PALM OIL-BASED POLYURETHANE FOR AUTOMOTIVE COMPONENTS (car seat) - PART 2

MOHD NORHISHAM, S; HOONG, S S; TUAN NOOR MAZNEE, T I; KOSHEELA DEVI, P P; NURUL AIN, H; YEONG, S K; HAZIMAH, A B and SALMIAH, A



MPOB INFORMATION SERIES • ISSN 1511-7871 • JUNE 2009

MPOB TT No. 432

olyurethanes are made from two basic raw materials: polyols and diisocyanates. A key advantage of polyurethanes is that specific parts and combinations of each chemical group can be chosen to create the desired end-products. The targeted applications for these end-products are numerous, the major ones being in automobiles, medicines, comfort mattresses, buildings, paints, coatings, adhesives and packaging materials. In addition, the chemistry of polyurethanes allows for the synthesis of foams (flexible and rigid) or thermoplastic polymers, depending on their synthesis conditions. Flexible polyurethane foams are widely used, and their market segment is in excess of 40% of the total global urethane market, and is the single largest application for urethanes. Main sectors of application are the automotive and aircraft industries, in upholstered furniture and mattresses. The important characteristics of the flexible foams are density, hardness, resilience and dampening behaviour of the foam, and, in order to fit each application, these characteristics should be optimally balanced and adjusted.

POLYURETHANE FOAMS IN AUTOMOTIVES

Today's key objective in the automotive industry is to develop cars which are clean, safe, energyefficient and affordable. Polyurethanes (PU) are a combination of lightweight and flexible materials with great strength and durability. Normally, a typical family car contains around 18 kg of PU while a luxury car contains about 30 kg. Since its introduction in 1930, the success of PU has been due to its ability to be produced in many different forms, from flexible foams (with a density of 30 kg m⁻³) for items such as headrests to the more rigid, harder PU systems suitable for floor covers, bumpers and cover stocks (with a density of 1100 kg m⁻³). Many other properties can be tailored during the developmental phase to meet the needs of a particular automotive application.

PALM OIL-BASED POLYOLS AND THEIR PROPERTIES

The properties and specifications of palm oil-based polyols (POP Premier 90) are shown in *Table 1*.

Telefax: 03-89259446

TABLE 1. PROPERTIES OF PALM OIL-BASED POLYOL (POP Premier 90)

Parameter	Property	Test method
Colour	Brownish yellow	Visual
Odour	Slight/typical	Olfactory
Hydroxyl value, mg KOH g-1 sample	60-85	AOCS Cd 13-6
Viscosity, cP @ 25°C	600-1 000	ASTM D 4878
pН	6	pH meter
Acid value, mg KOH g-1 sample	0.7	AOCS Cs 3d-63
Iodine value, g I ₂ /100 g sample	7	AOCS Cd1d-92
Moisture content, %	< 0.05	AOCS Ca2e-84





MOULDED PALM OIL-BASED POLYURETHANE (car seat)

The moulded palm oil-based PU formulation is prepared by blending palm oil-based polyol (POP Premier 90) and petroleum-based polyol with the necessary additives. Isocyanate is then added into the blended polyols. The mixture is stirred for 8 s and then poured into a mould of dimensions 390 mm x 390 mm x 100 mm, and left for 5 min. The moulded palm oil-based PU is allowed to cure for seven days before its characterization. The performance of the moulded palm oil-based PU in car seat application was tested according to ASTM 3574 and compared to the General Motors standard (GM 6293M), and the results are summarized in *Table* 2.

To produce flexible foams, about two parts of polyol are used for each part of isocyanate. Assuming that the global market for PU in automotive components is about 1.6 million tonnes, there is a potential for 1.07 million tonnes of polyol to be used for these automotive components.

ECONOMIC ANALYSIS

Critical economic indicators are as follows:

- return on investment (ROI): 17%; and
- payback period: 5.8 years.

TABLE 2. PHYSICAL PROPERTIES OF MOULDED PALM OIL-BASED PU FOR CAR SEAT APPLICATION

Parameter	Unit	GM 6293M	Result
Density	Minimum, kg m ⁻³	24	78
Tensile strength	Minimum, kPa	82	108.5
Elongation at break	Minimum, %	100	405.3
Tear strength	Minimum, Nm ⁻¹	180	235
Compression set at 50%	Maximum, %	25	4
Sag factor	Minimum	2.4	2.6

ADVANTAGES OF PALM OIL-BASED PU

There are several advantages in using palm oil-based PU:

- palm oil-based polyol is made from renewable resources;
- the product offers an opportunity for PU suppliers and customers to reduce their dependence on natural gas and crude oil; and
- the use of a polyol from a plant-based oil can help to reduce global warming, smog, environment pollution and fossil fuel depletion.

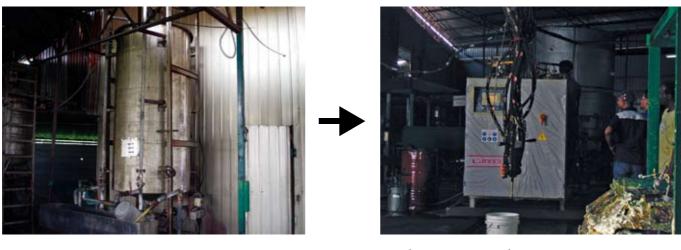
POTENTIAL MARKET

In general, most of the PU used in the automotive industry (70%-80%) are moulded flexible foams. The major applications for PU in the automotive industry are for seats and acoustic insulation, followed by other components such as door panels, steering wheels and dashboards. It is estimated that there are about 16-18 kg of PU materials in a basic car and about 25-30 kg in a more expensive car.

CONCLUSION

The formulation for the moulded palm oil-based PU for car seat application fulfills the requirements for car seats and, in some properties, performed even better.

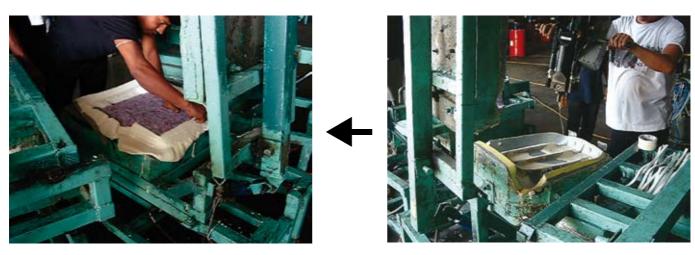
PROCESS TO PRODUCE PALM OIL-BASED POLYURETHANE FOR CAR SEATS



Tower mixer

High-pressure machine





+

Spraying the product into the mould



Car seat

For more information kindly contact:

Director-General MPOB P. O. Box 10620 50720 Kuala Lumpur, Malaysia. Tel: 03-87694400

Website: www.mpob.gov.my Telefax: 03-89259446