MODIFIED POLYURETHANES FOR CONSTRUCTION INDUSTRY

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Introduction

Polyurethanes are a type of polymeric materials of great industrial importance, combine such qualities as flexibility, durability, lightness, good thermal insulation, and resistance to abrasion. [1-7].They can be used as adhesives, corrosion resistant coatings, as well as insulating materials for pipes and walls of residential and administrative buildings. They include high molecular compounds containing urethane, amide, urea, ester groups, as well as aromatic and aliphatic radicals.

Quality enhancement of polyurethane materials can be achieved by improving the composition and production technology. Polyurethane compositions are a result of chemical reactions of the two components (A and B) under a strict compliance with the stoichiometric ratio when mixing the components or improving recipes using activators, extenders and modifying additives.

The aim of this work is the application of industrial wastes as active additives in the synthesis of polyurethanes.

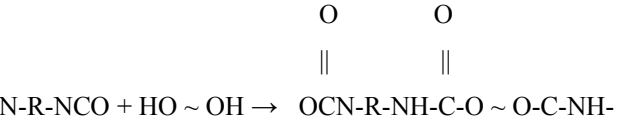
Experimental

We used the ethers and esters, polyalcohol (polyols) - Part A and di-polyisocyanates - component B with various additives - synthetic rubber, metal oxides, waste leather, rubber, secondary polyurethane (PU) and polyvinyl chloride (PVC) and an extension cord chains - the 1,4-butanediol, foaming agents - water and filler "IGRI", activator - polyethylene polyamine - (PEPA).

Obtaining the component A: a simple polyester butanediol, rubber solution, a few drops of water, aluminum oxide were placed in a porcelain cup fitted with a stirrer; obtained composition was thoroughly mixed for 30 min at 60° C, then the catalyst was added and again the composition was mixed for 1-2 min.

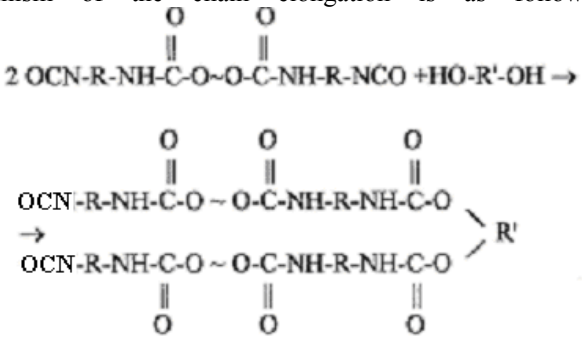
Obtaining the component B: Polyester and diisocyanate at a ratio of 1:2 were thoroughly mixed with a stirrer in a porcelain cup for 1 hour at 60° C. Component B is a pre-polymer. It is a low-molecular compound with urethane groups, which react with compounds containing active hydrogen atoms. Components A and B were mixed in a porcelain dish at 60° C for 5 seconds. The resulting foaming mass was placed under the press with a temperature at 60° C. After 10 min, hardened samples were extracted and left under a room temperature for 24 h.

Physical mechanical testing of samples was carried out in CFL JSC Almaty production and sales shoe association Dzhetysu on a tensile testing machine RT-250. Prepolymer B is obtained by a chemical interaction of diisocyanate with a part of polyester.

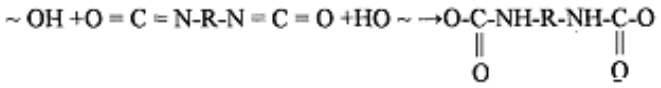


This prepolymer - Component B - further interacts with other agents of polyurethane composition (component A), participating in the reaction of the growth of the polymer chain. Component A contains the remainder of the polyester, chain extender, foaming agent, catalyst, emulsifier, pororegulyator and ink pasta.

We used 1,4 butanediol as an extension chain. Mechanism of the chain elongation is as follows:



Reaction to get polyurethane is as follows:



The reaction rate of synthesis of polyurethanes and the degree of conversion are limited by the processes of activation of the contact surface in the injection molding machines, extruders or injection molding machines.

The selectivity of the process of polycondensation in the synthesis of polyurethanes with different structures was evaluated IR-spectroscopically. Identification of synthesized samples as polyurethanes was done with IR spectroscopy, by characteristic groups of thin films prepared in 2% solutions of formic acid with a UR-20 spectrometer for the full spectrum from 400 to 4000 cm.

Physical and mechanical tests of samples of polyurethanes on Shore A tensile strength and tear, as well as the relative and residual elongation were carried out in the Central Technology Laboratory (CTL) Almaty at Zhetysu company using a tensile testing machine PT-250 in accordance with standard GOST 263-53, 270-64 and 12632.

The strength characteristics of the synthesized polyurethanes and polyurethane foams depending on the nature of ethers and esters, isocyanates, chain extenders and

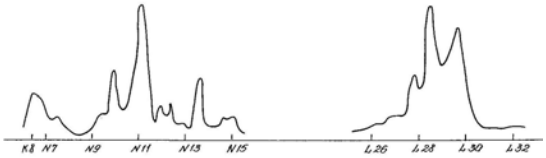
activators, the influence of additives of various wastes, as well as of the foaming agents and catalysts were studied.

Table 1 shows the physical and mechanical properties of the synthesized polyurethanes, including wastes of various industries.

Table 1. Results of the physical mechanical testing of samples for shoe soles

Sample	Sample code	Sample hardness, Shore A, conv. unit	Strength, kg/cm^2		Elongation %, conv. units	
			Gap	tear	relative	residual
1	40	30	3,5	2,0	650	10
2	45	30	4,5	2,5	175	10
3	49	30	3,0	2,0	100	10
4	52	30	2,5	2,5	50	10
5	53	30	1,2	2,0	275	5
6	55	40	4,3	1,35	50	5
7	57	50	4,0	2,0	200	5
8	59	27	10,3	2,5	150	5
9	60	50	5,9	2,5	75	5
10	61	44	1,04	2,4	50	5
11	62	42	21,4	7,0	400	10
12	64	40	6,4	2,5	250	5
13	1	60	76,5	10,0	50,0	5
14	2	55	80	25,0	400	10
	Norm	55-65	65-75	10-15	400-450	10 - 20
	Standard GOST	63-53	270-64	12632	270-64	270-64

Identification of the synthesized polyurethanes was carried out on a UR-20 spectrometer by infrared (IR) spectroscopy of thin films with thickness of 15-25 microns, dissolved in 2% formic acid and dried in vacuum to constant weight. Figure below shows the infrared spectrum of the synthesized polyurethanes.



Found that in ether (Part A) spectra of ether were found at frequencies of 1000-1120 cm^{-1}, amide group at 1370 cm-1, CHs-group - at 2780-2970 cm^{-1}. It is shown that the isocyanate (MDI) (Component B) spectra of CHs groups were found at a frequency of 557 cm-1, diizotsianatnaya group - at 920-1120 cm ', aromatic radicals - at 1530 cm-1 carbonyl group CO - in 1770 cm-1, NCO-isocyanate group - at 2290 cm^{-1}.

As a result, the infrared spectroscopic analysis of the synthesized polyurethanes based on MDI ether and shown that the isocyanate groups formed at 700-900 cm-1 ether group - at 1020-1150 cm^{-1}, and rethane - at 1200-1280 cm-1 , amide group - at 1360 cm-1, aromatic group - at 1520 cm-1, the OH-group - at 1610-1270 cm^{-1}.

Thus, the infrared spectroscopic methods proved the possibility of obtaining polyurethanes.

Promising for further research are areas connected with the use and application of semiproducts of transformation and of deep cracking of oil from various fields in Kazakhstan.

The relevance and actuality of this research is due to the synthesis of polymer resins and naphthenic resins, and unsaturated compounds from the pyrolysis products of oil, gas and natural raw materials, wastes at the following chemical plants: hydrolytic Shymkent, Pavlodar ON Khimprom, Temirtau PO Carbide, "ON" Mangistau MunaiGas "etc.

Conclusions

1. The possibility of obtaining modified polyurethanes for construction industry using industrial waste, such as: rubber crumb, rubber dust, polyurethane, PVC, rubber, wood dust, etc was shown.

2. Wastes of various industries for application as additives were investigated.

3. Synthesized polyurethanes with specified physical and mechanical parameters were obtained.

4. Insulating foams for the construction industry, including industrial waste with a low density of 0,037-0,066 g / cm 3 were obtained, with characteristics surpassing those of the known foams.

5. The infrared spectroscopic methods proved the possibility of obtaining polyurethanes.

References

1. Composite materials based on polyurethanes. Ed. JM Byuista. -M.: Chemistry. 1982. -238 pp.

2. Wright, P., Cumming A. Polyurethane elastomers. - L., Chemistry, 1973. -304 Pp.

3. Abdikarimov M.N., Turgumbaeva R.H, Mynzhanov S.K. Thermal insulation materials based on polyurethane. Proceedings KarPTI, 2003, pp. 214-215.

4. Abdikarimov MN, Mukataev J., Tyulbaev SS Development of technology for polyurethane additives, waste light thoughts. Proceedings of the conference dedicated to 30-year anniversary of the Institute, Almaty, 1996, pp.116-117

5. Abdikarimov M.N. - IR spectroscopic determination of the synthesized polyurethanes - The Sat "National Seminar-Workshop on Analytical Chemistry", Almaty, 1995, 10-11 October, pp. 96

6. Turgumbaeva R.H., Abdikarimov M.N. Investigation of physical and mechanical properties of polymer and composite materials based on modified polyurethanes. In interuniversity collection of proceedings "Chemical processes", Almaty, 1999, pp. 15-19

7. Abdikarimov M.N., Turgumbaeva R. H. Kusainova A. S., Makan, W., Uskembaeva ZK Synthesis of polyurethanes with additives, waste. Synthesis of polyurethanes with additives of waste. - Proceedings of the International scientific-practical conference "Valihanovskie reading - 9", Kokshetau, 2004, p.11-14.