes)

Year	All India production			Andhra Pradesh		
	No.of mines	Mica crude	Mica scrap	No.of mines	Mica crude	Mica scrap
1988-89	148	3949	3440	44	1435	569
1989-90	145	4140	3557	49	1606	682
1990-91	135	3806	2639	49	1568	656
1991-92	133	3353	1944	50	1268	728
1992-93	127	2507	1490	49	1166	494

Andhra Pradesh also contributed 46.5% of All India production of crude mica in 1992-93. Out of total 49 mines (1992-93) in A.P., 43 mines are located in Nellore district alone.

Nellore district is the sole producer of mica in A.P. which produced 1,126 tonnes of crude mica out of total State's production of 1,166 tonnes in 1992-93. Other producing districts are Khammam and Visakhapatnam, their production is very small.

5.3 Mining Method

In Andhra Pradesh mica deposits are mined by underground mining method. The mines are semi-mechanised. Drilling is done by jack hammers. The blasted material is transported manually upto the hoisting point in the mine, and hoisted to the surfaces by mechanical hoist. Stoping is done by cut and fill method.

The method of mining of some of the mica mines is described below :-

1. Seetharama Mica Mine[22]

It is a semi-mechanised underground mine. The production during 1992-93 was 160 tonnes of crude mica, with average labour employment of 55 persons/day. Drilling of blast holes, and hoisting are mechanised.

There are 13 levels in the mine and the maximum depth reached is 143 m. Extensive underground development has been carried out in the form of drives, cross cuts, winzes, raises and shafts. The mine has a strike length of 640 m. Blast holes are drilled with the help of compressed air operated Jackhammer. Holes are drilled in wedge/diamond cut pattern. Blasting is done by using ordinary/electrical detonators. The blasted ore is loaded manually into tubs of 0.6 to 0.7 tonnes capacity and trammed upto the hoisting point in the mine and from these hoisted to the surface.

Development and stoping are in progress in this mine. Stoping is done by cut and fill method and is carried out from wall to wall to ensure near total extraction of crude mica. Exploratory drill holes have been put in the stope walls for deciphering the shape and size of pegmatites as well as to locate parallel pegmatites, if any.

2. Sri V.K. Durga and Uma Maheswara Mica Mine [22]

This is a semi mechanised underground mine. The production during 1991-92 was 167 tonnes only with average labour employment of 32 persons/day. Drilling and hoisting operations are mechanised. Holes are drilled in Diamond cut pattern and blasted in three stages for effective blasting as given below.

Dummy hole	1	Not charged
Cut holes	8	First
Easers	8	Second
Dresses	12	Third

Blast holes are drilled to a depth of 0.9 m. For blasting superdyne explosives is used. The blasted material is filled manually in the baskets and the baskets are kept on trolly and trammid upto the hoisting point in the mica. From these it is hoisted to the surface, into two stages, by 15 HP hoists.

About 90% of crude mica is hand sorted from the blasted material in the underground face itself. The remaining stuff is brought to the surface and subjected to further hand sorting.

For protection of environment in the area, mango plantation has been done over an area of 5.03 hectares by planting 500 Nos. of plants.

3. K.S.R. Mine

This is a semi mechanised underground mine reached to a depth of 92 m with eight levels developed. The production during 1992-93 was 50 tonnes of crude mica, with average daily employment of 18 persons.

4. Sri Rajeswari Mica Mine

This is an underground semi-mechanised mine. The production during 1992-93 was 133.6 tonnes of crude mica. The average daily employment was 77 persons.

There are two vertical shafts from surface, one of the shaft is 27 m and other 60 m depth . One of the shaft is used for manway and the other for hoisting and ventilation. Since the mine has gone upto a depth of 269 m, two anxiliary vertical shafts are provided in underground for handling purpose. One is from 66 m level to 157 m and the other is from 157 m to 269 m level.

As the pegmatites in the mine are dipping steeply and narrow, the lateral development of the mine is highly restricted.

Drilling of holes in drives/cross cuts is done by using compressed air operated jack hammers, following 'V' cut pattern of holes.

The mica pieces are sorted out manually from the blasted material underground itself. The remaining material is transported manually to the loading point at 269 m level. From 269 m level it is hoisted to the surface in three stages. On surface the crude mica is dressed. It is cut, splitted and scinored to different sizes suitable for markets.

5.4 Processing of Mica

A uniue feature of mica is that it can be separated from other associated minerals by simple hand dressing and picking. Crude mica is recovered manually by hand dressing and picking from the blasted material in the underground at the face itself to the maximum extent and transported to the surface. Still certain quantity of small sized mica (incidentally generated scrap waste mica) is left with the debris underground. This remaining debris mixed with scrap mica is also transported to surface to recover further mica pieces as far as possible.

Crude mica obtained from the mine is not used in the industry directly. It requires processing before it is put to industrial use. Crude mica produced in the mine is transported to the surface and is subjected to preliminary dressing called hand combing, to remove unwanted material associated with it. It is then dressed with sickle, knife and scissors. During this dressing, the part of the mica containing deformities, such as fracture, unevenness, cracks etc. are removed and only the better material is retained as 'block'. Such blocks are classified into various sizes and qualities on the basis of visual estimates. The cuttings resulting from the cleaning operations are called 'scrap mica' or 'waste mica'.

Block mica is further sub divided into films and splittings depending upon the thickness. Films are prepared from superior quality block mica free from all impurities.

Blocks, films and splittings (collectively called sheet mica) are processed further by cutting and trimming and to make them conform to the necessary sizes for export. This is done exclusively by hand, by the experienced workers. For final use sheet mica is cut, punched or stamped into particular shapes and sizes. Such cut, punched and stamped mica is called 'fabricated mica'. The fabrication indeed is only mechanical cutting or punching and no foreign material is added to the mica. The scrap resulting from the processsing of blocks during fabrication is known as factory scrap. This form of scrap is quite different from the scrap resulting from preliminary dressing of crude mica.

The splittings are further processed by hand to make a product called as 'built up mica' or 'micanite'. This is done by alternating the layers of splittings and binder. The sheets or plates so formed are heated, pressed and trimmed to give a final product of any desired thickness.

A more sophisticated processing is resorted to make reconstituted mica or mica paper. The factory scrap is laid down as a continuous mat and then impregnated with a binding agent.[4,28]

Another type of mica processing is grinding. Even when ground, mica retains its flat laminary structure and mechanical properties down to a fine particle size.

Grinding of mica scrap by dry process in high speed hammer mills results in loosing of shining of mica powder. To produce mica powder without loosing its shine, wet grinding is carried out. This process used to be secret of some U.S. Firms. The Central Glass and Ceramic Research Institute, Calcutta (CGCRI) has developed a process for wet grinding of mica and the product obtained is reported to be comparable in properties and performance to foreign material. The process is covered by Indian patent (SS454). Though the National Research Development Corporation made several attempts to lease this technology to several companies in the country, the process has not yet been successfuly adopted. The R & D cell of Mica Trading Corporation (MITCO) claims to have developed the know-how to produce wet ground mica powder on laboratory scale. [23]

Chapter-6
Uses and Mica Based Industries - A.P.

There are seven important species under mica group, of which only muscovite and phlogopite are of commercial importance. Phlogopite is superior to muscovite in heat resistance but is less elastic than muscovite. Mica is invaluable to electrical industry because of its di-electric properties and low power factor (di-electric strength is the ability to withstand high voltage without puncturing). It also withstand high temperature and is non-conductor of electricity.[24-26]

Mica is used in the electrical industry generally in the form of built up mica known as micanite, cut into different sizes and shapes according to requirements. Mica films as such are also used in radio valves. A number of products like mica tubes, mica cloth, mica paper, mica silk, mica tape are manufactured for use in electrical and electronic appliances. Some of the latest uses of mica capacitors are in high temperature sustaining equipments such as in space rockets, missiles, telestar transmission and also jet engine ignition system etc.[27-29]

6.1 Sheet Mica

Natural sheet mica, either as blocks, splittings and films or as composite pieces in the built-up form, also as micanite (made from mica splittings), is principally used in the electronic and electrical industry because of its unique electrical and thermal insulation properties and its ability to be cut, punched or stamped to a very fine tolerance. The largest quantity of block and film mica is consumed in the fabrication of vacuum tubes spacers. Block mica is also fabricated into washers of various sizes to act as insulators in various types of electronic apparatus. Its another important use is in the manufacture of capacitors. Electrical equipments incorporating mica components includes transformers, small heating elements, rheostat, fuses, incandescent bulbs, and commutator and armature insulation in generators. Very high quality sheet mica has several non-electrical uses. Transparent and extremely flat pieces are used in gauge glasses of high pressure steam boilers, metallurgical furnace windows, diaphrams for oxygen breathing equipment, marker dials for navigation, wave retardation plates for specialised optical equipment, X-ray equipment and acoustical apparatus and in helium neon lasers where it is used as retardation plates.

Built-up mica from splitting serves as a substitute for natural sheet mica when the primary property needed is electrical insulation. It is used as segment plate, moulding plate, flexible plate, heater plate.[30, 31]

6.2 Mica Paper

The main forms of mica paper and their end-uses are summarised below :-

MICA PAPER END-USE APPLICATIONS

	Form of mica paper	End-uses
i)	Insulating mica paper tapes	Phase insulation in D.C. armature coils, A.C. starter coils, rotating field coils and transformers.
ii)	Impregnated high temperature paper or laminates.	Transformers coil wrappings, foil, slot liners.
iii)	Silicon bonded composites of mica paper with glass cloth.	Heavy duty traction motors.

(Contd.)

(Contd.)

	Form of mica paper	End-uses
iv)	Electrical grade tape, sheet or board	Small domestic appliances, toasters, percolators, water heaters, cigarette lighters.
v)	Sheet insulation	Jet engine ignition system, missiles, capacitors.
vi)	Flexible sheets of capacitor grade paper.	Cylindrical capacitors.
vii)	Precision-punched stamping from mica paper sheets.	Commutator segments in automotive electrical system.
viii)	Rigid laminates of inorganically bonded mica paper	Vacuum tube spacers and high temperature insulation.
ix)	Silver or copper clad laminates	Printed or etched circuitry.
x)	Washers and spacers	Flat insulation mounting.

The hi-tech use of processed scrap mica is in the manufacture of mica paper which competes with the block mica and micanite. India is the sole producer of factory scrap in the world suitable for the manufacture of mica paper. So far only scrap from ruby mica factory has been used in the manufacture of mica paper, but the green mica scrap from Andhra Pradesh can also be used for this purpose to some extent.

As the name implies, mica paper is actually a paper like material. However, it differs from ordinary paper since it consists entirely of tiny flakes of mica without any organic additives. Instead of gaining its strength by the intervening of fibrous material, mica paper is held together by natural adhesive force between adjacent flakes. This natural force is unaffected by temperatures as high as 550^{o} C and is sufficient to give mica paper a tensile strength of the order 70 Kg / cm^{2} in lengthwise direction. Mica paper has excellent compression and sheer strength, but without a binder its other mechanical properties are relatively poor. Mica paper is also known as reconstituted mica.[30, 31]

6.3 Mica Capacitors

Capacitors are one of the important electronic components and are broadly classified as fixed and variable capacitors. They are made out of mica paper, ceramics, glass, etc. and because of a wide range of operating temperatures, low power loss, extremely close tolerance, etc. and also because of size considerations, mica capacitors have been preferred in the electronic circuits.

Two types of mica capacitors are generally used, viz. dipped mica capacitors and moulded mica capacitors and, of these two, the former are preferred owing to their greater reliability. Capacitors are used as passive components. These are mainly used in entertainment, military and telecommunication equipments.[30, 31]

6.4 Glass-bonded Mica

Glass bonded mica consists of low temperature glass and mica flakes. It is a stone-like material, grey to white in colour and has excellent electrical, mechanical, and thermal properties. Mouldings and sheets made from glass-bonded mica have many applications, usually as small components in the following industries :

(1) Aircraft and automobile components.

(2) Electrical distribution equipment, insulation and control gear, switch gear, and cable attachments.

(3) Electrical machinery components, armatures, commutators fan housing, and traction gear.

(4) Radio and T.V. transmission equipment.

(5) Printed circuits, computer components and business machine.

(6) Telephone and telegraph apparatus, memory and encoding devices.

(7) Domestic appliances and microwave components.

(8) Welding gear and X-ray equipment.

6.5 Mica Powder

Mica scrap and waste obtained while processing mica is ground and pulverised into flakes and powder of different meshes (fineness) by three processes, viz. dry grinding, wet grinding or micronisation.

Dry ground mica in large quantities is used in oil well drilling. The mica particles act as a sealant and prevent the loss of drilling fluids which would otherwise escape into the porous formations. In the electrical industry, mica is employed as dusting agent in the manufacture of electrical cables, to prevent the adhesion of rubber insulation to the cores. The plastic industry uses dry ground powder as filler. It is also used as an effective thermal insulator. Other minor uses of dry ground mica are as an additive in inks and paints, as an annealing agent in metal treatment, as a filler in insulator board as an absorbent for explosives and disinfectants, and as an ornamental finish on concrete tile and stucco surface.

Wet ground mica is used in the paint industry as a specialised pigment extender. The addition of mica to paints imparts to them a tough and flexible shield against chemical attack and solar radiation. It also enhances such properties as washability, adhesion and corrosion resistance. In rubber industry, wet ground mica is used as a lubricant. It is also used in the manufacture of rubber tyres. Other uses include wall paper manufacture in which it is used to give silvery sheen to the surface.

Micronised mica is also used, like wet ground mica in paints, plastics and rubber industries.[30, 31]

6.6 Mica Bricks

A few other products like heating elements and mica bricks also find uses in the country, while mica bricks are used as refractories, heating elements are used in domestic electrical appliances.

6.7 Mica Based Industries in A.P.

According to the information gathered by the District Industries Centre, Nellore, there are 21 mica based industries operating in Andhra Pradesh and their location and product manufactured are given below :-

Sl. No.	Name of plant/project (Location and address)	Products
1.	Associated Mica Exports, Gudur-Rapur Road, At Goginenipuram, Gudur.	Wet ground Mica powder and Mica flakes.
2.	Indian Insulators, Magnur Road, Chillakur.	Mica powder
3.	Laxmi Pulverising Mills, Near Bus Stand, Kodavalur.	Mica scrap powder
4.	R.R. Industries, Bhavani Bhawan, Gudur.	Mica powder
5.	Shri Chandan Industries, Main Road, Gudur.	Mica flakes and powder
6.	W.D. Macron and Mica Co. Ltd., Gudapallipadu.	Mica powder
7.	Vijabharati Flour Mills, 12/170-1 GNT Road, Sullurpet.	Mica powder
8.	Continental Di-Electricals, 18/79 Ponnulurupalem, Chennur, Gudur.	Mica Fabrication
9.	Mica Fab, 2-57, Narsingrao Mills, Gudur.	Mica Fabrication

(Contd.)

(Concl.)

Sl. No.	Name of plant/project (Location and address)	Products
10.	Radha Mica Suppliers, 12/236, Kataka Raja Street, Gudur.	Fabrication of Mica
11.	Ravi Insulating Company, Goginenipuram, Gudur.	Fabrication of Mica
12.	Revathi Mica Company, 9/37, Nandammagudi Street, Gudur.	Fabrication of Mica
13.	Southern Insulators, 13/73, Bhavani Bhawan, Park Street, Gudur.	Fabricated mica components
14.	Electro Heat Products, 10/454-27, Gudur.	Mica heating elements
15.	Suguna Industries Company, 1/429, Malviya Nagar, Gudur.	Mica heating element
16.	ACN Electro Corporation, W 3/86-1, Convent St., Bangisaheb Street, Gudur.	Mica elements
17.	Sujatha Insulators, Narsingraopeth, Gudur.	Mica elements
18.	PA Azeed Mica Chimneys Works, 3/24, Bangisahebpet, Gudur.	Mica Chimneys
19.	Vishal Enterprises, Jankirampet, Gudur.	Mica Chimneys
20.	Alfa Mica Electricals, 3/86, Bangisaheb Street, Gudur.	Mica Insulators.
21.	Precision Pump Products, Goginenipuram, Gudur.	Mica Washers

It may be seen from the above that there are 7 mica powder manufacturing units and remaining 14 units manufacture mica products like insulators, mica washers, heating elements etc. Among these units, M/s. Continental Di-electricals, Gudur, Gudur Mica Fabrication Unit and M/s. Associated Mica Exports, Gudur, M/s. Laxmi Pulverising Mills, Nellore and M/s. W.D. Micron and Mica Co. Ltd., Nellore (Mica Powder Unit) are important from the point of investment and production.

Chapter-7
Outlook, Prospects and Problems

India is one of the major producers and exporters of sheet mica and various forms of mica products. Mica has been a traditional export commodity to the international markets all along the period. [28]

7.1 Internal Demand [28]

The average consumption of mica of all types during the period 1989-90 to 1991-92, in the country has been 9,260 tonnes. The future demand by 2000 A.D. estimated by the Working Group on Mica set up by the department of mines in 1988 is 18,200 tonnes and the break up is given in table No. 7.1.

TABLE NO .7.1 : FUTURE DEMAND

(In tonnes)

	Type of mica	Demand 2000 A.D.
1.	Mica blocks for electrical heating elements and fabricated mica products.	800
2.	Mica films for cut condenser plates, silvered mica plates and silvered mica capacitors.	300
3.	Mica splittings for micanite sheets and tubes, mica folium and tapes.	700
4.	Mica paper based products like Samicatherm and Samicaflex tapes and folium.	400
5.	Scrap mica.	16,000
	Total	18,200

Source : Report of the Working Group on Mineral Development (1990-1995), Aug.,1989

7.2 Export Performance

The export of Mica and Mica products from India, which was 16,852 tonnes valued at Rs. 10.15 crores in 1982-83 has increased to 33,466 tonnes, valued at Rs. 34.56 crores in 1991-92, showing the increasing demand of Indian Mica in the World market. The export figures from 1982-83 to 1991-92 are given in the table No. 7.2.

TABLE NO. 7.2 : EXPORTS OF MICA AND MICA PRODUCTS , 1982-83 TO 1991-92

Year	Quantity in tonnes	Value in Rs. crores
1982-83	16,832	10.15
1983-84	12,430	17.85
1984-85	16,430	19.56
1985-86	18,104	20.92
1986-87	19,462	19.56

(Contd.)

Table 7.2 (Concld.)

Year	Quantity in tonnes	Value in Rs. crores
1987-88	13,529	18.52
1988-89	19,520	23.89
1989-90	37,879	30.00
1990-91	10,781	26.42
1991-92	33,466	34.58

Source : Note on Mica, ME Division IBM.

It may be seen that the export of mica is fluctuating. The export was maximum at 37,879 tonnes in 1989-90 and minimum at 10,781 tonnes in 1990-91. This may be due to fluctuating demand for mica in the world markets.

As per the Report (1989) of the Working Group on Mineral Development (Eighth Five Year Plan), the exports of processed sheet mica (blocks, films and splittings) are likely to decline in future. Mica Trading Corporation (MITCO) has projected that export of processed sheet mica may come down to about 2,700 tonnes by 1994-95.

The export of scrap mica from India in future years are likely to continue at the present level of about 12,000 tonnes per annum, unless the exports are restricted as a matter of policy. Exports of manufactured mica products by 1994-95 is estimated to be as under and the value of exports, a decade ago in 1985-86 is also given. [31]

(In Rs. million)

Mica products	1985-86	1994-95
Fabricated mica	17	56
Mica powder	23	45
Others (silvered mica plates, mica paper)	112	199

7.3 Export Policy

As per the export policy of Government of India for the period 1992-97 - Mica waste (including factory cuttings) and scrap which is obtained by processing mica and which because of size and colour is considered below the specifications of processed mica - can be exported through MMTC, New Delhi and MITCO, Bihar.

Marketing of Mica c'her than the above has been decanalised.

7.4 Survey of Mica Mines by IBM

The IBM has carried out a techno-economic survey of mica mines in India under sponsored project of the MITCO. Both, the working and closed mines have been investigated in all the three major belts of Bihar, Andhra Pradesh and Rajasthan. After the investigation, it has been estimated that out of 144 (reported working mines), 32 working mines have got potential for increasing production of crude mica if the investment needed is made.

IBM has prepared a compendium on about 350 prematured closed mines in Bihar mica field and the same is under preparation for Nellore Mica field.

7.5. R & D Activities by IBM

IBM took up R & D activities in Bihar mica field, the activities involved (i) structural studies for the delineation of locales for emplacement of mica pegmatites (ii) Crystallisation history leadng to the concentration of commerical mica (iii) Petromineralogical studies (iv) Geochemical and Geo-physical studies - for succcessful exploration for mica mineralisation. [15]

7.6 Problems

Indian mica Industry is mostly export oriented. In recent years there has been an appreciable decline in the export demand of natural sheet mica, because of large scale use of substitutes for mica. As a result, there has been steep decline in the production of crude mica.

7.7 Need for Exploration and Research and Development[31]

The working group on Mineral Development (Eighth Five Year Plan) in their report have suggested the actions required to be taken for exploration and research & development.

(i) **Exploration** : The GSI, IBM and the concerned State Directorate of Mines and Geology should jointly make resource assessment of mica deposits in the country based on available knowledge on geology, mineralisation and the historical data on the recovery of mica from the pegmatites in the three mica belts of Bihar, AP and Rajasthan.

(ii) **Research and Development** : Research and development activities may be concentrated on the following aspects :-

1. Production of mica paper by different techniques and mica paper based products for use in the electrical, electronic and electrical heating element industries.
2. Production of mica splittings based products and their evaluation vis-a-vis mica paper based products both in relation to technical and economic aspects.
3. Development of glass bonded mica (Mycalex)
4. Development of mica paints especially pearlescent pigments.
5. Use of mica as a filler in rubber and plastics.
6. Development of mica laminates with high polymeric bond and cement bonded building boards.
7. Production of small size silvered mica capacitors.
8. Utilisation of currently unsalable processed

7.8 Conclusions

Mica Mining Industry in India is more than 100 years old. All the exposed productive pegmatite bodies have mostly been exploited. No new mica mines are opened up recently. Many of the mica mines have reached considerable depths, mining beyond has become uneconomical.

In recent years, the demand for sheet mica in the international market has fallen, because of large scale use of substitutes for mica. But the demand for waste and scrap mica has been increasing in the international market. It is not possible to produce only scrap and waste mica as these have to be generated from sheet mica during dressing of the same.

In India, there are a number of prematuredly closed mica mines, because easily available pegmatites have been worked out upto economic depths, and abandoned. Some of the closed mines, can be selected and reopened for production of mica, scrap/waste mica. IBM has prepared a compendium on about 350 such prematuredly closed mines in Bihar mica field and the same is under preparation for Nellore mica field. The compendium contains plans and sections of the closed mines and comments on future potential of the pegmatites. This information is valuable for aspirant investors.

IBM could forsee the problems in mica mining industry and took up R & D activities in Bihar mica field to start with and later in Rajasthan and Andhra Pradesh fields to a limited extent.

Present scenario of occurrence of mica pegmatite indicates that there is good scope of finding out concealed productive pegmatites in all the three fields by studying the structural controls of mica mineralisation, resorting to geophysical and geochemical exploration techniques. Therefore, exploration of pegmatite bodies through systematic preliminary and detailed exploration methods and following the guidelines for location of mica may be taken up to open new mines for augmenting the production of mica and mica products.

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