

(13)

- 1 -

METHOD OF PRODUCING HIGH DENSITY FLEXIBLE PU FOAM

5 This invention relates to a method of producing
a high density and resilient flexible polyurethane
foam.

 Polyurethane foam is generally formed by the
reaction of isocyanate with a polymer having a
10 hydroxyl group or carboxyl group. This polymer can
be polyester or polyether, which is generally called
polyol. During the reaction, the gas generated, such
as carbon dioxide, causes the reaction mixture to
swell into the form of foam. In the case of a
15 polymer with a hydroxyl group, to liberate carbon
dioxide some free water must be contained in the
reaction mixture. In some cases, halocarbon is
added as a blowing agent. In these reactions, other
chemicals, such as a catalyst surfactant, are also
20 used. It is important that the reaction mixture must
be rapidly and sufficiently mixed.

 The polyurethane foams are divided into flexible
foam, semi-rigid foam and rigid foam. The flexible
foam is easy to deform under load and can recover

from deformation upon removal of load. There are generally two processes for producing flexible polyurethane foam: a one shot process and a prepolymer process. The former process is done by mixing the properly formulated polyol, isocyanate, catalyst, blowing agent and then poured into the mold. In the prepolymer process, polyol is firstly mixed with isocyanate to form a prepolymer which has terminal isocyanate group and is stable for storage. When this prepolymer reacts with a blowing agent such as water in the presence of a catalyst a polyurethane foam product can be obtained.

The polyurethane foams produced by the processes as described above are flexible foams and the density thereof is 18-30kg/m³. These are low density flexible foams and have poor resilience and load characteristic so that they are mostly used as packing and rubbing materials. However, it is found that a higher density polyurethane foam has better mechanical properties, resilience, comfort and air permeability and can be used in shoe soles, hat liners and others where a better load characteristic is required.

The higher density flexible foam can be produced under high molding pressure. This method is costly

and the formed foam has a layer of skin surface that causes poor air permeability. Although there are other high density foams made from other polymers, their comfort characteristics are not as satisfactory as polyurethane foam.

5

In accordance with the invention there is provided a method for manufacturing a high density polyurethane foam comprising : pulverizing waste polyurethane foam to a particle size of 0.5 mm to 3 mm, drying the pulverized polyurethane foam, mixing the dried foam with polyurethane forming composition which includes a polyol and a diisocyanate compound, allowing the mixture to foam in a mold and mechanically compressing the foamed body to achieve a predetermined volume. As waste polyurethane foam is reused by this process, this is not only economical but also can save the energy supply for treatment of waste foam.

10

15

The pulverized foam powder should be sufficiently dried before mixing with the polyurethane-forming composition so that these powders can be completely soaked in the viscous mixture. To obtain a uniform size distribution of powder, the pulverized powder can be screened before mixing.

20

25

The polyurethane-forming composition may include

polyol, diisocyanate, a catalyst and additives. The mixture is formulated with a proper ratio and thoroughly mixed with a suitable amount of pulverized foam. The cured foam is found, upon testing, that its density, resilience and load characteristic are higher than those produced by any known process as described above.

An object of the invention is to provide a method of making a higher density flexible polyurethane foam from waste polyurethane foam.

Another object of the invention is to provide a method of re-using waste polyurethane foam, thereby saving the production cost and the energy supply for treatment of waste polyurethane foam that can cause air pollution in the environment.

The following example is presented in illustration of the process of this invention and is not intended as an undue limitation on the generally broad scope thereof.

About 100gm of waste polyurethane foam is ground into a powder form until the particle size thereof is 0.5mm - 3.0mm. The powder is then placed in a drying apparatus for drying. After drying the powdered substance is subjected to screening to get a uniform size distribution. The screened powder is

(17)

- 5 -

then put into a mixer into which 25gm of Voranol 3800 polyol, 12.5gm of TDI, about 0.32gm of silicone and Tin-9 are further added. ("Voranol" is a Registered Trademark).

5 After mixing for 30 minutes, the reaction mixture is poured into the mold. At that time, the powder is completely soaked in the reaction mixture and uniformly incorporated with the formed foam which swells to a volume as large as five times. This
10 expanded foam in the mold is then compressed mechanically and cooled at room temperature for 24 hours. The cast foam is finally released from the mold after cooling. This foam is a higher flexible polyurethane foam and test data for this foam is
15 given as follows :-

	1.	Density of PU foam	0.178g/cm ³
	2.	Hardness (ASKER TYPE C)	37
	3.	Tensile Strength	3.0kg/cm ²
	4.	Elongation	65%
20	5.	Influence of Heating	No stickiness & crack
	6.	Decrease in Elongation	-8%
	7.	Decrease in Tensile	
		Strength	-7%
	8.	Air Permeability	200 l/m ² sec.

9. Water Vapour Transmission

Rate 3036

(g/m²/40°C, Above 90% RH/24hrs)

(19)



- 7 -

CLAIMS

1. A method for manufacturing a high density polyurethane foam comprising : pulverizing waste
5 polyurethane foam to a particle size of 0.5 mm to 3 mm, drying the pulverized polyurethane foam, mixing the dried foam with polyurethane forming composition which includes a polyol and a diisocyanate compound, allowing the mixture to foam in a mold and
10 mechanically compressing the foamed body to achieve a predetermined volume.
2. A method as claimed in Claim 1, wherein the polyurethane-forming composition consists essentially of polyol, diisocyanate, a catalyst and additives.
- 15 3. A method as claimed in either one of the preceding claims, further comprising the step of screening the pulverized polyurethane foam before mixing.
4. A method as claimed in claim 1 of making a
20 polyurethane foam substantially as hereinbefore described.
5. A polyurethane foam when manufactured by a method as claimed in claim 1, substantially as hereinbefore described.