A PYRO-LIGNO BINDER FROM OIL PALM EMPTY FRUIT BUNCH

ASTIMAR ABDUL AZIZ; WAN HASAMUDIN WAN HASSAN; ZAWAWI IBRAHIM; ROSNAH MAT SOOM; ROPANDI MAMAT and ANIS MOKHTAR

MPOB INFORMATION SERIES • ISSN 1511-7871 • JUNE 2009

MPOB TT No. 426

Empty fruit bunches (EFB) contain 18%-21% lignin, 40%-45% cellulose and 19%-21% hemicellulose (Astimar *et al.*, 1997). Lignin is produced mainly as a by-product from the pulp and paper industry, separated from the wood by chemical pulping processes such as Kraft pulping and sulfite pulping. The black liquor from these pulping processes contains lignin which is separated via acid precipitation or CO_2 precipitation. The bulk of the lignin available in the market is from sulfite pulping in the form of lignosulfonates.

Lignin is one of the most complex natural polymers that exist in lignocellulosic materials in terms of its structure and heterogeneity. It is a highly branched polymer attached with polysaccharides, and is composed of phenyl propane-based monomeric units linked together by several types of ether linkages and also various kinds of carbon-carbon bonds (Goheen, 1978). The distribution and content of these monomers distinguish the origin of the plant from where it was extracted. Lignin is non-toxic and an extremely versatile product for use in industrial and food processing. Conventional isolated lignin suffers from degradation and contains impurities, and it is difficult to obtain lignin identical in chemical composition each time.

FIELDS OF APPLICATION

Lignosulfonates are known to be useful in many product applications, and can be a very effective and economical adhesive, acting as a binding agent or 'glue' in pellets or compressed materials. Lignosulfonates used on unpaved roads reduce environmental concerns over pollution from airborne dust particles as well as stabilize the road surface. This binding ability makes them a useful component for the following products (Krinqstad, 1978):

- biodegradable plastics;
- coal briquettes;
- plywood and particleboard;
- ceramics;
- animal feed pellets;
- carbon black;
- fibreglass insulation;
- fertilizers and herbicides;
- linoleum paste;
- dust suppressants; and
- soil stabilizers.

The extraction of lignin from lignosulfonates is normally possible when there is a pulping industry where there is excess black liquor (black liquor is also being used as an energy source for the mill). The process normally involves high cost of chemicals and the use of heat for black liquor concentration, precipitation and drying. Furthermore, the lignin will undergo a severe pulping process that can modify the chemical constituents of the precipitated lignin.

The extraction of pure lignin or natural lignin directly as a main product from lignocellulosic material will also be very costly as it involves the costs of solvent extraction, ball milling and a further purification process.

The technology presented here basically involves the preparation of a lignin-based polymer or ligno-polymer from the lignocellulosic materials of oil palm biomass, using a novel process different from the conventional process of extracting lignin from the black liquor. The ligno-polymer extracted via this process may contain some other polysaccharide polymers as shown from the existence of –OH groups in the Fourier Transform Infra-red Spectroscopy (FTIR) analysis (*Figure 1*), but most of the content is lignin. This product exhibits characteristics comparable to those of commercial lignin and is suitable for use as a bio-binder. The typical characteristics of EFB pyro-lignin as compared to lignosulfonate are also shown in *Table 1*.

ISSN 1511-7871

9 771511 787001

MPOB

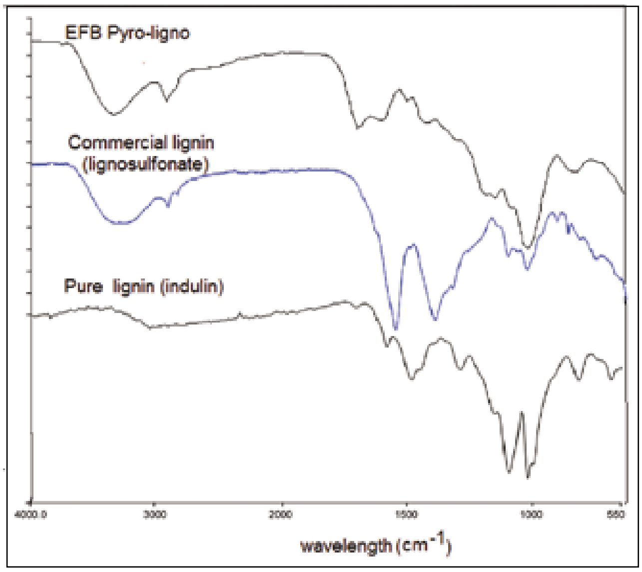

Figure 1. FTIR analysis showing the comparison of EFB pyro-ligno powder with commercial lignin and pure lignin.

TABLE 1. TYPICAL CHARACTERISTICS OF EFB PYRO-LIGNO AND LIGNOSULFONATE

Characteristic	Lignosulfonate powder	Pyro-ligno powder
Colour	Brown	Dark brown
pH	7.2-7.5	6.8-7.2
Moisture	6.0%	5.5%-6.0%
Total sulphur	5.0%	Nil
Yield (per weight of EFB)	13%-15%	20%-25%

THE PROCESS

The process involves the pre-carbonization of the biomass chips using slow vacuum pyrolysis at an optimum temperature, sufficient to pyrolyse the hemicellulose and part of the cellulose, leaving a pyrolysed biomass that contains mostly lignin. The pyrolysed portion which still contains residual cellulose, wax, resins and other impurities is treated using an optimal concentration of acid at an optimum temperature, leaving a solid residue which contains lignin of a high purity (acid wash) (*Figure 2*).

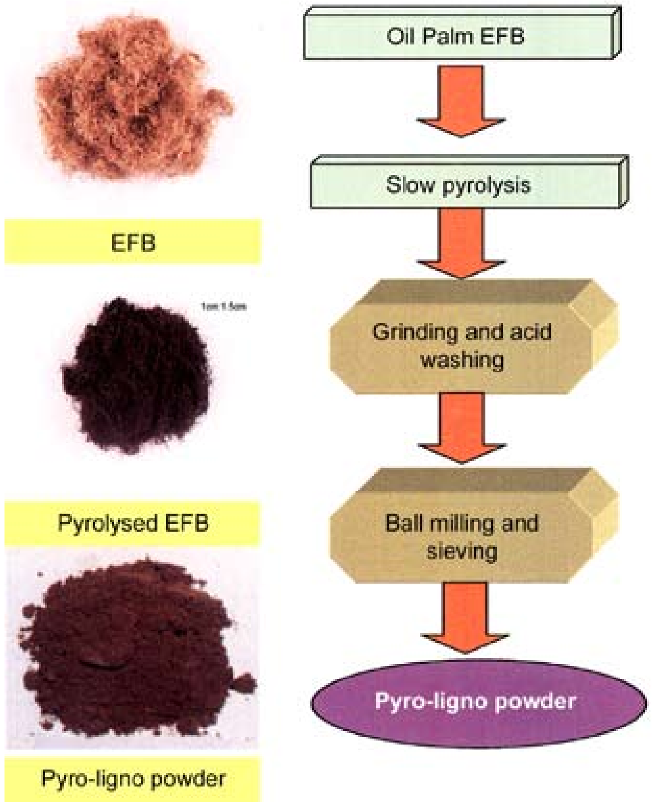

Figure 2. Flow chart of the preparation of pyro-ligno powder from EFB.

REFERENCES

ASTIMAR, A A; HUSIN, M; ANIS, M and RAMLI, R (1997). Multistage processes of chemical production from palm oil by-products. *Proc. of the 4th Oil Palm Tree Utilization Committee Seminar – Progress Towards Commercialization*. p. 173-183.

GOHEEN, D W (1978). Chemicals from lignin. *Organic Chemicals from Biomass* (Irving and Goldstein, eds.). CRC Press, United States of America.

KRINQSTAD, K (1978). The challenge of lignin. *Resources of Organic Matter for the Future* (St. Pierre, L E ed.). World Conf. Future Sources of Organic Raw Material. Multiscience, Montreal.

For more information kindly contact:

Director-General
MPOB
P. O. Box 10620
50720 Kuala Lumpur, Malaysia.
Tel: 03-87694400
Website: www.mpob.gov.my