INTISARI

Kegunaan gipsum hemihidrat (*plaster of gypsum*) sangat luas dalam bidang industri dan bidang kesehatan antara lain sebagai perekat hidrolis bahan bangunan, adukan plesteran, cetakan benda keramik, pembalut patah tulang, cetakan gigi dan penambal gigi. Pengaktifan kembali gipsum bekas pembalut patah tulang menjadi gipsum hemihidrat dapat dilakukan melalui proses dehidrasi gipsum dengan cara menguapkan air yang terkandung dalam kristal gipsum. Tujuan penelitian ini adalah menghasilkan produk gipsum hemihidrat sesuai syarat mutu gipsum plesteran (minimal 66% berat $CaSO_4.0,5H_2O$), pemodelan matematis proses dehidrasi gipsum dan menentukan nilai parameter proses kecepatan reaksi dan kecepatan perpindahan massa volumetris.

Penelitian ini dilakukan dengan persiapan sampel bahan baku, kemudian pemanasan dengan *Thermal Gravimetry-Differential Thermal Analysis* (TG-DTA) dan furnace pada suhu 30^{o}C sampai 300^{o}C. Variabel penelitian ini adalah laju pemanasan (2,5^{o}C/menit, 5^{o}C/menit, 10^{o}C/menit) dan ukuran partikel (+35 mesh, +60 mesh, +80 mesh, +170 mesh). Data yang diperoleh adalah massa gipsum setiap waktu dan suhu sampel setiap waktu. Analisis sampel dan produk dilakukan dengan menggunakan *X-ray Diffractometer* (XRD).

Hasil penelitian menunjukkan bahwa gipsum hemihidrat yang dihasilkan mempunyai kemurnian 94,49%. Pemodelan matematis proses reaksi dehidrasi gipsum bekas pembalut patah tulang didekati dengan persamaan kinetika reaksi semu orde satu dan persamaan laju pengeringan. Nilai parameter yang didapatkan adalah nilai tetapan Arrhenius dan energi aktivasi sebesar A_1=6,7x10^{+18}(1/menit), E_1=1,5091x 10^{+5}(J/mol) dan A_2=2,4428x10^{+9}(1/menit), E_2=7,6227x10^{+4}(J/mol). Hubungan koefisien perpindahan massa volumetris dan laju pemanasan didekati dengan persamaan $k_y a = 0{,}8063\left[\frac{dT}{dt}\right]^{-1{,}0787}$. Hubungan koefisien perpindahan massa volumetris dan diameter partikel didekati dengan persamaan $Sh = 0{,}000423\left[\frac{dp}{dw}\right]^{-0{,}6791}$.

Kata kunci: dehidrasi, gipsum hemihidrat, TG-DTA, XRD, pemodelan matematis

ABSTRACT

Hemihydrate gypsum (plaster of gypsum) is widely used in manufacturing industry (building material hydraulic adhesive, plastering mortar and ceramics molding) and medical equipment industry (fracture bandages, dental casting and dental implant). The reactivating process of fracture bandage gypsum to produce hemihydrate gypsum can be performed by evaporating the water contained in gypsum crystal. The aims of this research were to produce hemihydrate gypsum within standard quality (<66% w/w of $CaSO_4.0,5H_2O$), to formulate mathematical model that represents the dehydration process of gypsum and to determine the processing paramater of reaction rate and volumetric mass transfer rate.

This research was conducted by preparing the raw materias then heating the materials with Thermal Gravimetry-Differential Thermal Analysis (TG-DTA) and furnace temperature at 30^oC - 300^oC. The research variables were the heating rate (2.5^oC/min, 5^oC/min and 10^oC/min) and particle size (+35 mesh, +60 mesh, +80 mesh and +170 mesh). The obtained data are the mass of gypsum and sample temperature at various time. Samples and products were then analyzed with X-ray diffractometer (XRD) analysis.

The results showed that the hemihydrate gypsum produced in this research had the purity of 9.49%. The mathematical modelling of dehydration reaction of used fracture bandage gypsum was approached by pseudo first order reaction and drying rate equation. The Arrhenius constant for both processes were $6.7x10^{+18}$ (min^{-1}) and $2.4428x10^{+9}$ (min^{-1}) respectively. While the activation energy for both processes were $1.5091x\ 10^{+5}$(J/mol) and $7.6227x10^{+4}$(J/mol) respectively. The correlation of volumetric mass transfer coefficient with drying rate was approached with Equation of $k_y a = 0.8063\left[\frac{dT}{dt}\right]^{-1.0787}$ and the correlation of volumetric mass transfer coefficient with particle diameter was approached with Equation of $Sh = 0.000423\left[\frac{dp}{dw}\right]^{-0.6791}$.

Keywords: *dehydration, hemihydrate gypsum, TG-DTA, XRD, mathematics modeling*