

1

3,558,417

WATER-REPELLANT RESINOUS FOAM

Ival O. Salyer, James L. Schwendeman, and Charles E. McClung, Dayton, Ohio, assignors to Monsanto Research Corporation, St. Louis, Mo., a corporation of Delaware

No Drawing. Filed Feb. 14, 1968, Ser. No. 705,312

Int. Cl. B32b 7/00; B44d 1/08, 1/94

U.S. Cl. 161-160

4 Claims

ABSTRACT OF THE DISCLOSURE

A buoyant member for a collapsible buoyant device, comprising (1) an inner open-cell flexible resinous foam surface-coated with a compound selected from the group consisting of stearic acid, lead stearate, and zinc stearate and (2) an outer water-impermeable membrane.

The invention herein described was made in the course of or under a contract or subcontract thereunder, with the Department of Navy.

BACKGROUND OF THE INVENTION

This invention pertains to a foamed synthetic resin which has been surface-treated to render it water-repellant and compression-set-resistant, and more particularly to an open-cell flexible urethane foam treated with stearic acid, lead stearate, or zinc stearate. It further pertains to an improvement in a life raft wherein the buoyant member is collapsible and resistant to compression set at moderately elevated temperatures.

For certain applications such as floats, buoys, life rafts, life preservers, etc., open-cell flexible resinous foams have inherent advantages of flexibility, compactibility, lightness, buoyancy, etc. For such uses they may be enclosed in water-impermeable covers such as rubberized fabric. One disadvantage is that their open-cell structure is permeable to liquids and they may quickly become water-logged if the outer cover is torn. A further disadvantage is that, although they are easily compactible by compression and folding, they may develop compression set if stored at moderately elevated temperatures, say 60-80° C. (140-180° F.)

Life rafts utilizing a buoyant member, such as a flotation tube, are well-known (e.g., the PK-2 raft of Specification MIL-I-8664A(Aer)). In the past the flotation tube has been filled with a gas when the raft was deployed.

SUMMARY OF THE INVENTION

An object of this invention is to provide a water-repellant, compression-set-resistant open cell flexible urethane foam. Another object is to provide a buoyant member for a collapsible life raft, utilizing water-repellant, compression-set-resistant open cell flexible urethane foam.

These and other objects hereinafter defined are met by the invention wherein there is provided a composition comprising an open-cell flexible resinous foam surface-coated with a compound selected from the group consisting of stearic acid, lead stearate, and zinc stearate.

Although the invention is directed particularly to urethane foams, it encompasses any other flexible resinous foams. Thus, foams of rubber, cellulose acetate, polyvinyl chloride, styrene-butadiene copolymers, etc., may be used in combination with stearic acid or zinc stearate. For optimum water-repellancy it is preferred that the pore size of the foam be smaller than about 1 mm.

The process for surface-treating the foam is simply to coat the foam with a solution or suspension of stearic acid, lead stearate, or zinc stearate in a low-boiling organic liquid and evaporate off the liquid. To avoid dusting prob-

2

lems the coating may be heated above the melting point of the stearic acid (melting point 69° C.), lead stearate (melting point 115° C.) or zinc stearate (melting point 130° C.). The add-on of the coating may be in the range of 3 to 30% by weight of the foam, but preferably 5 to 20%. Other methods of application include dusting the powdered additive over the surface, followed by a melting step to cause adherence; or immersion of the foam in molten additive.

The treated foam is both water-repellant and compression-set-resistant. It may be collapsed and stored for many days, even at moderately high temperatures where compression set would normally be objectionable within a few days, thereafter quickly and positively snapping back to its full extended shape when released. It is water-repellant and resists the normal capillary flow of water through its porous structure.

In utilizing the surface-treated foam in a life raft, the surface-coated foam serves as the inner part of a buoyant member as flotation tube. It is preferably enclosed in an outer thin, low-density, water-impermeable, flexible membrane, e.g., a barrier such as a film, or coated or rubberized cloth. To allow compressing and expanding, the cover may contain air vents which are closable or sealable. The buoyant member may encircle a circular or somewhat elliptical shaped area and may be provided with a floor consisting of a water-impermeable flexible fabric. The entire assembly may be collapsed into a relatively small volume for storage, from which it is readily deployed into full volume for use.

The surface-coated foam may also be used in floats, buoys, life preservers, buoyant vests, buoyant jackets, etc.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention is further illustrated by, but not limited to, the following examples.

Example 1

This example illustrates the block foam test for water-proofing.

Blocks of urethane open-cell foam measuring 2 in. x 4 in. x 8 in. were cut from larger blocks. The properties of the foam were as follows:

Density (lb./cu. ft.)	1.59
Tensile strength (p.s.i.)	10.0
Elongation (percent)	175.0
Compression set (percent) at 90% compression	15.0
Cell size (cells/linear inch)	50-60
Open cells (percent)	90-95

Block No. 1 was left untreated for a control. Block No. 2 was treated with a coating of stearic acid by saturating the foam with a 5% by weight solution of stearic acid in hexane and allowing the hexane to evaporate. The add-on was estimated to be about 5.0%. Block No. 3 was treated with a coating of zinc stearate by spraying with a zinc stearate dry powder mold release spray. The add-on was estimated to be about 5.0%.

A comparison of the effectiveness in water-proofing was made by floating the blocks on calm water. The depth of foam immersion was noted after 21 days as follows: No. 1, 1.5 inch; No. 2, none; No. 3, none.

Example 2

This example illustrates the 1/3-scale model life raft test.

A model raft was constructed to one-third linear scale of the Navy PK-2 life raft (MIL-I-8664A(Aer)). The full-size raft is approximately 3' wide x 5' long in size. A nylon base cloth or bottom cloth was used for the

3

floor as specified in MIL-C-21109. An encircling buoyant tube fabricated from nylon fabric, Specification MIL-C-6819, served as a gunwale. Inside the tube was a core of open-cell flexible urethane form having the properties tabulated in Example 1. All joints and laps of the fabric were sealed with cement, Specification MIL-C-5539.

Prior to closure within the buoyant tube, the urethane foam was surface-coated with zinc stearate by saturating with a 5% by weight suspension of zinc stearate in hexane, and the hexane removed by evaporation. The add-on of zinc stearate was about 15%.

The model raft floated easily in water and was capable of supporting a 10 lb. weight even when the raft was filled with water to its topsides. The 10 lb. load is equivalent to a 270 lb. load on the full-size raft.

To test the buoyancy of the raft when the outer fabric was torn, a cut was made 1½ inches in length on the bottom side of the buoyant tube. This permitted water to enter the foam-filled buoyancy chamber. To further simulate service conditions, the water on which the raft floated was agitated as short choppy waves. Under these conditions the raft and 10 lb. load remained afloat for the duration of the test (11 days).

By comparison, a model raft which contained untreated urethane foam in the buoyant tube sank within several hours after a 1½ inch cut was made on the bottom side of the buoyant tube.

Example 3

This example illustrates the effect of zinc stearate on compression set.

The method of test was by ASTM D395-61, Method B, "Compression Set Under Constant Deflection." Compression set is defined as percentage of the original deflection and is expressed by the formula

$$C = \frac{t_0 - t_1}{t_0 - t_s} \times 100$$

where:

C=compression set

t_0 =original thickness

t_1 =thickness after removal from clamp

t_s =thickness of spacer bar in clamp

Blocks of open-cell flexible polyurethane foam having the properties tabulated in Example 1 were cut, measuring 2 in. x 4 in. x 4 in. Block No. 1 was tested with no surface treatment. Block No. 2 was treated with a surface coating of zinc stearate by the procedure of Example 2. The

4

estimated add-on was about 5.0%. Each block was compressed by clamps to 10% of its original height, i.e., to 0.2 inch. It was then stored at 71° C. (160° F.) for 56 days under compression. At the end of this time the clamps were removed and the height measured (a) immediately upon release and (b) after 1 hour. Results for the two blocks are summarized in the following table:

COMPRESSION SET (PERCENT)		
	Measured immediately	Measured after 1 hr.
Untreated foam.....	95	95
Zinc stearate treated foam.....	22	17

It is to be understood that although the invention has been described with specific reference to particular embodiments thereof, it is not to be so limited since changes and alterations therein may be made which are within the full intended scope of this invention as defined by the appended claims.

What we claim is:

1. A composition comprising an open-cell flexible resinous foam surface-coated with a compound selected from the group consisting of stearic acid, lead stearate, and zinc stearate.

2. The composition of claim 1 in which the resinous foam is urethane foam.

3. In a collapsible buoyant device, a buoyant member comprising:

(1) an inner open-cell flexible resinous foam surface-coated with a compound selected from the group consisting of stearic acid, lead stearate, and zinc stearate and

(2) an outer water-impermeable membrane.

4. In a collapsible life raft, a buoyant member comprising an inner open-cell flexible urethane foam surface-coated with a compound selected from the group consisting of stearic acid, lead stearate, and zinc stearate and an outer covering of water-impermeable barrier.

References Cited

UNITED STATES PATENTS

2,642,920 6/1953 Simon et al. 161—190

WILLIAM J. VAN BALEN, Primary Examiner

U.S. Cl. X.R.

9—6, 11; 117—138.8, 167; 161—164, 190, 411; 260—2.5