شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

شبكة المعلومـــات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

قسم

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15 – 25c and relative humidity 20-40 %

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بالرسالة صفحات

لم ترد بالأصـــل

Study on Crystallization of Calcium Sulfate Dihydrate under Simulated Conditions of Phosphoric Acid Production

A thesis
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By

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Approval Sheet

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Ph.D. thesis

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ABBREVIATIONS

a	Activity of the solute
A	Surface area
a_{eq}	Activity of the Solute in Saturated Solution
AH	Anhydrite Process
A_t	Arrhenius Constant
A^o	Angstrom
ASTM	American Standards for Testing and Materials
^oC	Degree Celsius
C	Concentration
cc	Cubic centimeter
Ceq	Concentration at equilibrium
CTAB	Cetyl Trimethyl Ammonium Bromide
D	Partition coefficient
d_{50}	Median
DAP	Diammonium phospnate
DH	Dihydrate Process
DHBDSA	1.2-Dihydroxybenzene 3.5-disulfonic acid
DH-HH	Dihydrate-Hemihydrate Process
d_p	Pressure difference
E	Activation energy
G	Gypsum
G.E.	Growth efficiency
H	Hemihydrate
HDH	Hemihydrate – Dihydrate Process
HH	Hemihydrate Process
HRC	Hemihydrate Recrystallization Process
IR	Infra red
J_s	Nucleation rate
k	Rate constant
K_b	Boltzman constant
K_{sp}	Solubility product
Kv	Kilo-volt
m	Molality
m^2	Meter square
mA	Milliampre
min	Minute
N_A	Avogadro number
NTU	Nephelometric Turbidity Unit
ppm	Parts per million, mg/l

R	Gas constant
r	Radius of the nucleus
R_p	Precipitation rate
rpm	Resolution per minute
S	Supersaturation ratio
SDS	Sodium Dodecyl sulfate
Sec.	Second
SEM	Scanning electron microscope
t_{ind}	Induction time
UNIDO	United Nation Industrial Development Organization
V_m	Molecular volume
XRD	X-ray diffraction analysis
B	Shape Factor
γ	Surface energy
δ	Distance
ΔC	Supersaturation
ΔG_c	Free energy for critical size nucleus
ΔG_v	Free energy of the phase transformation
μm	Micron
σ	Relative supersaturation
λ	Wave length

Study on Crystallization of Calcium Sulfate Dihydrate under Simulated Conditions of Phosphoric Acid Production

Abstract

The effect of organic and inorganic additives on the crystallization of gypsum under simulated conditions of phosphoric acid production "Dihydrate Process" was studied using calcium hydrogen phosphate $CaHPO_4$ and sulfuric acid as primary nucleation substances in the medium of phosphoric acid and sulfuric acid. Gypsum crystallization occured as reaction taking place. The reaction was carried out at 80°C, agitation speed 550 rpm, 25% final P_2O_5 concentration and 2.0% final free SO_4^{2-} concentration. The effect of different additives included citric acid as example of carboxylic acids, 1,2-dihydroxybenzene 3,5-disulfonic acid (DHBDSA) as example of sulfonate compounds, two type of surfactant, i.e. cetyl trimethyl ammonium bromide (CTAB) as cationic one and sodium dodecyl sulfate (SDS) as anionic one and two impurities present in phosphate rocks to explain its effects individually like magnesium oxide and aluminum oxide on the induction time and growth efficiency are studied. The obtained results revealed that the presence of CTAB, DHBDSA and Al^{3+} decreased the induction time and increased the growth efficiency. While the presence of SDS, citric acid, Mg^{2-} increased the induction time and decreased the growth efficiency compared with the control test (without additives). The change on crystal size distribution and co-crystallized P_2O_5 in the absence and in the presence of additives are also measured. The change in the reaction kinetic and the surface energy were also calculated in the absence and in the presence of additives. Gypsum morphology was investigated using the scanning electron microscope. The studied additives were applied individually during leaching of the Egyptian Abu-Tartur phosphate concentrate. The results showed that the presence of CTAB and DHBDSA improved the filtration rate by 59.76% and 26.92%, respectively. On the other hand, the filtration rate is decreased in the presence of citric acid and SDS to 8.88% and 30.18%, respectively.

Key words: gypsum , phosphoric acid, calcium sulfate, dihydrate process, wet process, sulfuric acid process, production, crystallization, crystal growth, filtration rate