INTRODUCTION

It is recognized that in phosphate fertilization only a small percentage of the added phosphorus is absorbed by plant and the remainder is fixed in the soil in various relatively insoluble forms. Fixation is generally attributed to either/or chemical precipitation, physico-chemical sorption and the utilization by micro-organisms.

The present literature on phosphate fixation by soils gives a somewhat confusing picture regarding the reactions involved and the compounds formed. The information available prior to 1957 is reviewed by Hemwall ⁹.

For inorganic soils the experiments of Harward et al. ⁷, Haisman et al.⁶, Hemwall ⁸, Russell and Low ¹⁷ and many others showed that clay minerals fix phosphorus through chemical reaction with the absorbed aluminum. Wey (quoted by Hemwall ⁹) showed by X-ray diffraction evidence that fixed phosphorus is not sorbed between the lamellae of the clay minerals and does not interfere with their physical properties.

In acid systems phosphorus is known to form relatively insoluble compounds of iron and aluminum; Ghani and Islam ⁵ and Yuan ¹⁹.

In alkaline and calcareous soils fixation is usually attributed to the formation of a whole series of insoluble phosphate compounds of calcium; Burd ⁴ and Pratt and Thorne ¹⁶.

For organic soils, Larsen et al. ¹³ showed negative adsorption evidence of phosphorus induced by humic acids. This negative adsorption was diminished when iron and aluminum were added to soil.
The present study was devoted primarily towards the investigation of the magnitude of changes in phosphorus fixation in desert calcareous and gypsiferous soils. Fixation by clay minerals calcium carbonate (lime) and calcium sulphate (gypsum) was studied with respect to their type, grain size and concentration in soil.

An isotopic technique using NaH$_2$P$_{32}$O$_4$ was adopted. The results obtained illustrate quantitatively the relative importance of the studied factors for the process of phosphorus fixation in soil.

**MATERIALS AND METHODS**

The soils used were collected from Wadi El-Arish (North Sinai) and Ginah and Maharik (Kharga Oasis, Western Desert). The clay fraction; diameter < 2 micron, was separated according to the method described by Naga. Calcium carbonate and the other salts were removed through washing with 0.1 N HCl, then the clay separates were treated with 2 N Ca Cl$_2$ to be saturated with calcium.

Limestone from the Mukattam area and gypsum from El Gharbaneyat were graded into size fractions ranging between 2 and < 0.07 mm.

Samples of the minerals thus obtained were added to bottles containing 45 ml of NaH$_2$P$_{32}$O$_4$ solution (2.5 mc and 13 ppm P) in amounts ranging between 0.5 to 3 g for clay and lime, and between 0.02 to 3 g for gypsum.

Cellophane sacks (10 ml capacity) each containing 5 ml water and closed tightly, were then embedded into the bottles. The bottles were then shaken for a period of 48 hours for equilibration. One ml samples from the cellophane solution were removed for radioactivity measurements using an end-window G. M. counter.

The equilibration period required for equal distribution of soluble phosphate on both sides of the cellophane membrane was determined by radioactivity measurements of samples taken from the mineral and sack solutions at intervals.

**RESULTS**

Figures 1 and 2 show the equilibration periods required for initial concentrations of phosphate solutions of 15 and 60 ppm P respectively. The upper curves represent the radioactivity measurements expressed as corrected counts per minute per ml solutions outside the cellophane sacks. The lower curves represent the same values for the sack solution at the intervals indicated.

It is obvious that decreasing the concentration has delayed the equilibrium. Addition of mineral samples caused further delay depending on the extent of P$_{32}$-fixation by the mineral particles.