

ABSTRACT

FORMULATION ADHESIVE OF WATERPROOF CAT'S EYES DAMMAR RESIN USING VARIATIONS OF CO-SOLVENT AS A FORMALDEHYDE-FREE ADHESIVE FOR PLYWOOD PRODUCTION

By

WIDIA NATASA

One of the forest products that holds significant economic value in Indonesia is plywood, as this product contributes substantially to the country's foreign exchange through export activities and serves as a mainstay of the national forestry industry (Malau et al., 2022). Although plywood is a leading commodity in the wood industry, its production still relies on formaldehyde-based synthetic adhesives (UF, MUF, PF), which are known to release emissions harmful to human health and the environment. This research aims to optimize the use of low-grade damar mata kucing (DMK) resin as a formaldehyde-free adhesive for plywood production through variations in co-solvent types, namely acetone, ethanol, and toluene. The experiment was conducted at the Bioproduct Laboratory of BRIN Cibinong and at the University of Lampung using a completely randomized design with three factors: adhesive formulation, pressing temperature (120°C and 150°C), and pressing time (3, 5, and 7 minutes). Analyses included physical and chemical characterization of the adhesive (FTIR, viscosity, and mass loss), as well as physical and mechanical testing of plywood, including moisture content, density, delamination, bonding strength, Modulus of Elasticity (MOE), Modulus of Rupture (MOR), and percentage of wood failure.

The results demonstrated that co-solvent variations significantly influenced the thermal stability, bonding strength, and delamination resistance of the plywood. The adhesive formulation with medium-polarity solvent combination, particularly T6 (acetone–toluene mixture) at a pressing temperature of 150°C for 3 minutes,

showed the best performance, with delamination values $<13\%$ and bonding strength >0.7 MPa, meeting the requirements of SNI 01-5008.7-1999 and JAS 233-2003 standards. The use of co-solvents improved resin solution homogeneity, reduced viscosity, and enhanced adhesive interaction between the resin and wood substrate. Overall, this study demonstrates that low-grade damar mata kucing resin can be optimized into a high-performance, formaldehyde-free natural adhesive through appropriate co-solvent selection. These findings have the potential to support the development of a sustainable plywood industry while increasing the economic value of Indonesia's local forest resources.

Keywords: *damar mata kucing, co-solvent, plywood, natural adhesive, formaldehyde-free.*

ABSTRAK

FORMULASI PEREKAT DAMAR MATA KUCING TAHAN AIR DENGAN VARIASI *CO-SOLVENT* SEBAGAI PEREKAT BEBAS FORMALDEHIDA UNTUK PRODUKSI KAYU LAPIS

Oleh

WIDIA NATASA

Salah satu komoditas hasil hutan yang memiliki nilai ekonomi penting di Indonesia adalah kayu lapis (plywood), karena produk ini memberikan kontribusi signifikan terhadap devisa negara melalui kegiatan ekspor serta menjadi andalan industri kehutanan nasional (Malau dkk. 2022). Meskipun menjadi komoditas unggulan industri kayu, produksinya masih bergantung pada perekat sintetis berbasis formaldehida (UF, MUF, PF) yang dikenal memiliki emisi berbahaya bagi kesehatan dan lingkungan. Penelitian ini bertujuan untuk mengoptimalkan penggunaan damar mata kucing (DMK) tahan air sebagai bahan dasar perekat bebas formaldehida pada industri kayu lapis melalui variasi penggunaan *co-solvent*, yaitu aseton, etanol, dan toluena. Penelitian dilaksanakan di Laboratorium Bioproduk BRIN Cibinong serta di Universitas Lampung dengan rancangan acak lengkap tiga faktor, meliputi jenis formulasi perekat, suhu kempa (120°C dan 150°C), dan waktu kempa (3,5,7 menit). Analisis meliputi karakterisasi fisik dan kimia perekat (FTIR, viskositas, dan mass loss), serta pengujian sifat fisis dan mekanis kayu lapis, yaitu kadar air, kerapatan, delaminasi, keteguhan rekat, *Modulus of Elasticity* (MOE), *Modulus of Rupture* (MOR), dan persentase kerusakan kayu.

Hasil penelitian menunjukkan bahwa variasi *co-solvent* berpengaruh signifikan terhadap stabilitas termal, keteguhan rekat, dan ketahanan delaminasi kayu lapis. Formulasi perekat dengan kombinasi pelarut berpolaritas sedang, khususnya T6

(campuran aseton–toluena) pada suhu kempa 150°C dan waktu 3 menit, menghasilkan performa terbaik dengan nilai delaminasi <13% dan kekuatan rekat >0,7 MPa sesuai standar SNI 01-5008.7-1999 dan JAS 233-2003. Penggunaan co-solvent terbukti meningkatkan homogenitas larutan damar, menurunkan viskositas, serta memperbaiki interaksi adhesif antara perekat dan substrat kayu. Secara keseluruhan, penelitian ini membuktikan bahwa damar mata kucing tahan air dapat dioptimalkan menjadi perekat alami berperforma tinggi dan bebas formaldehida melalui pemilihan *co-solvent* yang tepat. Hasil ini berpotensi mendukung pengembangan industri kayu lapis berkelanjutan sekaligus meningkatkan nilai ekonomi sumber daya hutan lokal Indonesia.

Kata kunci: damar mata kucing, *co-solvent*, kayu lapis, perekat alami, bebas formaldehida.