CHEMICAL TREATMENT OF POLYURETHANE AND PET WASTES FOR PRODUCTION OF RAW MATERIALS

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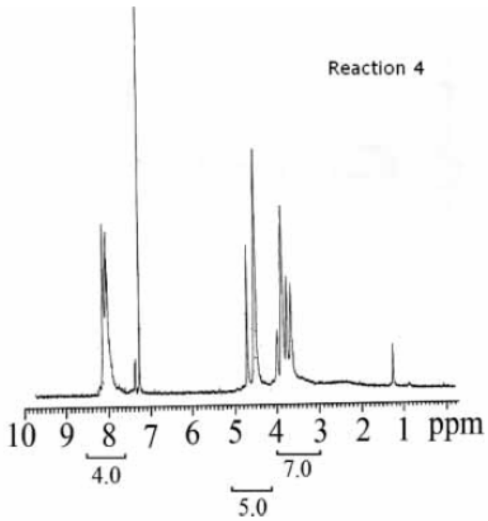
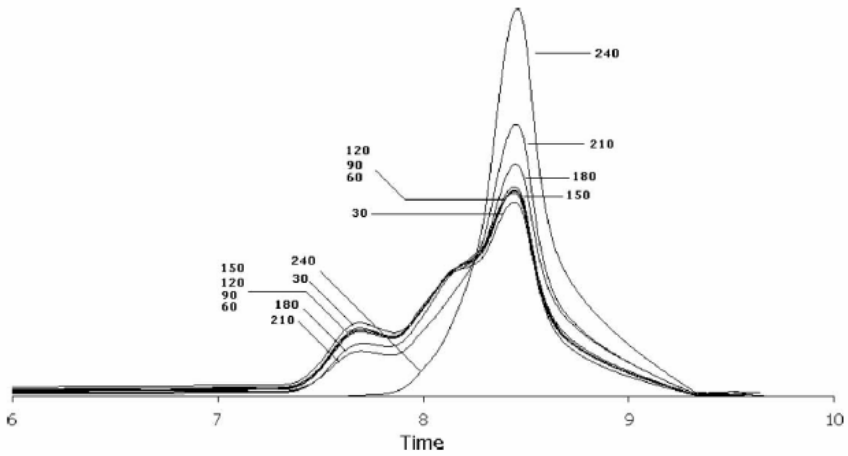
Polyurethanes (PU) are one of the most versatile groups of polymers. The variety of PU types reaches from flexible and rigid foams over thermoplastic elastomers to adhesives, paints and varnishes. Flexible integral skin foams have found wide application in the automotive industry today as wide-ranging physical characteristics after polymerization. New styling trends, surface design, safety functions and comfort are made possible by these materials. The interior of cars, trucks and public transportation (bus, rail, and airplane) must satisfy functional and passive safety requirement; e.g. crash energy should possibly be absorbed reversibly by the protection padding. Steering wheels manufactured with integral skin foam have found wide application in automotive industry.

This variety is one of the reasons, why the development of cost-efficient recycling methods is very difficult. On the other hand, the production of PUR is rather expensive compared to the mass-produced plastic materials like the polyolefins. This fact is the reason for development of PU recycling methods. Over the last several decades, recycling of polymer waste has been attracting the attention of many polymer scientists. Polymer recycling is very important for at least two main reasons: 1) to reduce the ever increasing volumes of polymers waste produced from any sources such as daily life packaging and materials and, 2) to generate valuable materials from low cost sources by converting them in to some extent similar to virgin materials. While polymer applications are expanded daily, PET is one of the most consumed polymers as its noticeable physical properties in the manufacture of high strength fibers, soft drink bottles and photographic films and its consumption increased to more than 3,000,000 tons per year at the end of the last century. In the polymer recycling industry, there are several recycling methods which have been investigated during much research. Four main approaches have been proposed namely primary or in-plant recycle of the scrap material of controlled history, secondary or mechanical, tertiary or chemical and quaternary or recovery of plastic energy recycling. Glycolysis has recently being applied more often in those favorable cases where a suitable application for the glycolysate has been identified. A lot of research has resulted in several process variations. Some of them include purification and chemical processing of the regenerate before use in polyurethane applications. So the glycolysis of waste PU and PET into raw materials is one of the principle methods for their recycling. Many studies and reviewed literature indicate that proper glycolysis may be used to resolve the disposal problems of wastes and obtain high quality polyols. In order to improve the ability of previous routes and also introducing new methods for PU and PET recycling, Glycol-Amine binary system was selected to be investigated. Several PU or PET based wastes were treated by the chemical system using conventional heat and microwave. The product was used in formulation of PU foams, demonstrating excellent results.



Typical ^{1}H-NMR spectra of PET recyclate.



Gel permeation chromatograms of recycled PET during 4 h of reaction time.

Integral skin foam formulation, properties and reactivity

Foam Components (*pbw*)	S_1	S_2	S_3	S_4	S_5	S_6	S_7
Virgin Polyol (Daltorim® EK 20350)	100	70	70	70	60	50	40
Tertiary Amine Catalyst (Dabco® 33 LV/Teda)	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Pigment (Black Paste)	10	10	10	10	10	10	10
Blowing Agent (CFC 11)	4	4	7	5	5	5	5
Recycled Polyol (Glycolysis Product)	0	30	30	30	40	50	60
MDI Curing Agent (Suprasec® 2082)	40	40	60	65	80	100	120
Free rise density ($kg.m^{-3}$)	188	169.3	-	142.6	124.4	120.1	119.6
Molded density ($kg.m^{-3}$)	209	199.4	-	203.3	208.3	200.7	206.1
Hardness (Shore A)	85±1	87±1	-	93±1	95±1	95±1	94±1
Cream time (sec.)	50	46	-	44	47	42	43
String time (sec.)	88	79	-	72	79	74	77
End of rise (sec.)	107	100	-	93	96	89	93