PENGARUH DONOR IKATAN HIDROGEN ASAM OKSALAT, ASAM MALONAT, DAN ASAM SUKSINAT PELARUT EUTEKTIK TERHADAP PELINDIAN PERAK DARI LIMBAH *PRINTED CIRCUIT BOARD*

SKRIPSI

Diajukan untuk memenuhi sebagian syarat memperoleh gelar Sarjana Sains pada
Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

Oleh
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FAKULTAS PENDIDIKAN MATEMATIKA DAN ILMU PENGETAHUAN ALAM
UNIVERSITAS PENDIDIKAN INDONESIA
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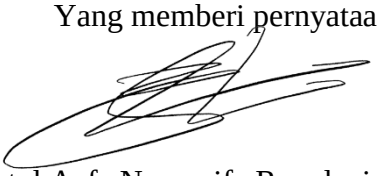
PERNYATAAN

Dengan ini saya menyatakan bahwa skripsi yang berjudul "**Pengaruh Donor Ikatan Hidrogen Asam Oksalat, Asam Malonat, dan Asam Suksinat Pelarut Eutektik terhadap Pelindian Perak dari Limbah *Printed Circuit Board***" ini beserta seluruh isinya adalah benar-benar karya sendiri. Saya tidak melakukan penjiplakan atau pengutipan yang tidak sesuai dengan etika ilmu yang berlaku dalam masyarakat keilmuan. Atas pernyataan ini, saya siap menanggung risiko/sanksi apabila di kemudian hari ditemukan adanya pelanggaran etika keilmuan atau ada klaim dari pihak lain terhadap keaslian karya ini.

Bandung, Agustus 2022

Yang memberi pernyataan,



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KATA PENGANTAR

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ABSTRAK

Sampah *Printed Circuit Board* (PCB) terdapat sebanyak 1,2 juta ton pada tahun 2022. PCB mengandung perak yang memiliki nilai potensi ekonomi yang tinggi. Tingginya produksi limbah dan adanya potensi ekonomi, menjadikan pentingnya daur ulang sampah PCB. Upaya daur ulang dapat dilakukan dengan melindi perak menggunakan *Deep Eutectic Solvent* (DES). DES bersifat ramah lingkungan dan mampu membentuk kompleks dengan berbagai jenis logam. DES berbasis kolin klorida digunakan sebagai Akseptor Ikatan Hidrogen (HBA) dengan asam oksalat, asam malonat, dan asam suksinat sebagai Donor Ikatan Hidrogen (HBD). Penelitian ini bertujuan untuk mempelajari pengaruh panjang rantai karbon HBD terhadap sifat fisik dan efisiensi pelindian perak. Optimasi rasio S/L, waktu, dan suhu dilakukan untuk mendapatkan kondisi optimum pelindian. Hasil sintesis menujukkan bahwa DES oksalin 2:1, malin 1:1, serta suksilin 2:1 memiliki kestabilan paling baik berwujud larutan tidak berwarna, jernih, dan kental. Hasil FTIR menujukkan adanya pergeseran bilangan gelombang pada gugus -OH karena interaksi ikatan hidrogen antar molekul HBA dan HBD dalam pembentukan DES. Hasil pelindian DES terhadap perak oksida diukur menggunakan AAS yang menujukkan bahwa DES oksalin 2:1 memiliki efisiensi paling besar dibandingkan dengan variasi DES lain, yaitu sebesar 59,25% yang menunjukkan bahwa panjang rantai mempengaruhi efisiensi pelindian dan HBD dengan panjang rantai pendek pendek memiliki nilai efisiensi yang baik karena tingkat keasaman yang tinggi. Hasil optimasi menujukkan kondisi optimum rasio S/L, waktu, dan suhu secara berturut turut adalah 40mg/mL, 18 jam dan 60°C yang menghasilkan persentase pelindian sebesar 90,90% pada Ag_2O dan 99,38% pada sampel PCB. Dapat disimpulkan bahwa DES berpotensi sebagai pelarut ramah lingkungan yang efisien dalam melindi perak.

Kata kunci: *Deep Eutectic Solvent*, *Printed Circuit Board*, Oksalin, Pelindian, Perak.

ABSTRACT

There are 1.2 million tons of Printed Circuit Board (PCB) waste in 2022. PCBs contain silver which has a high potential economic value. The high production of waste and the potential economic value make it important to recycle PCB waste. Recycling can be conducted by leaching silver using Deep Eutectic Solvent (DES). DES is environmentally friendly and able to form complexes with various types of metals. Choline chloride-based DES was used as Hydrogen Bond Acceptor (HBA) with oxalic acid, malonic acid, and succinic acid as Hydrogen Bond Donor (HBD). This research aims to study the effect of HBD carbon chain length on physical properties and silver leaching efficiency. Optimization of S/L ratio, time, and temperature was conducted to obtain optimum leaching conditions. The synthesis results showed that DES oxaline 2:1, malin 1:1, and succilin 2:1 had the best stability in the form of colorless, clear, and viscous solutions. FTIR results showed a shift in the wave number of the -OH group due to hydrogen bonding interactions between HBA and HBD molecules in the formation of DES. The leaching results of DES to silver oxide were measured using AAS which showed that 2:1 oxaline DES had the highest efficiency compared to other DES variations, which was 59.25%, indicating that chain length affects the leaching efficiency and HBD with short chain length has a good efficiency value due to high acidity. The optimization results showed that the optimum conditions of S/L ratio, time, and temperature were 40mg/mL, 18 hours and 60°C, respectively, which resulted in a leaching percentage of 90.90% on Ag2O and 99.38% on PCB samples. It can be concluded that DES has the potential as an environmentally friendly solvent that is efficient in leaching silver.

Keywords: Deep Eutectic Solvent, Printed Circuit Board, Oxaline, Leaching, Silver.

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