

'Phosphorites' one of mankind's most important non-renewable resources

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Phosphate Rock is a general term used in the mineral industry for naturally occurring raw material which contains one or more phosphate minerals and possesses chemical and physical characteristics acceptable for commercial use.

Phosphate rock forms the basis of a major mineral industry of worldwide importance, being the only suitable source of phosphorus in the manufacture of phosphate fertiliser and phosphorus based chemicals. There is no known substitute for the use of phosphate in agriculture.

Phosphorus is now recognised as one of the three major elements essential to plant growth, the other two being potassium and nitrogen. Depending on crop and soil conditions generally about 10-15% of the current application of phosphorus as fertiliser is taken up by the crop. Some remains within the soil for future crops and the rest stays fixed in the soil. Soils which are expected to fix very high amounts of phosphate are the moderately to highly weathered soils in rainy and humid climatic regions which make up a substantial proportion of the tropical soils covering large tracts of Asia, South America and, to a lesser extent, of Africa. Acid soils are usually markedly deficient in phosphorus. In such areas (virtually all in developing countries) the use of fertiliser is very important since without them food production can be increased to only a very limited extent.

The developing countries, however, use only 27% of the world fertiliser output, yet account for 73% of the world's population and 54% of the available arable area. Two thirds of the present population is believed to be inadequately fed. Adequate food supplies can be provided only by increasing fertiliser application. It has been estimated that the equivalent of about 1,700 mm tons of phosphate rock, about twelve times the current level of world rock production, needs to be added to soils cultivated at present (mostly in tropical regions) to achieve a moderate level of fertility.

The phosphate content or grade of rock phosphate is normally reported as

CHEMICAL ANALYSIS OF DIFFERENT TYPES OF PHOSPHATE ROCK

	U.S.A. Florida	Morocco Khourigga	U.S.S.R. Kala	Sri Lanka Eppawela
B.P.L. %	70	72/73	84	76
Composition wt. %				
Ca O	32.41	33.31	38.87	34.85
P ₂ O ₅	47.2	52.65	50.46	50.00
SiO ₂	7.5	3.25	1.16	0.54
Co	3.6	4.76	---	---
F.C.L.	3.83	3.92	3.30	3.39
	1.23	0.26	0.42	2.18
	1.03	0.18	0.29	4.80
Mgo	0.36	0.35	0.09	0.19
Others	3.04	1.92	3.41	4.05

phosphorus pentoxide (P₂O₅) determined by chemical analysis. It may also be expressed as tricalcium phosphate (Ca₃(PO₄)₂) and traditionally referred to as bone phosphate of lime B.P.L. = 2.1853 x P₂O₅. Marketable phosphate rock entering international trade usually contains more than 65 percent B.P.L. (30% P₂O₅).

Eppawela rock phosphate contains 28-40% P₂O₅. Rock Phosphate is represented by a general formula (A₅(PO₄)₃(OH.F.Cl.)). The composition of phosphate mineral varies considerably, however, according to its origin, with substitution, principally of carbonate and fluorine and various metals.

USES

1. More than 90 percent of world phosphate rock production is utilised for agricultural purposes, mainly in the manufacture of phosphate fertiliser.
2. Phosphate rock is also an essential ingredient in the manufacture of animal feed supplements.
3. About 5 percent of world production is used for a variety of industrial purposes, notably in the manufacture of detergents soaps and cleaners, particularly sodium tripoly phosphate (S.T.P.P.).
4. Elemental phosphorus is produced to make very pure phosphoric acid used to produce chemicals, tooth-pastes, and when further processed to make food or grade phosphoric acid.

MINING

Most of the world's production of phosphate rock comes from open pit mining. Underground mining still

accounts for a significant proportion of the output from USSR, Morocco, Tunisia and Jordan.

BENEFICIATION

A minimum of 28 percent P_2O_5 in phosphate is normally preferred by manufacturers of phosphate fertiliser. To achieve these grades most phosphate areas require beneficiation. Many techniques are available, including washing and screening, delimiting, magnetic separation, flotation and calcination, the procedures adopted being largely determined by area characteristics and end uses of the marketed product.

PROCESSING

The processing of phosphate ore can be divided into three categories, these are acidic, physical treatment and electric furnace. The optimum beneficiation route is naturally determined by the character of the ore and the desired end product of the process.

1) Acidic

- i. Sulphuric acid treatment is the most common method to manufacturer, Triple Super phosphate, Single Super phosphate, partially Acidulated Phosphate Rock and Phosphoric Acid.
- ii Nitric phosphate fertilizer can be manufactured by making reaction with nitric acid.
- iii Phosphoric Acid is produced using hydrochloric acid or sulphuric acid. Phosphoric acid is commonly used for manufacturing of calcium phosphate animal feed and ammonium phosphate fertiliser.

2) Physical Treatment

- i Fine grinding - direct application to acidic soil. This process is currently used at Eppawela.
- ii Removal of fluorine by heat to produce calcium phosphate for animal feed supplement.

3) Electric Furnace

- i Elemental phosphorus is made in the electric furnace. Elemental Phosphorus is produced to make very pure phosphoric acid, used to produce chemicals and, when further processed to make food grade phosphoric acid.

ii Rhenania phosphate (fertiliser) can be obtained by fusing rock phosphate, anhydrous soda and sand.

iii Calcium magnesium silicate phosphate can be obtained by fusing rock phosphate and salt of serpentine which is available at Udawalawe.

WORLD PRODUCERS

Although many countries produce phosphate rock, 70 percent of the world total comes from USA, USSR, Morocco and China.

Forecasts published by the United States Bureau of Mines suggest that the world demand for rock will reach 200 million by 2000, assuing a probable average annual growth rate of 2.4%, only half the rate forecast by U.N.I.D.O.

Phosphate rock is marketed primarily on its B.P.L. content and contracts normally providing for a guaranteed minimum grade as well as maximum contents of moisture and deleterious constituents, or allowing for a reduction in the price to the buyer if these

World Production of Phosphate Rock '000 tons					
Country	1970	1981	1985	1986	1987
1. U.S.A.	35,100	52,900	49,408	37,870	40,750
2. U.S.S.R.	17,800	25,200	33,000	32,000	33,300
3. Morocco	11,400	19,700	20,737	21,178	20,955
4. China	1,700	11,500	6,970	11,000	12,150
5. Jordan	900	4,200	6,067	6,249	6,801
6. Tunisia	3,000	4,600	4,530	5,951	6,388
7. Brazil	200	2,800	4,214	4,507	4,403
8. Israel	1,200	2,400	4,076	3,673	3,798
9. Togo	1,500	2,200	2,452	2,341	2,644
10. S/Africa	1,200	3,000	2,420	2,923	2,548
11. Senegal	-	1,927	2,145	1,982	2,080
12. Syria	-	-	1,270	1,606	1,986
13.	-	1,480	1,508	1,494	1,376
14. Egypt	-	-	1,074	1,272	1,110
15. Algeria	-	-	1,208	1,203	1,073
16.	-	1,423	1,199	825	842
17. Iraq	-	-	800	800	800
18. India	-	-	750	760	780
19. Sri Lanka	-	15	17	14	21
20. Others	2,730	5,150	1,459	1,403	2,807
Total	76,730	138,445	145,304	139,057	146,612

U.S. production is controlled by private companies, whereas many facilities elsewhere in the world are directly or indirectly managed by state-owned companies.

TRENDS IN DEMAND OUT LOOK

Demand for phosphate rock is governed primarily by that for phosphatic fertilisers. A joint F.A.O./U.N.I.D.O./I.B.R.D. working group forecasts that the world demand for phosphate rock may reach 365M. Tons by 2000, assuming an average annual growth rate of 5 percent.

limits are exceeded. There are also penalties for excessive impurities in the phosphate rock.

If only these lower estimates apply, significant new capacity will be required for the long term.

Increase in phosphate use is expected to come mainly from the agriculturally less mature regions of the world in future. Phosphate use in Asia especially should grow strongly over the next decade and this will give advantage to Sri Lanka which is geographically well suited to serve the region.