PALM OIL-BASED ADHESIVES FOR FIBRE BOARD

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Over the last decade, MPOB has embarked on research and development that is aimed at producing polyols from palm oil derivatives which can further expand the usage of palm oil in the non-food related sectors. The current MPOB palm oil-based polyol (POP resin), which can be produced on a pilot plant scale, can be formulated into various types of polyurethane (PU) foams. The PU foams can be rigid, semi-rigid or flexible, and are suitable for such industrial sectors as building, furniture, bedding and automotive parts. However, there is a sector of the PU industry which is known as CASE (coating, adhesive, sealant and elastomer) that cannot be satisfied by the current triglycerides-based polyols (POP resin).

In view of this limitation, MPOB has put in efforts to prepare a suitable palm oil-based polyol for CASE. The new polyol is made from oleic acid and glycerol, which are co-products of the palm kernel oil refinery and biodiesel plant, respectively. This new palm oil-based polyol is known as a fatty acid-based polyol (PolyMO) (*Figure 1*), and it has been found to be suitable for formulation into PU for adhesives application.

Figure 1. Physical appearance of PolyMO produced on a pilot plant scale.

APPLICATION OF PALM OIL-BASED ADHESIVES

We have identified a potential application for the PU adhesive, *i.e.* as a binder in the production of fibreboard (*Figure 2*). Locally, fibreboard is made from rubber wood fibres, and urea-formaldehyde (UF) resins are used as binders. The implementation of strict regulations in the European countries and Japan that require zero emission of formaldehyde is discouraging the use of UF resins in the local fibreboard industry. This scenario creates an opportunity for palm oil-based PU adhesives to be deployed by local fibreboard manufacturers. The palm oil-based PU adhesive formulation consists only of isocyanate and PolyMO.

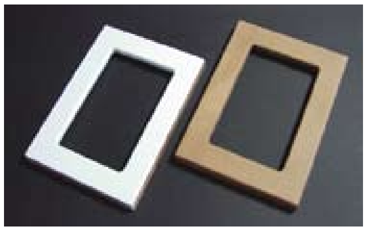
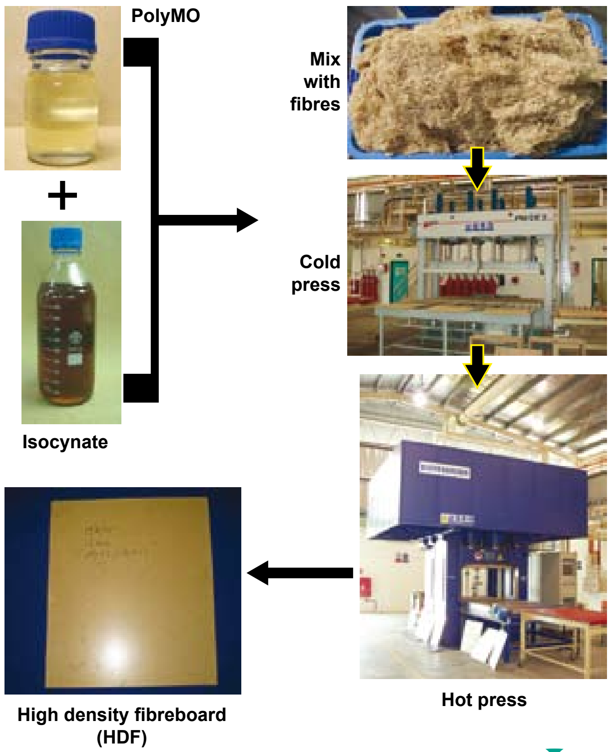


Figure 2. Fibreboard bonded with palm-based adhesive.

PROCESS TO PRODUCE FIBREBOARD USING PALM-BASED ADHESIVE



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CHARACTERISTICS OF A HIGH DENSITY FIBREBOARD COMPARED WITH A COMMERCIAL PRODUCT

High density fibreboard (HDF) bonded with palm oil-based PU adhesive meets the commercial requirement of HDF board as shown in *Table 1*.

TABLE 1. CHARACTERISTICS OF HIGH DENSITY FIBREBOARD COMPARED TO A COMMERCIAL PRODUCT

Property	Commercial standard	Palm oil-based PU adhesive		
		Trial 1	Trial 2	Trial 3
Type of adhesive	UF	PU	PU	PU
Total adhesive, %	12	12	5	5
Isocyanate, wt%	0	0	3.5	3.5
NCO substituition by polyol, %	0	0	30	30
Palm oil-based polyol, wt %	0	0	1.5	1.5
Tensile strength, Nm m^{-2} (min.)	1.0	2.4	2.2	1.5
Bending strength, Nm m^{-2} (min.)	42	44	43	49
E-modulus, Nm m^{-2} (min.)	3 200	4 300	4 600	5 011
Swelling, % (max.)	10	7	9	8
Moisture content, % (max.)	9	6	6	7
Thickness, mm	8-12	8-12	8-12	8-12

The test results show that the fibreboard bonded with palm oil-based adhesive exhibited better board properties than the commercial board, even at a lower adhesive content (Trials 2 and 3 in *Table 1*). In addition, this is also an improved technology for the fibreboard industry, because the process improved the safety features in making fibreboard by eliminating formaldehyde emission associated with the use of UF adhesives. A patent application for the process to produce PolyMO has been filed in Malaysia (PI 20055231). Patent applications were also filed in USA, Europe, Japan, Indonesia and China in order to safeguard this intellectual property.

BENEFITS TO THE INDUSTRY

For the oil palm industry, the technology based on PolyMO offers a platform for a new venture, shifting the focus from basic oleochemicals to intermediates (polyol), and from there into consumer products (specifically, PU products). Furthermore, the targeted end-product of this project is fibreboard that can be made from oil palm fibres (from oil palm trunk fibres and empty fruit bunch fibres) with PolyMO as the binder. The success of this project will broaden the usage of oil palm and palm oil derivatives such as oleochemicals and biomass in the composites industry (MDF board), where there will be value-addition to the palm products as well as transforming waste into wealth. Eventually, this will increase the profits in the palm oil industry and diversify the usage of palm oil in the non-food sectors.

In addition, the use of PolyMO as adhesive for fibreboard will enable the fibreboard industry to conform to the new regulation on zero emission of formaldehyde, as well as protect the public from exposure to toxic formaldehyde emission originating from UF resin, which is currently used in local manufacture of fibreboard. The palm oil-based PU adhesive made from PolyMO is free from any formaldehyde.

POTENTIAL MARKET

Global fibreboard production in 2008 was estimated at about 43.6 million cubic metres, with each cubic metre of fibreboard requiring 12 kg of fatty acid-based polyol (PolyMO). If palm oil-based PU adhesive can penetrate just 5% of the existing market, 25 000 t of PolyMO will be required per annum.

CONCLUSION

The palm oil-based adhesive can be used in the fibreboard industry, thus becoming a potential replacement for adhesives based on UF resins. The palm oil-based adhesive also offers fibreboard produced with competitive properties. Further tests are being conducted in collaboration with a local company to enhance the properties of the palm oil-based adhesive for fibreboard.

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