Ain Shams University
Faculty of Science

Chemical Studies on the Production and Purification of Phosphoric Acid from Abu-Tartur Phosphate Rocks

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ABSTRACT

Leaching of Abu-Tartur phosphate ore by hydrochloric acid was investigated. The influence of the various factors affecting the process as the particle size of the ore, leaching time, hydrochloric acid concentration, leaching temperature, mixing speed and phosphate ore/ HCl ratio have been investigated to estimate the favor phosphate ore leaching process in relation to an impurity.

The leaching kinetic of P_2O_5 and Ca from Abu-Tartur phosphate rock using dilute hydrochloric acid has been investigated. The influence of HCl concentration, liquid/ solid ratio, particle size and temperature were studied in order to explain the leaching kinetic of phosphate rock. The kinetic data show that the leaching process can be described by a shrinking-core model and leaching rate was controlled by the diffusion of reactants through a porous ore. The apparent leaching activation energy for P_2O_5 and Ca were found to equal 14.4 and 22.6 kJ/ mol, respectively.

The produced aqueous acidulate solution from leaching process was neutralized in such a way that a pure dicalcium phosphate (DCP) for animal fodder is precipitated. The different factors affecting on the (DCP) precipitation reaction as reaction time, reaction temperature, mixing stirring speed and acidulate solution/ calcium carbonate, v/ m, ratio were investigated.

DCP precipitate raffinate solution was treated with sulfuric acid in order to recover HCl for reuse in leaching process. The influence of the various factors affecting the process as precipitation time, H_2SO_4 concentration, precipitation temperature, mixing stirring speed and raffinate solution/ H_2SO_4 ratio have been studied.

The produced phosphoric acid from calcium phosphate is more pure than the phosphoric acid produced directly by Abu Tartur phosphate ore. The effect of added H_3PO_4 and H_2SO_4 concentrations, temperature, mixing time, H_3PO_4/ dicalcium phosphate, v/ m, ratio, H_2SO_4/ dicalcium phosphate, v/ m, ratio, H_2O/ dicalcium phosphate, v/ m, ratio and mixing stirring speed in production process were studied.

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ABBREVIATIONS

Abbreviation	**Definition**
DH	Dihydrate Process
HH	Hemihydrate Process
HRC	Hemihydrate Recrystalization Process
HDH	Hemi-Dihydrate Process
DH/HH	Dihydrate-Hemihydrate Process
D_2EHPA, HD	Di-2 ethyl hexyl phosphoric acid
WPPA	Wet Process Phosphoric Acid
AHLM	Aqueous Hybrid Liquid Membrane
DHBDSA	1,2-dihydroxybenzene 3,5-disulfonic acid
CTAB	Cetyl Trimethyl Ammonium Bromide
SDS	Sodium Dodecyl Sulfate
DCP	Dicalcium Phosphate
MCP	Monocalcium Phosphate
DCPD	Dicalcium Phosphate Dihydrate
τ	Time for Complete Conversion of The Reactant Particle to Product (S)
ρ_B	Molar Density (mol m^{-3})
R	Reactant Particle Radius (m)
b	Stoichiometric Coefficient
K_g	Mass Transfer Coefficient
C_{Ag}	Initial Concentration (mol m^{-3})
α	Fractional Conversion of Solid Particle
t	Time (min)
D_e	Effective Diffusion Coefficient
K_s	Surface Reaction Rate Constant (mol min^{-1})
D	Molecular Diffusion Coefficient (m^2 min^{-1})
REE	Rear Earth Elements
K	Leaching Rate Constant (m s^{-1})
R^2	Correlation Coefficient

K, Ḱ, b1, b2, c1, c2, d1, d2	Constants
Ea	Activation Energy (J mol^{-1})
T	Absolute Temperature (K)
R_o	Universal Gas Constant (8.314 J k^{-1} mol^{-1})
P	Particle Size
C	Acid Concentration
D	Hydrochloric Acid/Phosphate Ore Mass Ratio

LIST OF FIGURES