INVERSE ANIONIC FLOTATION OF EGYPTIAN
DOLOMITIC PHOSPHATE ORES

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INTRODUCTION

A wide variety of processes have been developed to
beneficiate the dolomitic phosphate rocks but few have
been operated on a commercial scale. Among these processes
applied are calcination\textsuperscript{1-3}, flotation\textsuperscript{4-7}, acid washing\textsuperscript{8-11}
heavy media\textsuperscript{12}, and high intensity magnetic separation\textsuperscript{13,14}

Calcination of phosphate rocks is very expensive at
to-day's fuel prices, therefore, flotation of carbonates
from phosphate ores is profitable.

Smani et al\textsuperscript{7} floated carbonates from sedimentary
phosphate rock of Morocco using sodium oleate. Selective
depression of phosphate minerals could be obtained at
precise collector dose, phosphate depressant and pH range.

Orthophosphoric acid was tried as phosphate depressant
during the flotation of carbonates from Kara-Tau
phosphate rocks, whereas fluosilicic acid was used as
phosphate depressant during the flotation of carbonate
from unaltered rock of the Phosphoria Formation\textsuperscript{15}.

EXPERIMENTAL

A representative sample of Abu-Shegilla (Red Sea)
phosphate rock supplied by the Red Sea Phosphate Company
was subjected to the following studies:

Mineralogy, X-Ray and Chemical Analyses

Mineralogical examination of the studied sample
indicated that it is composed mainly of francolite grains
and bone fragments. The cementing material is calcareous or dolomitic, partially replaced by isotropic collophane grains.

X-ray examination indicated the presence of francolite as major constituent, calcite, dolomite and quartz as minor constituents.

Results of the complete chemical analysis of the original sample as well as the prepared flotation feed are given in Table 1.

RESULTS AND DISCUSSION

Orthophosphoric Acid as Phosphate Depressant

As phosphate ions constitute the crystal lattice of phosphate minerals, they act as phosphate depressants in the anionic flotation circuits. Fig. 1 presents the effect of increasing amounts of phosphoric acid at pH = 5.5 on the carbonate flotation. From the illustrated data it is remarkable to note that although 2.0 Kg./ton phosphoric acid appears to be an optimum, the flotation efficiency does not exceed 50%. This poor result indicates that orthophosphoric acid is not a selective phosphate depressant at the studied test conditions.

Aluminium Sulphate/Tartaric Acid Mixture as Phosphate Depressant

Previous studies\textsuperscript{4,7} indicated that aluminium sulphate, Na, K-Tartarate mixture is a selective phosphate depressant during the flotation of carbonate by anionic collectors. Different ratios of the above mentioned depressant were mixed in order to investigate the effectiveness of an eventual depression of phosphate minerals. Fig. 2 indicates that 66.6\% tartarate (0.3
Kg./ton aluminium sulphate and 0.6 Kg./ton tartarate double salt) gives the highest efficiency and hence selected as an optimum.

Amount of Sulphate/Tartaric Acid Mixture on Phosphate Depression

Fig. 3 illustrates the effect of increasing the depressant dose at the optimum ratio selected (1:2 sulphate/tartaric acid double salt) on the depression of phosphate minerals during dolomite flotation. From the figure it is evident that 0.6 Kg./ton depressant gives the lowest magnesium assay in the phosphate concentrate and the highest flotation efficiency. At higher depressant doses, the assay of magnesium markedly increases in the phosphate concentrate due to the depression of both of carbonate and phosphate.

Effect of pH

The pH of the pulp proved to play an important role in the flotation process. Fig. 4 indicates that the best flotation results can be obtained at a narrow pH range (pH 7.5-8.0). Below this pH range, the flotation of carbonate is poor and above it phosphate minerals start to float, deteriorating the efficiency of separation.

Smani et al.\(^7\) floated calcite from sedimentary phosphate rock of Morocco using oleic acid and sulphate/tartarate mixture as a phosphate depressant. The optimum pH range selected was 7.3-8.0, in accordance with our findings.

Amount of Collector (Sodium Oleate):

The effect of various doses of sodium oleate (S.O.) on the flotation response is illustrated in Fig. 5. From the presented data it is clear that on increasing the
collector dose up to 0.6 Kg./ton, the magnesium assay in the non-float decreases indicating dolomite flotation. Further increase in the collector dose results in a marked decrease in the P₂O₅ recovery in the phosphate concentrate and the flotation efficiency due to the flotation of both of carbonate and phosphate.
REFERENCES

<table>
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<th>Size</th>
<th>wt.%</th>
<th>P$_2$O$_5$ (ins.)</th>
<th>SiO$_2$</th>
<th>CaO</th>
<th>CaO</th>
<th>M $\text{g}$</th>
<th>Fe$_2$O$_3$</th>
<th>Al$_2$O$_3$</th>
<th>F</th>
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<th>Moisture</th>
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<td>Finer Size Slimes (-0.025 mm)</td>
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<td>2.5</td>
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Fig. (1) Effect of phosphoric acid as phosphate depressant on dolomite flotation by S.O.
Fig. (2) Effect of aluminium sulphate/tartarate ratio on dolomite flotation by S.O.
Fig. (3) Effect of Al₂(SO₄)₃ as Phosphate depressant on dolomite flotation by S.O.
Fig. (4) Effect of pH on Dolomite Flotation by S.O
Fig. (5) Effect of amount of collector S.O. on dolomite flotation