

OPTIMASI PELINDIAN SiO₂ DARI ABU SEKAM PADI GAMAGORA 7 SEBAGAI BAHAN GELAS BOROSILIKAT UNTUK VITRIFIKASI

Nuri Kalbu Anugrah
21/481016/TK/53092

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INTISARI

Silika dari abu sekam padi (ASP) berpotensi menjadi sumber SiO₂ untuk pembuatan gelas borosilikat sebagai matriks vitrifikasi limbah radioaktif tingkat tinggi. Penelitian ini menganalisis pengaruh konsentrasi NaOH, waktu, dan suhu reaksi dari proses pelindian abu sekam padi terhadap persen kandungan SiO₂ dari ASP varietas Gamagora 7, sekaligus menentukan kondisi optimumnya dengan *Response Surface Methodology-Box Behnken Design* (RSM-BBD).

Proses diawali kalsinasi sekam padi pada 700°C, diikuti pelindian asam menggunakan HCl dan pelindian basa menggunakan NaOH dengan konsentrasi rentang 1 hingga 3 M, waktu 60 hingga 180 menit, dan suhu 80 hingga 100°C sesuai rancangan BBD (15 percobaan). Presipitasi dengan HCl dilakukan hingga pH \approx 7, dilanjutkan pencucian, pengeringan, dan karakterisasi XRF Bruker S2 PUMA. Data diolah dengan Design-Expert 13 untuk memperoleh persamaan prediksi, *analysis of variance* (ANOVA), dan optimasi.

Hasil pelindian abu sekam padi varietas Gamagora 7 menunjukkan kandungan SiO₂ 76,66 hingga 89,36 wt.%. Waktu dan suhu merupakan pengaruh dominan terhadap kandungan SiO₂ hasil pelindian. Interaksi waktu dengan suhu serta waktu kuadrat menghasilkan puncak optimum. Pengaruh konsentrasi NaOH tampak melalui interaksinya dengan waktu dan suhu. Kandungan SiO₂ tertinggi sebesar $(86,857 \pm 0,706)$ wt.% dicapai saat konsentrasi NaOH 1,005 M pada suhu 80,174°C selama 155,055 menit.

Kata Kunci: abu sekam padi, *Box Behnken Design*, SiO₂, NaOH, waktu, suhu, vitrifikasi

Pembimbing Utama : Ir. Nunung Prabaningrum, M.T., Ph.D., IPU.
Pembimbing Pendamping : Ir. Raden Sumarbagiono, M.T.



OPTIMIZATION OF SiO₂ LEACHING FROM GAMAGORA 7 RICE HUSK ASH AS A BOROSILICATE GLASS FRIT FOR VITRIFICATION

Nuri Kalbu Anugrah
21/481016/TK/53092

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ABSTRACT

Silica from rice husk ash (RHA) has the potential to be a source of SiO₂ for the manufacture of borosilicate glass as a vitrification matrix for high-level waste (HLW). This study analyzes the effect of NaOH concentration, time, and reaction temperature of the rice husk ash leaching process on the percentage of SiO₂ content from Gamagora 7 rice husk ash, while also determining the optimum conditions using Response Surface Methodology-Box Behnken Design (RSM-BBD).

The process began with the calcination of rice husks at 700°C, followed by acid leaching using HCl and base leaching using NaOH with a concentration range of 1 to 3 M, a time of 60 to 180 minutes, and a temperature of 80 to 100°C according to the BBD design (15 runs). Precipitation with HCl was carried out until pH ≈ 7, followed by washing, drying, and characterization using XRF Bruker S2 PUMA. The data were processed using Design-Expert 13 to obtain prediction equations, analysis of variance (ANOVA), and optimization.

The results of Gamagora 7 rice husk ash leaching showed SiO₂ content of 76.66 to 89.36 wt.%. Time and temperature were the dominant factors affecting the SiO₂ content of the leaching results. The interaction between time and temperature, as well as the square of time, produced an optimum peak. The effect of NaOH concentration was evident through its interaction with time and temperature. The highest SiO₂ content of (86.857 ± 0.706) wt.% was achieved at a NaOH concentration of 1.005 M at a temperature of 80.174°C for 155.055 minutes.

Keywords: Box Behnken Design, NaOH, rice husk ash, SiO₂, temperature, time, vitrification

Supervisor : Ir. Nunung Prabaningrum, M.T., Ph.D., IPU.
Co-supervisor : Ir. Raden Sumarbagiono, M.T.

