Pakistan. J. Sci. Ind. Res., Vo. 27, No. 3, June 1984

TREATMENT OF PHOSPHATE ROCK OF HAZARA FOR THE PRODUCTION OF PHOSPHATE FERTILIZER BY FUSION WITH ROCK SALT AND MAGNESIUM SULPHATE.

M. Riaz, M. Amin and M.A. Khattak

PCSIR Laboratories, Peshawar, Pakistan

(Received November 25, 1983)

Thermal treatment of phosphate rock of Hazara for the production of phosphate fertilizer with various fluxes were studied. Optimum conditions such as rock to charge ratio, temperature and time are reported. It was found that phosphate rock when treated at 900-1000°C with optimum rock/charge ratio gave conversion of 95% citrate soluble P_2O_5.

INTRODUCTION

The phosphate deposits of Hazara offer a wide scope for its utilization and development for the fertilizer industry in Pakistan. The rock phosphate unlike the weathered imported rock of Jordan or Morocco is comparatively unweathered, sufficiently hard and creates problems durring size reduction and grinding. Moreover, the phosphate rock of different localities is of variable composition and graded as low medium and high. At present a small quantity of the rock phosphate of Hazara is being used by National Fertilizer Corporation at the rate of 10 tons/day for making Single Super Phosphate after blending it with imported rock.

In view of the current shortage of elemental sulphur used for the production of sulphuric acid and the cherty nature of the abundantly available phosphate rock of Hazara, efforts have therefore been made towards thermal treatment of the phosphate rock of Hazara with somewhat cheaper additives at low temperature.

Extensive work has already been done regarding the production of phosphate fertilizer by melting a mixture of natural phosphate with different additives, such as a mixture of Polyhalide and Silica [1-2] and Serpentine [3]. All these investigations were carried out at high temperatures. The procedure for thermal treatment was basically the same as suggested by earlier workers, and encouraging results were achieved and the yield was upto 95%.

EXPERIMENTAL

Indigenous phosphate rock (35% P_2O_5) of Hazara was ground to 200 mesh and mixed with potasium and magnesium sulphates and rock salt (sodium chloride) in the ratios of 1:1:3 and 1:5:3 respectively. The mass (Rock & Charge) contained in a graphite crucible was heated at 900°C for 1 hr. The same was then ground and analysed for water and citrate soluble P_2O_5 (available P_2O_5). [4].

RESULTS AND DISCUSSION

Effect of Charge Composition. Phosphate rock was mixed with different amounts of charge and heated at 900°C. A ratio of 1:1:3 (rock K_2SO_4: $MgSO_4$) gave 78.1% citrate soluble P_2O_5. Whereas a ratio 1:5:3 (Rock: $MgSO_4$: NaCl) gave 95.0% citrate soluble P_2O_5. The results are given in Tables 1 and 2.

Table 1. Effect of charge composition (K_2SO_4 + $MgSO_4$).

Phosphate rock	K_2SO_4	$MgSO_4$	Cit. sol. % P_2O_5
1	1	0	28.0
1	1	1	37.5
1	1	2	66.2
1	1	3	78.1
1	1	4	54.0
1	1	6	51.1

Table 2.

Phosphate rock	$MgSO_4$	NaCl	Cit. sol. % P_2O_5
1	0	3	10.3
1	1	3	37.1
1	2	3	72.0
1	3	3	82.2
1	4	3	86.1
1	5	3	95.0
1	6	3	91.0

Effect of Time. Phosphate rock was fused at 900°C at various time intervals ½ hr. To 2 hours with the charge i.e. potassium and magnesium sulphates and magnesium and sodium chloride in optimum ratios respectively The results are given in Tables 3 and 4.

Effect of Temperature. The effect of temperature on the fusion of phosphate rock was studied with addition agents to convert the insoluble P_2O_5 content of rock to citrate soluble P_2O_5. The studies were made between 500°C to 1000°C. The results are given in Tables 4(a) and 4(b).

From these experiments it is concluded that the optimum parameters for the thermal treatment of phosphate rock of Hazara for the production of phosphate fertilizer are 1:1:3 (Rock: K_2SO_4: $MgSO_4$), 1:5:3 (Rock: $MgSO_4$: NaCl) at 900° to 1000°C. Under the conditions mentioned the reaction is completed in a period of one hour. It is also observed that if the amount of charge is less than that of the optimum ratio the conversion of insoluble P_2O_5 into citrate soluble P_2O_5 decreases whereas by the addition of more quantity of additives the citrate soluble form also decreases. This may be due to incomplete conversion of insoluble P_2O_5 into citrate soluble P_2O_5 and the formation of more water soluble P_2O_5 respectively. The above experiments indicate that with magnesium sulphate and sodium chloride conversion of insoluble P_2O_5 of the phosphate rock into citrate soluble form is almost quantitative.

It is also observed that sodium chloride does not take part in the reaction as the availability is very low (Table 2), however, the mixture may acquire liquid consistency in the presence of NaCl.

Table 3. Effect of time

(a)

Phosphate rock	K_2SO_4	$MgSO_4$	Time hrs.	Cit.sol $\% P_2O_5$
1	3	1	½	60.0
1	3	1	1	78.3
1	3	1	1½	80.1
1	3	1	2	82.0

(b)

Phosphate rock	$MgSO_4$	NaCl	Time hrs	Cit. sol. $\% P_2O_5$
1	5	3	½	84.0
1	5	3	1	95.0
1	5	3	1½	95.6
1	5	3	2	96.5

Table 4. Effect of temperature.

(a)

Phosphate rock	K_2SO_4	$MgSO_4$	Temp. °C	Cit. sol $\% P_2O_5$
1	1	3	500	10.0
1	1	3	600	23.40
1	1	3	700	32.8
1	1	3	800	63.3
1	1	3	900	78.8
1	1	3	1000	80.3

(b)

Phosphate rock	$MgSO_4$	NaCl	Temp. °C	Cit.sol $\% P_2O_5$
1	5	3	500	11.5
1	5	3	600	29.1
1	5	3	700	63.0
1	5	3	800	84.6
1	5	3	900	95.0
1	5	3	1000	95.8

REFERENCES

1. G.P. Kiyatkin, B.A. Berem Zhanov, (USSR) Khim Khim. Tekhnol. 1969 No. 10 L 211.
2. B.A. Berem Zhanov, G.P. Kiyatkin, Omarova, Alma – Ata (USSR) 12V. Aked Nauk Kaz. SSR, Ser, Khim, 21, 1 (RUSS) (1971).
3. B.A. Berem Zhanov, Yu. A. Pokrov-Skoya G.S. Kurnysheva, (USSR) Khim Khim Tekhnol. 1969. No. 9 5-9 (RUSS).
4. Association of official Agricultural Chemists 1950. Official Methods of Analysis, Washington, D.C., seventh edition (pp. 10-11).