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APATITE AND ROCK PHOSPHATE

(ADVANCE RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
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1 Apatite and Rock Phosphate

Apatite is a group of phosphate minerals named by German Geologist Abraham Werner in 1786. It is the most abundant crystalline phosphate mineral found as an accessory mineral in practically all kinds of igneous rocks. Sometimes, it is concentrated in pegmatites, metallic veins and magmatic deposits. It also occurs in metamorphic rocks and as a secondary mineral in phosphatic rocks of sedimentary origin. It is a group of phosphate minerals, usually referring to hydroxy apatite, fluorapatite and chlorapatite. Fluorapatite $Ca_5(PO_4)_3F$ is the most common variety of apatite and also a secondary source of fluorine. Collophane ($Ca_3P_2O_8$) is apparently a cryptocrystalline or amorphous calcium phosphate complex. Rock phosphates or phosphorites are sedimentary phosphatic deposits comprising fine-grained mixture of various calcium phosphates, most important being hydroxylapatite, carbonateapatite, fluorapatite and their solid solutions. About 80% phosphate production in the world is derived from phosphate rocks (phosphorite) containing one or more phosphatic minerals, usually calcium phosphate of sufficient purity and quantity to permit its use directly or after concentration in manufacturing commercial products.

Phosphate rock is also the source of by-product fluorine. Apatite & rock phosphate containing 3 to 4% CaF_2 are useful for recovery of fluorite. Hydrofluoro-silicic acid is recovered as by-product from phosphoric acid plants during processing of rock phosphate. Phosphate rocks are also considered as a significant and secondary resource of uranium.

India is deficient in Apatite & Rock Phosphate availability. In case of apatite, the country is fully dependent upon imports, while the Rock Phosphate production is only from two States, namely, Rajasthan and Madhya Pradesh.

RESERVES/RESOURCES

Apatite

The total Reserves/Resources of apatite as per NMI data, based on UNFC system as on 1.4.2020 has been placed at 21.11 million tonnes. Out of these resources, the Reserves are placed at 0.029 million tonnes, while 21.08 million tonnes are placed under Remaining Resources category. Of the total reserves/resources, West Bengal accounts for the bulk of 50%, followed by Jharkhand (34%) and Meghalaya (6%). The remaining 10% resources are located in Rajasthan, Andhra Pradesh, Gujarat and Tamil Nadu. Gradewise, soil reclamation grade accounts for 45% followed by beneficiable grade (32%), Low/Non-beneficiable grade (15%) and remaining Blendable, Unclassified & Not-known grades (7%). The resources of Chemical Fertilizer grade are about one per cent (Table-1).

Rock Phosphate

The total reserves/resources of rock phosphate as per NMI data, based on UNFC system as on 1.4.2020 has been placed at 311.25 million tonnes. Out of these, the reserves constitute only 30.87 million tonnes while 280.37 million tonnes are under Remaining Resources category. Of the total reserves/resources, 34% are in Jharkhand, 30% in Rajasthan, 19% in Madhya Pradesh, 8% each in Uttar Pradesh & Uttarakhand, respectively. Meagre quantities of resources are also located in Gujarat and Meghalaya. Gradewise, Low-grade account for 37%, followed by Beneficiable (22%), Soil Reclamation (15%) Blendable (10%), Chemical Fertilizer (9%) and remaining Unclassified and Not-known grades (about 7%) (Table-2).

EXPLORATION & DEVELOPMENT

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

PRODUCTION & STOCKS

Apatite

No production of apatite was reported since 2017-18 (Table-3).

The mine-head closing stocks at the end of 2020-21 was 6,306 tonnes same as in 2019-20 (Table-4). The average daily labour employed in apatite mines during 2020-21 was nil as against 01 in the previous year.

Table – 1 : Reserves/Resources of Apatite as on 1.4.2020
(By Grades/States)

(In tonnes)

State/Grade	Reserves				Remaining Resources								Total Resources
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
All India : Total	**27715**	**–**	**1680**	**29395**	**499149**	**–**	**–**	**2281521**	**11481250**	**5801338**	**1017646**	**21080904**	**21110299**
By Grades													
Chemical Fertilizer	27715	–	1680	29395	–	–	–	30000	–	200163	–	230163	259558
Soil Reclamation	–	–	–	–	236502	–	–	2233500	6243000	800000	–	9513002	9513002
Low/Non-beneficiable	–	–	–	–	–	–	–	3360	2363000	50000	666646	3083006	3083006
Beneficiable	–	–	–	–	–	–	–	12477	1875250	4561175	351000	6799902	6799902
Blendable	–	–	–	–	262647	–	–	2184	–	–	–	264831	264831
Unclassified	–	–	–	–	–	–	–	–	1000000	–	–	1000000	1000000
Not-known	–	–	–	–	–	–	–	–	–	190000	–	190000	190000
By States													
Andhra Pradesh	27715	–	1680	29395	–	–	–	–	–	200163	–	200163	229558
Gujarat	–	–	–	–	–	–	–	–	–	–	351000	351000	351000
Jharkhand	–	–	–	–	–	–	–	2110000	1620000	3540000	–	7270000	7270000
Meghalaya	–	–	–	–	–	–	–	–	–	1300000	–	1300000	1300000
Rajasthan	–	–	–	–	–	–	–	51521	1016000	–	–	1067521	1067521
Tamil Nadu	–	–	–	–	–	–	–	–	–	240000	–	240000	240000
West Bengal	–	–	–	–	499149	–	–	120000	8845250	521175	666646	10652220	10652220

Figures rounded off

Table – 2 : Reserves/Resources of Rock Phosphate as on 1.4.2020(P)
(By Grades/States)

(In tonnes)

State/Grade	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	**27103158**	**-**	**3772935**	**30876093**	**13669080**	**29796846**	**34526541**	**2879833**	**3539750**	**186657066**	**9308275**	**280377392**	**311253485**
By Grades													
Chemical Fertilizer	22177450	-	264965	22442415	-	1877652	1856628	-	-	2271077	-	6005357	28447772
Blendable	-	-	-	-	9384650	1660000	8349933	13333	-	12991513	-	32399429	32399429
Soil Reclamation	-	-	-	-	705867	12015437	16512812	700000	30000	16887166	-	46851282	46851282
Beneficiable	4925708	-	1053166	5978874	3578563	14243757	6976076	2166500	2769750	25288989	6650750	61674385	67653259
Low grade	-	-	-	-	-	-	-	-	-	115547549	-	115547549	115547549
Unclassified	-	-	2454804	2454804	-	-	831092	-	740000	10095773	2657525	14324390	16779194
Not-known	-	-	-	-	-	-	-	-	-	3575000	-	3575000	3575000
By States													
Gujarat	-	-	-	-	-	-	-	-	-	314820	-	314820	314820
Jharkhand	-	-	-	-	-	-	-	-	-	107370000	-	107370000	107370000
Madhya Pradesh	5258158	-	3772935	9031093	6460616	15688511	13880230	-	2730000	10615956	50625	49425938	58457031
Meghalaya	-	-	-	-	-	-	-	-	-	1311035	-	1311035	1311035
Rajasthan	21845000	-	-	21845000	4144961	13675437	15793355	119833	69750	28942783	9257650	72003769	93848769
Uttar Pradesh	-	-	-	-	-	432898	3118586	-	740000	21481960	-	25773444	25773444
Uttarakhand	-	-	-	-	3063503	-	1734370	2760000	-	16620513	-	24178386	24178386

Figures rounded off

Table – 3 : Production of Apatite, 2019-20 & 2020-21
(By Sectors/States/Districts/Grades)

(Quantity in tonnes; Value in ₹'000)

State/District	2019-20			2020-21 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	**-**	**-**	**-**	**-**	**-**	**-**
Public sector	-	-	-	-	-	-
Private sector	-	-	-	-	-	-
Andhra Pradesh	**-**	**-**	**-**	**-**	**-**	**-**
Visakhapatnam	-	-	-	-	-	-
West Bengal	**-**	**-**	**-**	**-**	**-**	**-**
Purulia	-	-	-	-	-	-

** Only labour reported.*

Table – 4 : Mine-head Closing Stocks of Apatite, 2019-20 & 2020-21
(By States/Grades)

(In tonnes)

State	2019-20	2020-21 (P)
India	**6306**	**6306**
Andhra Pradesh	-	-
West Bengal	6306	6306

Phosphorite/Rock Phosphate

The total production of phosphorite/rock phosphate is at 1,456 thousand tonnes in 2020-21 nearly same as compared to that in the previous year (Tables - 5 to 7).

There were 6 reporting mines in 2020-21 as same in 2019-20. Rajasthan continued to be the principal producing State contributing 93% of the total production and the remaining 7% share was contributed by Madhya Pradesh.

The mine-head closing stocks of phosphorite/ rock phosphate in the year 2020-21 was 2,231 thousand tonnes as compared to 2,300 thousand tonnes in 2019-20 (Table-8).

The average daily labour employed in phosphorite/ rock phosphate mines in 2020-21 was 969 as against 961 in the previous year.

Table – 5 : Principal Producers of Phosphorite/Rock Phosphate, 2020-21

Name and address of producer	Location of mine	
	State	District
Rajasthan State Mines & Minerals Ltd, C-89-/90, Janpath Lal, Kothi Scheme, Jaipur-302 015, Rajasthan.	Rajasthan	Udaipur
Khajuraho Stones (India) Pvt. Ltd, Sagar Road Dhadari, Chhatarpur-471 001, Madhya Pradesh.	Madhya Pradesh	Chhatarpur

Table – 6 : Production of Phosphorite/Rock Phosphate, 2018-19 to 2020-21 (By States)

(Quantity in tonnes; Value in ₹'000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**1421086**	**3883571**	**1400189**	**4731313**	**1455627**	**5441988**
Madhya Pradesh	98600	88543	99960	94304	97880	92007
Rajasthan	1322486	3795028	1300229	4637009	1357747	5349981

Table – 7 : Production of Phosphorite/Rock Phosphate, 2019-20 & 2020-21 (By Sectors/States/Districts/Grades)

(Quantity in tonnes; Value in ₹'000)

State/ District	2019-20							2020-21 (P)						
	No.of mines	Grade: P_2O_5 content				Total		No. of mines	Grade: P_2O_5 content				Total	
		Above 30%	Above 25-30%	Above 20-25%	Up to 20%	Qty	Value		Above 30%	Above 25-30%	Above 20-25%	Up to 20%	Qty	Value
India	**6**	**133422**	**677189**	**3550**	**586028**	**1400189**	**4731313**	**6**	**179327**	**561677**	**-**	**714623**	**1455627**	**5441988**
Public Sector	5	133422	677189	-	489618	1300229	4637009	5	179327	561677	-	616743	1357747	5349981
Private Sector	1	-	-	3550	96410	99960	94304	1	-	-	-	97880	97880	92007
Madhya Pradesh	**5**	**-**	**-**	**3550**	**96410**	**99960**	**94304**	**5**	**-**	**-**	**-**	**97880**	**97880**	92007
Chhatarpur	2	-	-	3550	96410	99960	94304	2	-	-	-	97880	97880	92007
Jhabua	2	-	-	-	-	-	-	2	-	-	-	-	-	-
Sagar	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Rajasthan	**1**	**133422**	**677189**	**-**	**489618**	**1300229**	**4637009**	**1**	**179327**	**561677**	**-**	**616743**	**1357747**	**5349981**
Udaipur	1	133422	677189	-	489618	1300229	4637009	1	179327	561677	-	616743	1357747	5349981

Table –8: Mine-head Closing Stocks of Phosphorite/Rock Phosphate, 2019-20 & 2020-21 (By States/Grades)

(In tonnes)

State	2019-20					2020-21 (P)				
	Grade: P_2O_5 content					Grade: P_2O_5 content				
	Above 30%	Above 25-30%	Above 20-25%	Up to 20%	Total	Above 30%	Above 25-30%	Above 20-25%	Up to 20%	Total
India	**480262**	**248142**	**81919**	**1489612**	**2299935**	**324547**	**286225**	**79148**	**1541030**	2230950
Madhya Pradesh	-	1377	6527	54126	62030	-	1377	3756	62728	67861
Rajasthan	480262	246765	75392	1435486	2237905	324547	284848	75392	1478302	2163089

MINING AND MARKETING

Apatite mining is confined to Visakhapatnam district, Andhra Pradesh and in Purulia district, West Bengal. In apatite mine of Andhra Phosphate (Pvt.) Ltd, manual mining was carried out by developing benches along the strike length, following the dip of ore body, and by lateral developments of levels along the strike. A mineral treatment plant at Srungavarapukota, about 20 km from the apatite mine

has two disintegration units of 15 hp and 50 hp that operate from two separate sheds. Apatite after disintegration is screened to 40 mesh, 60 mesh and 100 mesh. The screened material of right size is packed in quantities of 50 kg each in polythene-lined gunny bags and are despatched for sale to buyers through Srungavarapukota railway station.

West Bengal Mineral Development & Trading Corporation (WBMDTC) operates the only apatite mine in West Bengal which is located at Beldih. The mine is operated by using opencast mining method with the deployment of HEMM like JCB excavator, jackhammer drills, air compressor, tippers, etc. The mine has a production capacity of about 15,000 tonnes of in situ ore per annum. Half of the low-grade ore (10-12% P_2O_5) is blended with available high-grade ore (>22% P_2O_5) manually to produce additional quantity of saleable ore (18-20% P_2O_5). The desired grade (18-20% P_2O_5) of apatite ore is ground to 100 mesh and sold in the local market for direct application in the name of "PURULIA PHOS". However, no production was reported since 2017-18.

In the case of rock phosphate, the production of phosphorite/rock phosphate in India was reported from five State Public Sector mines. Of these, Chhatarpur, Jhabua districts of Madhya Pradesh have two mines each, and Sagar district has one mine, while Udaipur district of Rajasthan has one mine. The one fully mechanised mine under the Private Sector (Hindustan Zinc Limited) is also located in Udaipur district, Rajasthan. The strike of the mine is in NE-SW direction.

The Meghnagar mine in Jhabua district and Hirapur mine in Chhatarpur and Sagar districts of Madhya Pradesh are worked by opencast method and both the mines are operated by Madhya Pradesh State Mining Corporation Ltd. Compressed-air jack hammers are deployed for drilling. The present run-of-mine capacity of Jhabua mine is 1,50,000 tonnes per year. The production of Meghnagar Mine is used in Fertilizer Industries and Phosphorus Industries. The BRP plant at Hirapur mine is operated by Madhya Bharat Agro Industries Ltd. The processed ore from the plant is predominantly sold to manufacturers of phosphatic fertilizers and chemicals. Some parts of the ore are also internally consumed for fertilizer production.

In Rajasthan, the ore body at Jhamarkotra mine of M/s RSMML extends over a strike length of 10 km and the average width of phosphate bed is about 15 m with an average inclination of about 55^0 from the vertical. The height of the bench is maintained up to 10 m. Shovels (6.1 cu. m) and dumpers (85 tonnes) are used for removal of ore and overburden. The mine has an annual rock handling capacity of about 20 million tonnes. The thin and sharply dipping ore body results in long and narrow pits with great depth extension which leads to very high stripping ratio (about 1:10) with high lead distance and lift for waste and mineral. An effective dewatering scheme was implemented to tackle ground water problem. The working levels are kept dry by continuous pumping of ground water through tube-wells constructed on periphery of the pit limit. The beneficiation plant of RSMML at Jhamarkotra has 9 lakh tpy capacity to treat run-of-mine low-grade ore, with an average 16% P_2O_5. Production from Jhamarkotra mine is despatched to many phosphatic fertilizer and chemical manufacturers from Udaipur and Umra railway stations which are located at 18 km and 25 km, respectively, away from the mine. RSMML has put up a beneficiation plant for processing of 9 lakh MT of low-grade phosphate ore per annum.

RSMML produces the following products:

1) (+) 30% P_2O_5 crushed -1/2" size high-grade rock phosphate (for SSP manufacturing units).
2) 31.5% P_2O_5 high-grade rock phosphate Chips (for DAP/Phos Acid manufacturing units).
3) 18% P_2O_5 ground low-grade beneficiated rock phosphate (RAJPHOS) (direct application to acidic soils).
4) 31.54% P_2O_5 - BRP Grade (for SSP & DCP Manufacturing units, PROM, etc.)

RSMML was unable to market its low-grade rock phosphate (trade name-Rajphos) till 2005-06 because of its high R_2O_3 content which could neither be blended nor beneficiated. However, during recent years, this grade of rock phosphate has found takers especially, fertilizer manufacturers.

INDUSTRY

As per Ministry of Chemicals and Fertilizers Department of Fertilizers Annual Report 2020-21, presently, there are about 39 large size urea, 19 DAP and complex fertilizers, and 2 ammonium sulphate plants.

Among the major fertilizer products, the estimated production of urea during the year 2020-21 was 24.6 million tonnes (6.66 million tonnes from Public Sector, 6.99 million tonnes from Cooperative Sector and 10.94 million tonnes from Private Sector), Diammonium Phosphate (DAP) 3.77 million tonnes (1.85 million tonnes from Cooperative Sector and 1.92 million tonnes from Private Sector), complex fertilizers 9.32 million tonnes (1.45 million tonnes from Public Sector, 2.34 million tonnes from Cooperative Sector and 5.51 million tonnes from Private Sector).

The major phosphatic fertilizer plants in Public Sector are Fertilizers and Chemicals (Travancore) Ltd (FACT) at Udyogamandal, Kochi (Kerala); Rashtriya Chemicals and Fertilizer Ltd (RCF) at Trombay, Mumbai (Maharashtra); Madras Fertilizer Limited at Chennai (Tamil Nadu); Brahmaputra Valley Fertilizers Corporation Ltd (BVFCL) at Namrup (Assam); National Fertilizers Ltd (NFL) at Noida (U.P.); FCI Aravalli Gypsum and Minerals India Ltd (FAGMIL) at Jodhpur (Rajasthan); Projects and Development India Limited (PDIL) at Noida (U.P.); Fertilizer Corporation of India Limited (FCIL) in New Delhi; and Hindustan Fertilizer Corporation Ltd (HFCL) in New Delhi.

The plants in Private Sector are Gujarat State Fertilizer Company Ltd (GSFC) at Vadodara (Gujarat); Zuari Agro Chemicals Ltd in Goa; Mangalore Chemicals and Fertilizers Ltd at Mangaluru (Karnataka); Gujarat Narmada Valley Fertilizers & Chemicals Ltd (GNFC) at Bharuch (Gujarat); Nagarjuna Fertilizer and Chemicals Ltd (NFCL) at Kakinada (Hyderabad); Chambal Fertilizers and Chemicals (CFCL) at Gadepan (Rajasthan); Tata Chemicals Ltd (TCL) at Bardala (Uttar Pradesh); Kanpur Fertilizer and Cements Ltd (KFCL) at Kanpur (Uttar Pradesh); Indo-Gulf Fertilizers Limited at Jagdishpur Uttar Pradesh, etc.

The plants in the Co-operative Sector that manufacture phosphatic fertilizer are Indian Farmers Fertilizer Co-operative Ltd (IFFCO) at Kandla (Gujarat) and Krishak Bharti Cooperative Ltd (KRIBCHO) at Surat (Gujarat). The 2 plants of IFFCO are in Gujarat (Kalol and Kandla), 2 in Uttar Pradesh (Phulpur and Aonla) and one in Odisha (Paradeep).

Besides, RSMML has a beneficiation plant in Jhamarkotra in Rajasthan, while Krishna Phoschem Ltd has set up a 600 tpd rock phosphate beneficiation plant at Meghnagar in Jhabua district of Madhya Pradesh. The Company has long-term tie-up with Madhya Pradesh State Mining Corporation Ltd.

The other associate industries on rock phosphate include Coimbatore Pioneer Fertilizer Ltd and Rashtriya Chemicals & Fertilizers Ltd, Mumbai which have domestic plants that recover by-product fluorine from rock phosphate in the form of hydrofluorosilicic acid, sodium silico-fluoride; and aluminium fluoride. Department of Atomic Energy has issued sanctions for establishment of 2 units for recovery of uranium from rock phosphatic sources and these are Rashtriya Chemicals & Fertilizers, Mumbai in association with Heavy Water Board (HWB); and SPIC, Thoothukudi in association with IREL.

RCF is also setting up a rapidwall plant for manufacture of unique building material using phospho-gypsum as a raw material which is the by-product of phosphoric acid plant. The project is estimated to cost ₹ 75 crore.

Red phosphorus is manufactured mainly by United Phosphorus Ltd. Red phosphorus is consumed in Matches Industry. It also has applications as fumigant in Agriculture Industry and as flame retardant.

Joint Ventures Abroad

India's dependency on import at present is to the extent of 25% of our requirements of urea, 90% in case of phosphates either as raw material or finished fertilizers (DAP/MAP/TSP) and 100% in case of potash. The Government has been encouraging Indian companies to establish joint venture in countries which are rich in fertilizer resources with arrangements to buy back and to enter into long-term agreement for supplying fertilizer to India. The Department of Fertilizers has undertaken joint ventures abroad with 5 countries in the previous years. Although during the year 2021-22, no joint venture with any country was signed, a number of major developments place with the following countries:

Nepal

Memorandum of Understanding between the Government of India and the Government of Nepal on the supply of Urea and DAP to Nepal from India under Government to Government Arrangement has been approved by the Cabinet. MoU is to be signed shortly.

Russia

To explore the possibility of long term agreement between both the countries and to discuss the terms & conditions of arriving at a mutually long term agreement for supply of fertilizers to India VC meetings were held between both the sides on 21 June, 2021, 4 August, 2021, 09 September, 2021 and 30th December, 2021. An agreement of Intent has been signed between Indian PSUs and Russian Company, PhosAgro on 21.09.21 for supply of 2,50,000 LMT of four type of fertilizers from Russia to India during the year 2022 and options for further engagements for mutual cooperation are being explored.

Saudi Arabia

Rounds of meetings were held between Indian companies along with officials from DoF and Saudi Companies SABIC and MAADEN on 1st July,2021, 6th July, 2021 and 5th August, 2021 in coordination with Indian Embassy to Saudi Arabia for arriving at a mutually long-term agreement between Indian and Saudi Arabian Companies for collaboration in the fertilizer sector. Further, engagements for mutual cooperation are being explored.

Morocco

Rounds of meetings were held between Indian Companies along with officials from DoF and OCP, Morocco with the constitution of a joint committee/ expert committee.

Canada

A meeting held between Secretary (Fertilizers) and India's High Commissioner to Canada on 17.12.2021 was attended by representative of Indian companies importing Potash from Canada. The matter is being pursued with State Government of Gujarat to pursue the case of mining in Canada by GSFC.

Iran

Discussions were held and follow up actions were taken with Ambassador, Embassy of the Islamic Republic of Iran to strengthen the collaboration and establish a long-term relationship between both the countries for procurement of fertilizers specifically urea and ammonia from Iran.

RESEARCH AND DEVELOPMENT

RSMML has developed the organic fertilizer called Phosphate Rich Organic Manure (PROM) by using high-grade rock phosphate with farmyard waste and other organic matter. The field trials conducted through different agricultural unversities in the country have shown that the agronomic efficacy of this new P-fertilizer is higher than that of the complex phosphatic fertilizers available in the market today. 'PROM' is suitable to neutral and alkaline soils, which will prove to be a boon to the Indian farmers. RSMML with the help of GSFC is making efforts for utilisation of secondary Ore accumulated at Jhamarkotra mine either through beneficiation route or its direct conversion into phosphoric acid.

1. R&D efforts in the following areas strengthened the Company's operation through technology absorption, adaptations & innovation:
   a) Productivity studies of HEMM at Jhamarkotra Mines.
   b) Beneficiation of secondary rock phosphate.
2. Benefits derived as a result of the above R&D:
   a) Strengthening of market share.
   b) Converting waste into useful product.
   c) Conservation of Mineral.
   d) Future plan of action-Energy efficient process.
3. The Company has developed the low cost organic fertilizer "PROM".
4. Two patents have been filed by the Company jointly with MLS University, Udaipur, which got approved under the title i) "process for making slow release phosphate fertiliser". ii) "An eco-friendly process for making EPSOM and Gypsum".
5. The Company has introduced 30% crushed Rock phosphate replacing 31.5% CRP, which has improved mineral conservation.
6. Benefits derived as a result of the above efforts are product imporvement, cost reduction, product development, import substitution, etc.

   Above efforts helped in satisfying the consumer

needs as well as business requirements by introducing new products.

ENVIRONMENTAL CONCERNS

There are apparent concerns regarding phospho-gypsum which is formed as a by-product during manufacturing of phosphoric acid. It contains about 1% P_2O_5, 1% F and 10-30 times more radon, none of which is desirable. Environment Protection Agency (EPA) of USA stipulated in 1989 that phospho-gypsum is unsuitable for sale as common gypsum. Production of each tonne of P_2O_5 yields about five tonnes of phospho-gypsum. EPA has prescribed stringent measures for storage, transport and disposal of phospho-gypsum. In India, however, by-product phospho-gypsum is used widely in cement manufacture.

The use of phosphate also falls under scrutiny. Much attention has been paid to its role in stimulating the growth of algae and other organisms in surface water, the process known as eutrophication. This process is deleterious because it causes blooms of algae which consume dissolved oxygen in lakes and even in shallow, isolated arms of the ocean. Phosphate fertilizers are probably not the only cause of phosphate-induced eutrophication. Another concern is fertilizer phosphate does not leach readily from soil. One of the best ways to remove this phosphate is through the addition of lime which causes precipitation of apatite. However, this procedure, being relatively costly, has not been applied widely. Other application where the use of phosphate has been discouraged is in manufacturing of detergents.

USES

Most of the phosphate rock mined throughout the world is used to produce phosphate fertilizer. It is also used as animal feed supplements. Elemental phosphorus and phosphoric chemicals derived from phosphate rocks find application in detergents, insecticides, pharmaceutical products, soft drink, tooth paste, glass, photographic films, matches, fire -works, military smoke screens, incendiary bombs, etc.

Transparent specimens of apatite with vivid green, blue, yellow or pink colour and excellent clarity are often cut into faceted gemstone. Along with other phosphates, apatites are also a proposed host material for storage of nuclear waste.

SPECIFICATIONS

Elemental Phosphorus and Phosphoric Acid

BIS has prescirbed the IS:11224-1985, reaffirmed 2010 specifications for rock phosphate required for the manufacture of elemental phosphorus (Type-I) and phosphoric acid (Type-II).

Single Superphosphate

The P_2O_5 content in rock phosphate for manufacturing single superphosphate should be minimum 31%. Silica up to 8% can be tolerated. Iron and alumina, i.e., R_2O_3 should not be more than 3.5%. Higher R_2O_3 may tend reversion of available P_2O_5 (water soluble P_2O_5). Carbonate up to 5% will improve the reactivity of rock phosphate by increasing the reaction temperature and making the mass porous.

Direct Application of Rock Phosphate as Fertilizer

In India, the finely-ground rock phosphate containing 16% P_2O_5 is used for direct application to the soil for soil amendment. This application is dependent upon the structure and chemical composition of the rock. Direct application is suited mostly for pastures and forage crops and for acidic soils. According to PPCL the following specifications are considered for utilising any rock phosphate as phosphatic fertilizer for direct application in acidic soils.

1. Absolute citrate solubility index 7% (max.)
2. Apatite to carbonate ratio 0.035 CO_2% : P_2O_5%
3. Origin of rock phosphate Sedimentary
4. Mesh size 100
5. Hydroxyl ion in crystal lattice 2 is higher indicating substitution of OH for PO_4:H_2O
6. Grade of rock phosphate powder 16% P_2O_5 citrate soluble fraction
7. Iron as Fe_2O_3 5%
8. CaO to P_2O_5 ratio 1:8

The use of rock phosphate for direct application as fertilizer depends on its level of solubility in acidic soil.

CONSUMPTION

The apparent consumption of apatite and rock phosphate in 2020-21 was about 9.30 million tonnes as against the 9.0 million tonnes during preceding year, i.e., increased by 3.3% in 2020-21.

POLICY

Imports of natural calcium phosphates (including apatite), natural aluminium-calcium phosphates and phosphatic chalk are allowed 'free' under Heading No. 2510 as per the Import Policy ITC(HS) 2022. All chemical fertilizers except urea continue to be decontrolled. The Government of India has been implementing a scheme of concession fixing indicative maximum retail price (MRP) for enabling sales of decontrolled phosphatic and potassic fertilizers at reasonable prices.

In case of Phosphate Fertilizer Industry, the scarcity of domestic raw material constrains the attainment of self-sufficiency in the country. A policy has, therefore, been adopted which involves the following three options:

1. domestic production based on indigenous imported rock phosphate and imported sulphur.
2. domestic production based on imported intermediates, viz, phosphoric acid.
3. imports of finished fertilizers.

The Government of India notified new Urea Policy extended for the period 01.6.2015 to 30.9.2020 for existing gas-based urea manufacturing units. Thereafter the target energy norms of NUP-2015 have been enforced on these urea units from 1st October 2020.

WORLD REVIEW

The world reserves of phosphate rock are about 71 billion tonnes, located mainly in Morocco & Western Sahara (70%), China (5%), Egypt (4%) & Algeria (3%). The remaining 18% is located in other countries (Table - 9).

The world production of phosphate rock decreased slightly by 3% to 221 million tonnes in 2020 from 227 million tonnes in 2019. China (42%), Morocco (16%), USA (11%), Russia (6%), and Jordan & Peru (4% each) have been the major producers (Table- 10).

To provide a generalised view of the development in various countries the country wise description as sourced from the latest available publication of Minerals Yearbook 'USGS' 2017 is furnished below:

Morocco

OCP Group continued with an expansion programme that was to increase its mine capacity from 39.0 Mt/yr to 52.1 Mt/yr during the next decade. A 12 Mt/yr expansion at Gantour was ongoing in 2017 and was planned to be completed by 2023. OCP planned to open new mines at Meskala deposit in the Essaouisa Region after 2023.

Saudi Arabia

Ma'aden Phosphate Co. (MPC) began production in mid -2017 at the Umm Wu'al Phosphate Mine on the Al-Khabra deposit. The mine was part of the Wa'ad Al Shammal phosphate project joint venture among MPC (60%), Mosaic (25%) and Saudi Arabian Basic Industries Corp. (15%). The project included the phosphate rock mine beneficiation plant and production facilities for phosphoric acid, animal feed, purified phosphoric acid, sodium tripolyphosphate and sulphuric acid. Proposals to expand the existing fertilizer plants at Ras Al Khair are also part of the project. The production capacities planned are 5.3 million tpy of phosphate concentrate, 1.5 million tpy of phosphoric acid and 3.5 million tpy of phosphate fertilizers. The new phase of the project was planned to be operational by 2024.

Table – 9: World Reserves of Phosphate Rock (By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total (rounded)	**71000000**
Algeria	2200000
Australia	1100000[5]
Brazil	1600000
China[(6)]	3200000
Egypt	2800000
Finland	1000000
India*	46000
Israel	53000
Jordan	1000000
Kazakhstan	260000
Mexico	30000
Morocco & Western Sahara	50000000
Peru	210000
Russia	600000
Saudi Arabia	1400000
Senegal	50000
South Africa	1600000
Togo	30000
Tunisia	100000
Turkey	50000
USA	1000000
Uzbekistan	100000
Vietnam	30000
Other countries	2600000

Source: *USGS, Mineral Commodity Summaries,2022*

[5]*For Australia, Joint Ore Reserves Committee compliant reserves were 110 million tonnes.*

[*]*India's total reserves/ resources of rock phoshate as per National Mineral Inventory as on 1.4.2020 are 311.25 million tonnes.*

Table – 10 : World Production of Phosphate Rock (By Principal Countries)

(In '000 tonnes)

Country	2018	2019	2020
World: Total (rounded off)	**232000**	**227000**	**221000**
China	96326	93324	93000
Morocco	37600	35300	35000
USA	25700	23300	23400
Russia	13600	13800	13800
Jordan	8022	9223	8938
Peru	10308	11092	8594
Saudi Arabia	5444	5716	5700
Brazil [(d)]	5740	5300	5500
Vietnam	4332	4490	4390
Other countries	25519	25740	22844

Source : *BGS, World Mineral Production, 2016-20.*

d: Including beneficiated and directly shipped material.

FOREIGN TRADE

Exports

In 2020-21, exports of rock phosphate increased drastically by 221% to 825 tonnes from 257 tonnes achieved in the previous year. Exports of phosphatic fertilizers at 385 tonnes in 2020-21 increased drastically by 124% from 172 tonnes recorded in the preceding year. The exports of phosphoric acid decreased drastically by manifold to 460 tonnes from 2,630 tonnes. Export of elemental phosphorus decreased by 10% to 583 tonnes from 650 tonnes in the preceding year. Rock phosphate was exported mainly to Malaysia (33%), Bangladesh (31%), USA (12%) and Nepal (11%). Elemental phosphorus was also mainly exported to Egypt (57%) & USA (25%). In 2020-21, exports of phosphatic fertilizers were mainly to Srilanka (49%) and Nepal (34%) while phosphoric acid was mainly exported to UAE (16%), Singapore (15%), Nepal (12%) and Mozambique (10%) (Tables- 11 to 16).

Imports

Imports of rock phosphate increased slightly by 2% to 7.78 million tonnes in 2020-21 from 7.65 million tonnes in the previous year. Imports were mainly from Jordan (39%), Morocco (25%) and Egypt (22%). Imports of elemental phosphorus increased by 26% to 42,551 tonnes in 2020-21 from 33,751 tonnes in the previous year. The imports of elemental phosphorus were mainly from Vietnam (75%) and Russia (22%). During 2020-21, meager amount of phosphatic fertilizers were imported. Imports of phosphoric acid slightly increased by 0.5% to 2.51 million tonnes in 2020-21 from 2.50 million tonnes in the previous year. Imports were mainly from Morocco (39%), Jordan (25%) and Senegal (19%) (Tables- 17 to 22).

Table – 11: Exports of Rock Phosphate (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All countries	**257**	**2015**	**825**	5602
Malaysia	-	-	274	2040
USA	15	242	102	1923
Nepal	5	180	89	630
Bhutan	-	-	72	473
U K	-	-	22	272
Bangladesh	100	100	255	204
Kenya	-	-	6	22
New Zealand	-	-	1	16
Uganda	++	++	4	14
Thailand	10	179	++	5
Other countries	127	1314	++	3

Figures rounded off

Table – 12 : Exports of Rock Phosphate (Ground) (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**243**	**1660**	**436**	**4291**
Malaysia	-	-	274	2040
USA	15	242	102	1923
Nepal	1	6	60	328
Korea, Rep. of	126	1212	-	-
Bangladesh	100	100	-	-
Oman	1	100	-	-

Figures rounded off

Table – 13: Exports of Rock Phosphate (Unground) (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**14**	**355**	**389**	**1311**
Bhutan	-	-	72	473
Nepal	4	174	29	302
UK	-	-	22	272
Bangladesh	-	-	255	204
Kenya	-	-	6	22
New Zealand	-	-	1	16
Uganda	++	++	4	14
Thailand	10	179	++	5
Gambai	-	-	++	5
Czech Republic	++	2	-	-

Figures rounded off

Table – 14: Exports of Phosphorus (Elemental) (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**650**	**256687**	**583**	**246040**
USA	146	54315	144	56670
UAE	39	19382	90	43638
Russia	22	7511	68	23136
Brazil	54	24686	40	18141
Indonesia	28	12245	33	15015
Egypt	21	8058	333	13921
Israel	15	6036	28	11807
Peru	18	7067	20	8294
Hungary	-	-	20	8190
Philippines	20	8603	18	8174
Other countries	287	108784	89	39054

Figures rounded off

Table – 15: Exports of Phosphatic Fertilizers (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**172**	**13729**	**385**	15631
Nepal	35	715	130	4231
Korea, Rep. of	-	-	36	4004
Sri Lanka	++	46	190	3060
Germany	-	-	15	2317
Kenya	72	846	7	1722
New Zealand	6	394	4	258
Ethiopia	-	-	1	20
Maldives	-	-	2	14
Canada	-	-	++	5
Iran	56	11473	-	-
Other countries	3	255	-	-

Figures rounded off

Table – 16: Exports of Phosphoric Acid (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2630**	**196837**	**460**	50475
Singapore	23	7498	69	6830
UAE	160	10732	74	6559
USA	144	8470	36	4882
Nepal	96	6074	54	4612
Malaysia	++	415	10	3449
Mozambique	32	2482	45	3414
Burundi	6	608	27	2678
Bangladesh	20	2939	22	2672
Gabon	++	4	25	2149
Kenya	136	7365	29	2034
Other countries	2013	150250	69	11196

Figures rounded off

Table –17 : Imports of Rock Phosphate (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**7654867**	**54205952**	**7781423**	53709109
Jordan	3277010	23539768	3016512	21316732
Morocco	1989978	17840735	1964608	17290552
Egypt	1260634	5499357	1725014	8042720
Togo	618143	4468832	784085	5466808
UAE	260057	1374333	237540	1275558
Algeria	214817	1221745	31500	184139
Cyprus	31800	171249	21800	121894
Hong Kong	880	30047	152	5262
Netherlands	1416	55953	96	4066
Turkey	-	-	108	1014
Other countries	132	3933	8	364

Figures rounded off

Table – 18: Imports of Rock Phosphate (Ground) (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3354265**	**25970787**	**3673367**	**27621345**
Morocco	1989978	17840735	1959208	17262394
Togo	385228	2758132	727418	4965344
Egypt	416107	2081194	489772	2424762
Jordan	189955	1198614	205881	1377926
UAE	260057	1374333	237540	1275558
Algeria	78750	457128	31500	184139
Cyprus	31800	171249	21800	121894
Hong Kong	880	30047	152	5262
Netherland	1416	55953	96	4066
China	94	3367	-	-
Other countries	++	35	++	++

Figures rounded off

Table – 19 : Imports of Rock Phosphate (Unground) (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**4300602**	**28235165**	**4108056**	26087764
Jordan	3087055	22341154	2810631	19938806
Egypt	844527	3418163	1235242	5617958
Togo	232915	1710700	56667	501464
Morocco	-	-	5400	28158
Turkey	-	-	108	1014
China	24	284	5	208
Denmark	-	-	2	152
Senegal	1	4	1	3
Serbia	-	-	++	1
Algeria	136067	764617	-	-
Other countries	13	243	-	-

Figures rounded off

Table – 20 : Imports of Phosphorus (Elemental) (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**33751**	**6552640**	**42551**	**8199312**
Vietnam	19770	3828940	32059	6159010
Russia	12432	2422015	9523	1841954
Kazakhstan	1435	275569	965	196481
Philippines	-	-	4	1799
USA	++	144	++	52
Germany	++	26	++	11
UK	++	29	++	5
Japan	96	20326	-	-
China	18	5589	-	-
Belgium	++	2	-	-
Other countries	-	-	-	-

Figures rounded off

Table – 21: Imports of Phosphoric Acid (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2501094**	**119766817**	**2514246**	124688967
Morocco	918384	43969976	986637	48714772
Jordan	605783	28552168	620569	30712792
Senegal	549630	26568795	489173	23937276
Tunisia	148353	7024339	119301	5887970
USA	142785	6831999	71003	3271520
Vietnam	74590	3804598	50127	2910996
South Africa	27891	1244510	50794	2604320
Egypt	12004	519501	30817	1476012
U A E	25	1283	29629	1474299
Philippines	++	31	28056	1466382
Other countries	21649	1249617	38140	2232628

Figures rounded off

Table – 22: Imports of Phosphatic Fertilizers (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	16	2324	++	51
Korea	-	-	++	40
Ukraine	-	-	++	11
China	++	18	-	-

Figures rounded off

FUTURE OUTLOOK

There is no substitute for phosphorus in agriculture. The country is deficient in all fertilizer minerals. The reserves/resources of chemical and fertilizer grades apatite and rock phosphate in India are very limited. Therefore, detailed exploration is necessary for conversion of remaining resources into reserves. Secondly, the search for apatite and rock phosphate may have to be intensified in Andhra Pradesh, Rajasthan, Madhya Pradesh, Jharkhand, Tamil Nadu, Meghalaya, Gujarat, Uttar Pradesh, Uttarakhand, West Bengal, etc. Till the domestic resources of these two minerals are improved, the country has no alternative but to depend on imports. Concerted efforts should be made by way of constituting consortia of public-private companies to acquire assets abroad specifically in countries like Uzbekistan, Jordan, etc. Strengthening ties with mineral-rich countries and provinces with functional and specific MoUs and utilisation of IMG mechanism to align domestic stakeholders with MoUs is required. Only about 10-15% requirement of raw material for phosphate fertilizer production is met through indigenous sources. The remaining requirement is met through imports in the form of rock phosphate, phosphoric acid and direct fertilizers. Private Sector participation in rock phosphate mining needs to be promoted in order to make available the above two minerals to reduce import dependence for promotion of fertilizers for Agricultural Sector.

Demand for phosphatic fertilizer is expected to increase gradually in tandem with the growth in population and corresponding increase in food requirements.The Government has been

encouraging Indian Companies to establish joint venture abroad in countries which are rich in fertilizer resources.

In India, most of the existing phosphatic fertilizer and phosphoric acid plants have been designed for high-grade imported rock phosphate, mainly from Morocco and Jordan. The Indian deposits on the other hand, are of low-grade variety. Therefore, the fertilizer and phosphoric acid plants that are likely to be set up as replacement of the existing plants may have to be designed to accept indigenous ores as feed. In addition, beneficiation of domestic low-grade ores would be a step in the right direction and should be promoted persuasively.