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STUDYING THE LEACHING OF SYRIAN PHOSPHATE BY NITRIC ACID

Abstract: *This paper investigated the leaching of phosphore from Syrian phosphate using commercial nitric acid. The effect of different parameters such as liquid: solid ratio, concentration, time and temperature have been studied.*

The optimal dissolution efficiency (88.25 %%) for P2O5 was obtained by nitric acid under the following conditions: liquid: solid ratio (7:1 mL:g), acid concentration (49.09 %) after (30 min) contact time and reaction temperature at (80 °C). The fluoride transfer to the acid medium was also studied.

Keywords: *phosphate, floride, nitric acid, phosphoric acid.*

ИЗУЧЕНИЕ ВЫЩЕЛАЧИВАНИЯ СИРИЙСКОГО ФОСФАТА АЗОТНОЙ КИСЛОТОЙ

Аннотация: *В этой статье исследовано выщелачивание фосфора из сирийского фосфата с использованием коммерческой азотной кислоты. Было изучено влияние различных параметров, таких как соотношение жидкость: твердое вещество, концентрация, время и температура.*

Оптимальная эффективность растворения (88,25 %%) для P2O5 была получена азотной кислотой в следующих условиях: соотношение жидкость: твердое вещество (7: 1 мл: г), концентрация кислоты (49,09%) после (30 мин) времени контакта и температура реакции при (80 ° C). Перенос фтора в кислую среду также был изучен.

Ключевые слова: *фосфат, фторид, азотная кислота, фосфорная кислота.*

Introduction

Phosphate is an abundant element on Earth and it is crucial for the development of vegetable life. The presence of iron and aluminum cations has a tendency of absorbing phosphate anions which prevents the plants' growth due to the absence of phosphate, essential for animal and vegetable life The main phosphate source are phosphate rocks. Its trade started in 1847, when about 500 tonnes were extracted. Its consumption has gradually increased over the years. These days, about 93% of the world production is aimed at the fertilizer industry [1].

The main use of the apatite mineral is in phosphoric acid production which, in most cases, is destined to the chemical industry for the production of phosphate fertilizers. According to Bigarella [2] rocks are aggregates formed by one or more kinds of minerals which can have volcanic origin or be formed by organic material. They can be classified into igneous, metamorphic and sedimentary. Metamorphic rocks undergo transformations under high temperature and pressure conditions which causes them to generate new textures or minerals. Sedimentary rocks are the result of degradation of other kinds of rocks, due to weathering such as rain, wind and temperature variation. Igneous rocks are formed from the magma expelled from volcanoes at high temperature. On the surface of the Earth under lower temperature, this material solidifies and forms the rocks [2,3].

The main mineral as a source of phosphate is apatite which can have a wide range of P2O5, likely to vary from 5 to 30%. Apatite can be found both in igneous and metamorphic rocks. This mineral has other denominations such as: fluorine-apatite, chlorine-apatite, hydroxapatite and carbon-apatite [4]. Apatite mineral can be found in several deposits around the world. In its several deposits, it is possible to find complex reserves with impurities which compromise phosphate availability and its disposition to the plants [5]. Phosphoric acid can be produced by several processes in which the apatite ore, after going through some stages such as extraction and milling. Phosphoric acid can present grades which range from 28 to 30% P2O5 and can reach from 50 to 52% P2O5 after the evaporation stage [6].

In the stage of phosphate ore solubilization, the most common is using mineral acids: phosphoric, nitric, sulfuric acids and, in some cases, chloride acid. Acids are used because of the total or partial transformation of tricalcium phosphates contained in some kinds of phosphate rocks. Concentrated acid is added so as to get total acidulation in order to obtain phosphoric acid destined to the chemical industry of fertilizers or other chemical products. One of the main uses of this acid is the production of monoammonium phosphate (MAP) and triple superphosphate [7].
However, the main disadvantage of WPA is that during its manufacturing process, there are many impurities present, among which fluorine is one of the major
Impurities [8, 9].

This study aimed to determine the effect of different parameters on fluoride and P_2O_5 transferring during the dissolution of phosphate rock by nitric acids.

1. **Experimental:**

2.1. Materials:

All chemical materials, products of BDH Company, were of an analytical grade. The solutions used were prepared with distilled water.

2.2. Preparation of phosphate rock.

Phosphate rock were taken from Syrian Fertilizers Company, the folowing table shows the most chemical component.

Table 1: chemical composition of phosphate rock.

component	CaO	P_2O_5	F	SiO2
Con (%)	47.21	29.55	3.15	9.44

The samples were dried in an electric furnace at 125 °C for 8h. Then they were pulverized and homogenized to get particles with size ranging between 0.25 mm - 0.01mm.

2.3. Experimental procedure:

The phosphorus obtained by an acid extraction from the phosphate rocks used was determined by the ammonium molybdenum method. The corresponding complex obtained was measured at 420 nm [9]. Fluoride was determined using selective ionic electrode.

3. Results and Discussion:

3.1. Effect of liquid-solid ratio:

Weighted sample (10 gr) were treated at room temperatures with (30, 40, 50, 60, 70) ml of HNO_3 for specefic time (30 min).

The liquid phase separeted and analysed to detemin (P_2O_5, F), the yeld of transforming was caculated according to the folwing equation:

R%= $(m/m_0)*100$, m= the amount of element in the liquid phase, m_0= the amount of element in the phosphate rock.

The result optained were diagramed in the figure (1)

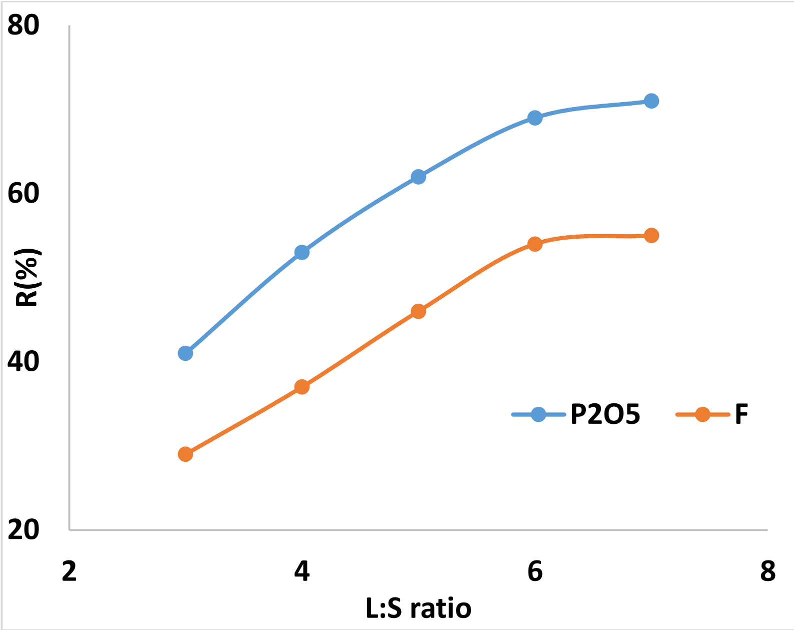

Fig 1: effect of L:S on the transfering of (P2O5, F)

3.2. Effect of Acid concentration:

Weighted sample (10 gr) were treated at room temperatures with (70) ml of HNO_3 with variable concentrations for specefic time (30 min).

The liquid phase separeted and analysed to detemin (P_2O_5, F), the yeld of transforming was caculated.

The result optained were diagramed in the figure (2).

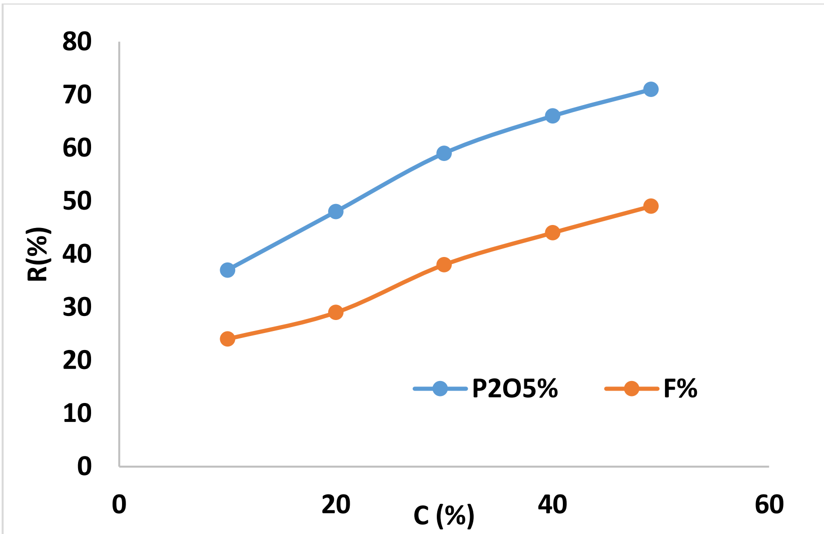

Fig 2: effect of Acid concentration on the transfering of (P2O5, F)

3.3. Effect of time:

Weighted sample (10 gr) were treated at room temperatures with (70) ml of HNO_3 (49.09 %) for variable time (10-60 min).

The liquid phase separeted and analysed to detemin (P_2O_5, F), the yeld of transforming was caculated.

The result optained were diagramed in the figure (3).

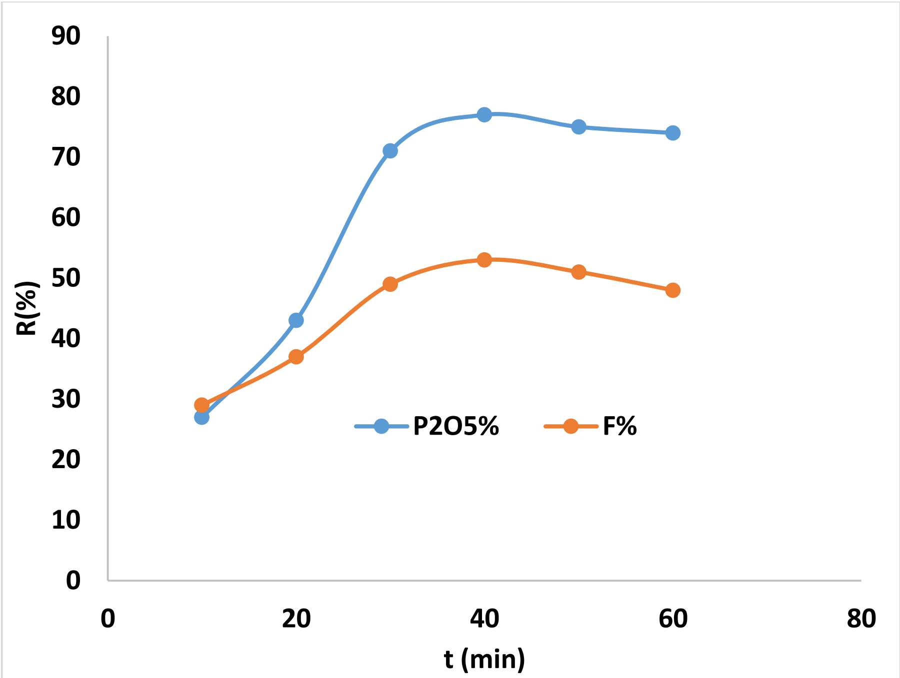

Fig 3: effect of time on the transfering of (P2O5, F)

3.4. Effect of temperature:

Weighted sample (10 gr) were treated undeer the previous optimum conditions, with deffernt temperatur (25, 40, 60, 80 °C)

The liquid phase separeted and analysed to detemin (P_2O_5, F), the yeld of transforming was caculated.

The result optained were diagramed in the figure (4).

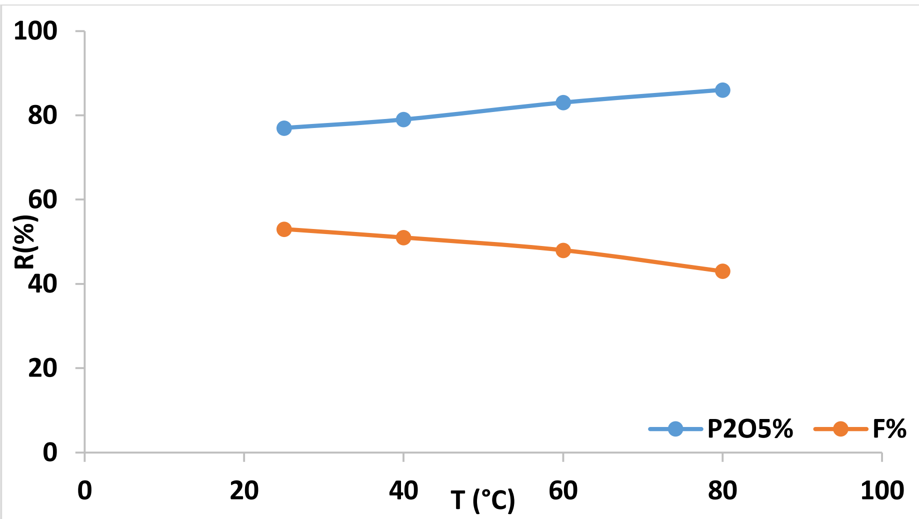

Fig 4: effect of temperature on the transfering of (P2O5, F)

4. Conclusion:

It is noted from the study that the Increased transmission of (P_2O_5, F) by increasing the liquid: solid ratio, acid concentration, and time due to the increased dissociation of phosphate rock.

As for the effect of temperature, we notice increasing in P_2O_5 transferring, while the amount of fluorine in the acid decreases due to the increasing of evaporation by increasing the temperature.

Thus we recommend increasing the temperature in order to get rid of the largest amount of fluorine.

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