UPJOHN CHEMICAL DIVISION

Upjohn

PRECAUTIONS
FOR THE PROPER USAGE
OF POLYURETHANES, POLYISOCYANURATES
AND RELATED MATERIALS

TECHNICAL
BULLETIN 107

by carelessly dropped cigarettes, ease of ignition may be a more important consideration in protecting the careless smoker than behavior of the material in an already established fire. Flexible polyurethane foams used in seat cushions and mattresses melt and flash-ignite at about 600-650°F. Autoignition occurs at about 750-800°F. Fabric covering containing flammability-retarding agent may protect flexible foam used in clothing innerlining, mattresses and seat cushions from ignition by low-energy heat sources, but offers no protection to the foam in a large-scale established fire wherein the foam melts, and vapors rising from the liquid material ignite.

Thermal Degradation Products

6.107 Since polyurethanes and related products do burn, concern has been expressed over the possible toxicity hazards of their thermal decomposition products. Numerous studies have been conducted to qualitatively and quantitatively determine the degree of hazard related to these products.

6.108 **Combustion or thermal degradation of polyurethane plastics results in a complex mixture of gases, smoke and solid residues (ash),** the overall composition of which depends primarily upon the chemical makeup of the urethane, availability of oxygen and temperature during exposure. This behavior is not unique to polyurethanes; it is universally true for any combustible material in a fire environment. For example, the National Commission on Fire Prevention and Control has reported[19] "A single material can give off many different products of combustion under varying conditions of temperature, humidity, pressure and other factors; burning cellulose, for example, can produce 96 compounds." (Cotton is almost pure cellulose.)

6.109 **Thermal decomposition of polyurethanes at temperatures below the ignition point results in generation of isocyanate vapors and other irritating volatile products.** Since there are temperature gradients within any fire, these same products may also be generated by burning urethane, particularly if the fire has limited oxygen access.

6.110 **Generally, the combustion products of urethane plastics in a clean, hot fire with adequate oxygen availability are carbon dioxide, water vapor, and varying quantities of nitrogen oxides, carbon, carbon monoxide and traces of hydrogen cyanide. If the urethane contains fire-retardant agents, corrosive, acidic vapors are also produced.**

6.111 Several investigators have reported[20,21,22,23,24,25] on concentrations of smoke, carbon monoxide, hydrogen cyanide and hydrochloric acid generated by thermal degradation of urethane plastics under various laboratory fire conditions. Concentrations of these gases vary considerably and depend primarily upon the type of urethane (flexible, rigid, blowing agent, etc.) and upon conditions of exposure.

6.112 **Recent work at the National Research Council of Canada, Division of Building Research,[25] on toxicity of gases produced by burning a number of common materials indicates that, on the basis of a proposed toxicity index which takes into account the major toxic products formed, burning a rigid polyurethane foam creates essentially the same toxicity hazard as burning white pine, approximately one-third that of urea-formaldehyde foam, one-fourth that of wool, one-fifth that of nylon and one-twelfth that of acrylic fiber. This and similar work indicates that polyurethanes DO NOT INCREASE the pre-existing toxicity hazard in an established fire to any appreciable extent.**