B.Sc. Semester-VI Organic Chemistry Paper-XIV

2. Synthetic Polymers

Coverage: 12. Polyurethanes



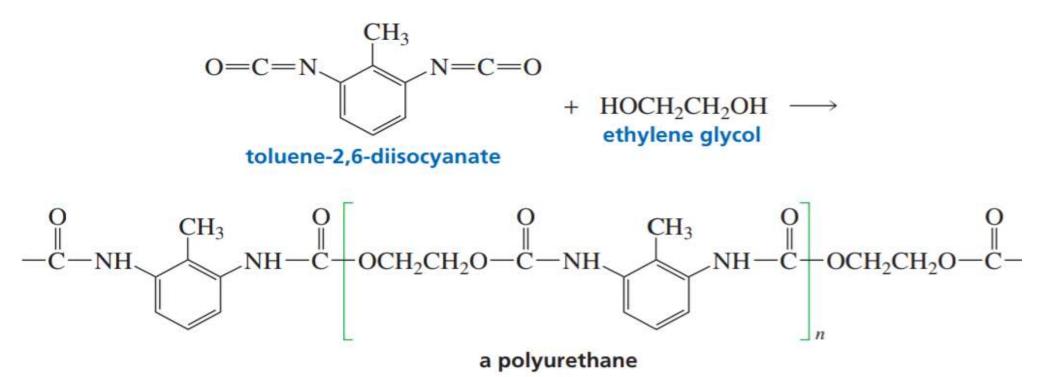
Dr. Rajeev Ranjan University Department of Chemistry Dr. Shyama Prasad Mukherjee University, Ranchi

12. Polyurethanes

A **urethane**—also called a carbamate—is a compound that has an OR group and an NHR group bonded to the same carbonyl carbon. Urethanes can be prepared by treating an isocyanate with an alcohol.



Polyurethanes are polymers that contain urethane groups. One of the most common polyurethanes is prepared by the polymerization of toluene-2,6-diisocyanate and ethylene glycol. If the reaction is carried out in the presence of a blowing agent, the product is a polyurethane foam. Blowing agents are gases such as nitrogen or carbon dioxide. At one time, chlorofluorocarbons—low-boiling liquids that vaporize on heating—were used, but they have been banned for environmental reasons Polyurethane foams are used for furniture stuffing, carpet backings, and insulation. Notice that polyurethanes prepared from diisocyanates and diols are the only step-growth polymers that we have seen in which a small molecule is *not* lost during polymerization.



Dr. Rajeev Ranjan

Polyurethanes

One of the most important uses of polyurethanes is in fabrics with elastic properties, such as spandex (Lycra[®]). These materials are block copolymers in which some of the polymer segments are polyurethanes, some are polyesters, and some are polyamides. The blocks of polyurethane are soft, amorphous segments that become crystalline on stretching When the tension is released, they revert to the amorphous state.

Polyurethane foams for upholstery and insulating materials are made by adding small amounts of water during polymerization. Water reacts with isocyanate groups to produce gaseous carbon dioxide, which then acts as the foaming agent.

$$RN = C = O + H_2O \longrightarrow \begin{bmatrix} O \\ RNH - C - OH \end{bmatrix} \longrightarrow RNH_2 + CO_2$$

An isocyanate A carbamic acid (unstable)

Polyurethane is an incredibly resilient, flexible, and durable manufactured material that can take the place of paint, cotton, rubber, metal, and wood in thousands of applications across all fields.

Polyurethane might be hard, like fiberglass, squishy like upholstery foam, protective like varnish, bouncy like rubber wheels, or sticky like glue.

FORM	USES
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Fibers	swimsuits, stretch undergarments
Elastomers	small wheels, heel lifts
Foams	pillows, cushions, clothing insulation
Coatings	dance floors, synthetic varnish
Molded objects	bowling balls, artificial hearts
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