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3,810,841

**SOAP IMPREGNATED RESILIENT
POLYURETHANE FOAMS**

Ferdinand Joseph Richter, Danbury, Conn., assignor to American Cyanamid Company, Stamford, Conn.
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1 Claim

ABSTRACT OF THE DISCLOSURE

Flexible polyurethane sponges, having a dry bland soap integrally incorporated therein, are provided by forming and foaming a mixture comprising a polyester with a hydroxyl number of 40 to 80, a molecular weight of 2,000 to 6,000 and a carboxy number of less than 1.5; an aromatic diisocyanate; water; a basic catalyst; and finely divided and intimately mixed bland soap with or without an effective amount of a germicide in an amount equal to 25 to 110% of the combined weight of the polyester and the diisocyanate to thereby form a sponge having from 60 to 100 pores per inch and the soap evenly distributed therethrough, in a finely subdivided state.

CROSS-REFERENCES

This application is a continuation-in-part of Ser. No. 879,564, filed Nov. 24, 1969, now abandoned in favor hereof.

FIELD OF INVENTION

This invention relates to foamed polyurethane impregnated with a dry bland soap and to methods of preparing the same. It relates further to surgical scrub sponges and the new means of obtaining the same.

BACKGROUND OF INVENTION

The ever-widening demand for "convenience" products, coupled with technological advances in the plastics field and in the manufacture of reasonably durable and economical sponges, has led to the commercial availability of disposable sponges impregnated with functional impregnants. These sponges function both as sponges and as the source for the cleansing agent which cleansing agent would otherwise have been obtained from a separate source, such as a container or a cake of soap. The user is thus required to bring only an impregnated sponge, and not both a sponge and the active agent, to the job. The convenience of these impregnated sponges is an important enough reason for their commercial sale, but there are other major reasons.

The problem of eliminating bacteria and other microorganisms from the skin of a surgeon's hands or the hands of a sterile nurse is a very serious one. It is standard hospital practice for operating room personnel to scrub their hands and forearms intensively before putting on sterile rubber gloves. Traditionally, the scrub has been with a scrub brush and an anti-bacterial soap, the most common of which is one containing 2,2'-dihydroxy-3,5,6-3',5',6'-hexachlorodiphenylmethane, often called "hexachlorophene." Other germicidal agents such as the "iodophors" have been used to great advantage in surgical scrubs. While the germicidal agents are quite effective, there is a serious problem of contamination because the soap dispensers cannot be maintained sterile even though the dispensers are cleaned and autoclaved once a day, which is the procedure in the best hospitals. By the use of sterile wrapped disposable sponges containing the germicidal cleansing agent, the problem of cross-contamination from the soap dispenser is completely avoided. Thus, in

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addition to the convenience which a pre-packaged germicide-impregnated disposable sponge provides, there is also the advantage of the elimination of the problem of cross-contamination from the otherwise necessary soap dispenser.

There are available at the present time sponges which are impregnated with materials such as detergents, germicides and/or soaps which are prepared by a wide variety of methods. The most usual method for impregnating the sponge is to dissolve and/or disperse the selected impregnant in a liquid medium, most usually water, and thereafter soak the sponge in the solution or dispersion. The liquid is then evaporated from the sponge to leave the impregnant deposited throughout the sponge.

Another method of adding a powdered cleansing agent to the sponge is shown in U.S. Pat. 3,619,843, Richter and Messer, Nov. 16, 1971, "Sponges With Dry Impregnants." Here spikes and gas flow methods are used.

Sponge materials which are most widely used are synthetic in origin. Natural sponges are not in sufficient supply to fill all the modern-day needs for sponges. Moreover, natural sponges cannot be "manufactured" to have desired degrees of porosity, texture and uniformity required in modern-day applications. Commonly, synthetic sponges are prepared from regenerated cellulose or expanded polyurethanes. Other expanded polymers such as polyethylene, polyacrylate and polyvinyl acetate, have also been used for sponge applications.

Since the liquid or dry impregnating method has severe limitations, it is highly desirable to have a process whereby sponges are impregnated without the need to use liquid dispersing media for the purpose of carrying the impregnant into the sponge structure or adding a powder to the foamed sponge.

It is one of the objects of the present invention to provide a method whereby sponges can be impregnated without the need of dissolving or dispersing the impregnant in large quantities of water.

It is a further object of the present invention to provide impregnated sponges which can be stored for long periods of time without deterioration of either the sponge material or the cleansing agent. It is a still further object of the present invention to provide means for impregnating a sponge material with a dry cleansing agent whereby the cleansing agent is evenly distributed throughout the sponge and is retained therein without loss due to leakage of the impregnant from the cellular structure of the sponge.

Still more particularly, it is an object of the present invention to provide a polyurethane surgical scrub sponge which is capable of being stored for long periods of time without deterioration of either the cleansing agent or the sponge material.

Further objects will be apparent from the ensuing description of this invention.

THE PRESENT INVENTION

The present invention accomplishes these and other objects in a surprisingly simple and efficient manner. In accordance with this invention polyurethane foams having a dry bland soap powder integrally and internally incorporated therein are easily and efficiently made. The said soap intimately dispersed in the polyester resin which eventually is reacted with diisocyanate to produce the polyurethane foam. As the polymer-forming materials in the reaction mixture react with each other the result is the production of sponge material and the distribution of the said soap therein. Thus, by the present invention one obtains an impregnated sponge with little more difficulty than is involved in obtaining an unimpregnated sponge as can be understood from the fact that the steps of sponge formation and cleansing agent incorporation are simultaneously accomplished. The polyurethane sponges

of the present invention are completely distinct from sponges prepared by the after-impregnation of sponge material.

They are also distinguished from polyurethane sponges in which a chemically combined portion of the polyurethane molecule functions as a surfactant. The sponges of the present invention contain large quantities of the said soap cleansing agent (at least 25 weight percent based on the weight of the polyurethane itself). The said soap is not chemically combined as part of the polyurethane molecule, but is an integral part of the physical structure of the sponge and not merely occluded within the open cells of the sponge structure.

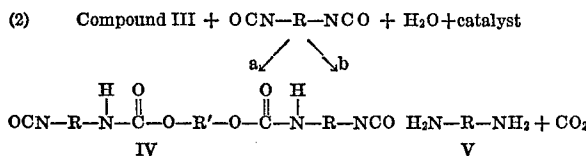
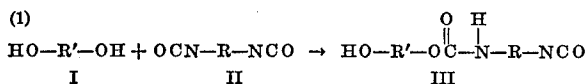
The type of polyurethanes which can be used for the sponges of the present invention, the process by which they can be made, the variety of cleansing agents which can be employed and the character of the "impregnated" sponges provided by the present invention are described in greater detail below.

Polyurethane foams

In order to achieve the primary object of the present invention which is to provide sponges with a high proportion of cleansing agent it is necessary to choose as the foam-producing materials those having a capacity to form cellular bodies in the presence of large quantities of materials not entering into the foam-producing reaction. In some instances the polyurethane forming materials are incapable of efficiently forming cellular bodies in the presence of high quantities of the cleansing agent. In other instances the distribution of the cleansing agent into the foam-producing mixture results in such an increase in viscosity of the mixture that the mixture is practically unworkable in conventional processing equipment. Thus, the choice of the foam-forming materials must take into account the unusually high loading factor imposed upon it by the presence of up to nearly equal weights of a cleansing agent.

Polyurethane foams are formed by the reaction of a dihydroxy compound and a diisocyanate in the presence of a basic catalyst and water. Generally, the reaction is carried out stepwise. A dihydroxy compound is reacted with an equivalent quantity of a diisocyanate to give a reaction product which is a mixture of polymeric molecules having both hydroxy and isocyanato terminal groups. The polymeric material is then reacted with excess diisocyanate in the presence of a basic catalyst and water. The latter reaction leads to the formation of the desired polyurethane molecules and also, by reaction with water, to the generation of the foam-producing gas (i.e. carbon dioxide).

These reactions are illustrated by the following equations:



In the foregoing equations R' is the radical of a polyester and R is an aliphatic or aromatic radical corresponding to the diisocyanate used as starting material. The same reactions have been employed prior to the present invention to prepare foamed polyurethanes, the distinction in the present invention being in the polyesters used in the reaction of Equation 1. Those which are useful in the present invention should have an hydroxyl value in the range of 40 to 80, preferably 50-52, an acid number of less than 2.0, preferably below 1.5 and they should be the reaction product of a dibasic acid free of

ethylenic unsaturation with an excess of at least one polyhydric alcohol. The polyhydric component is normally comprised of a mixture of a major portion of glycol and a trihydric alcohol. Suitable glycols are alkylene glycols in which the alkyl moiety has 2-4 carbons such as ethylene glycol, propylene glycol, trimethylene glycol, tetramethylene glycol, 1,3-butylene glycol, diethylene glycol, dipropylene glycol, polyethylene glycol and the like. Suitable trihydric alcohols are glycerol and trimethylolpropane.

Particularly suitable polyurethanes are obtained from polyesters having a molecular weight of 2,500 to 2,800 derived from an aliphatic dibasic carboxylic acid of 4 to 6 carbon atoms and a glycol of 2 to 4 carbon atoms. Reaction of a polyester of this type, e.g., poly(ethylene adipate) or poly(butylene adipate) with an aromatic diisocyanate such as toluene diisocyanate or methylene bis(4-phenylisocyanate).

The present invention contemplates the use of laminated sponges of polyester-based polyurethanes, such as those having a relatively thick central layer of fine pore material covered on either side by a thin layer of relatively coarse sponge material. The thicker layer, having at least about 60 pores to the inch acts as a reservoir for the cleansing agent. The coarse outer layers, one layer optionally being considerably coarser than the other, have generally 10-20 pores per inch. If layers of different coarseness are used, one layer can have about 10 pores per inch and the other may have about 20 pores per inch. The coarser layer is useful for removing greater amounts of dirt and the less coarse material is useful for scrubbing skin surfaces, where the surfaces are delicate or less heavily soiled. The coarse layers may be formed from sponge material which is nonreticulated or has a lower degree of reticulation. One layer needs to be reticulated to provide a passage for water into the central part of the sponge and for egress of the water and the cleansing agent. The fine pore central portion of the sponge has open pores to thereby permit contact between the cleansing agent and the water used in connection with the cleaning operation.

Process for preparing impregnated sponges

In general the process of the present invention involves the formation of a mixture comprising the polyurethane-forming materials and the cleansing agent. The mixture upon being subjected to conditions which lead to the formation of the polyurethane foam yields in one step an impregnated foam material. Since the impregnated sponges as provided by the present invention contain large amounts of the cleansing agent it is critical that the foam-forming material possess the proper viscosity whereby even in admixture with the functional additive it is not so viscous as to be unworkable. Moreover, the foam-forming materials must be capable of foaming in the presence of large amounts of inert materials.

In general, the process of the present invention involves bringing a mixture of a hydroxy terminated polyester and a surfactant into reactive contact with a diisocyanate, water and a catalyst. Thus the surfactant should be added to the polyester component before it is mixed with the other reactants. It is important that the materials which are to be used in forming the polyurethane foam are intimately blended prior to commencement of the foam-forming reaction by heavy shear, such as in a 3 roller paint mill or mortar and pestle. The precise means of blending materials will be determined by the physical state of the impregnated material. Thus, where the impregnant is a liquid which will not increase the viscosity of the foam producing materials it can be admixed with a viscous polyester component prior to addition of the other components. When the impregnant is a solid material which may increase the viscosity, it is better practice to add the impregnant to the less viscous polyester resin so that it does not interfere with the proper blending of all

the other materials of the foam-producing reaction mixture.

The reaction between the diisocyanate and the polyester is catalyzed by basic materials such as N-methyl-morpholine, triethylamine, dimethylethanolamine, N-(2-hydroxypropyl)dimethylmorpholine or dimethylformamide.

The water which enters the foaming reaction may be supplied through the addition of water or a water-releasing reagent such as hydrated salt, e.g., magnesium sulfate hepta-hydrate, to the reaction mixture.

In addition to the above mentioned essential components of the foam-producing reaction mixture, there may be present other materials such as emulsifiers and dispersants to aid in homogeneously blending the materials in the reaction mixture whereby the polyurethane product has a cellular structure of desirable physical characteristics and the cleansing agent is evenly incorporated throughout.

A foam-producing formulation which is satisfactory for the objectives of the present invention will contain polyester, a suitable diisocyanate, a water releasing reagent a catalyst, the cleansing agent and, optionally, an emulsifier. The cleansing agent should constitute at least 25% by weight of the combination of polyester and the diisocyanate. Preferably, the cleansing agent will be present in an amount equal to about 90 to about 110% of the weight of the combination of these materials, for maximizing sudsing duration.

The foam-producing reactions proceed with the formation of gas for foaming the mixture. Advantageously, the reaction proceeds at room temperature. Sometimes it is desirable to control the rate of reaction by chilling; but it can also be promoted by the application of mild heat. The reaction is optionally conducted in a mold so that as the mixture expands, it is formed into the desired shape. From the reaction exotherm, reaction temperatures in large masses reach the range of 100–200° C.; foaming is generally completed in under two hours, after which time the foam can then be removed from the mold and used as desired. An alternative preferred method is to cast the reaction mixture onto a moving belt directly from the mixing head. The mixture distributes itself across the width of the belt and expands as the gas is formed. The resultant foam has a noncellular surface covering when the foaming takes place in the open atmosphere, which surface is usually discarded. The sponge produced is cut to size and shape, by conventional methods. In small laboratory sized batches, an oven can be used to simulate similar curing agents.

Impregnating materials

The present invention contemplates the preparation of polyurethane foams impregnated with any of a wide variety of cleansing agents. The impregnant should be chemically inert to the sponge and it should not interfere with the reaction required to produce the foam. The sponges thus may have cleansing agents and other agents (e.g., abrasives) or germicides which it may be desired to use in combination with sponges.

The abrasives can be such materials as pumice, kaolin, chromium oxide, iron oxide and the like. Detergents which can be dispersed in the polyurethane foam including alkyl-aryl sulfonates, the fatty acid sulfates, and the polyalkylene oxides in combination with a fatty acid soap to provide lathering action.

The present invention is particularly useful for the preparation of polyurethane sponges impregnated with a germicidal cleansing agent for either home or hospital use. Such preferred germicidally active sponges contain a bland neutral soap, preferably a high grade toilet soap; a detergent which may be of the nonionic, cationic, or anionic type; and optionally a sequestering agent such as tetrasodium ethylene-diamine tetraacetic acid. The combination of the detergent, the soap and the sequestering agent provides excellent cleansing action without being

too harsh on the skin as would be the case if only detergent were used. In addition, preferred germicidal compositions should contain a dry emollient to help replace skin oil removed during the scrubbing process and help solubilize the germicidal agent. Among such dry emollients are ethoxylated lanolin and high molecular weight polyethylene glycols.

A bland neutral soap refers to a reaction product of a caustic such as sodium hydroxide or sodium carbonate and a fatty acid, or mixture of fatty acids, such as in palm oil, or olive oil or tallow, containing palmitic acid, stearic acid, lauric acid etc. in which the proportions are such that essentially all of the caustic is reacted with a fatty acid, so that no free alkali remains, and which has a pH of about 7 to about 11, when dissolved in water, depending on the soap concentration and the quality of water. In distilled water, a 1% solution typically has a pH of 10.1 at 25° C. for a typical such soap (Dial soap powder). In tap water, the pH measured 7.4 for tap water at Pearl River, N.Y. The pH varies depending on the amount of CO₂ and other materials in the tap water—and can vary from day to day in a given location.

An essential feature is that the dispersed particles of said soap be sufficiently finely dispersed that a single particle of maximum size be smaller than the strands forming the reticular cell wall structure of the open pore polyurethane foam. U.S. Pat. 3,171,820, Volz, "Reticulated Polyurethane Foams and Process for Their Production" shows methods of preparing open foams, in which the cell walls have open areas to allow liquids to pass through readily.

Here cleansing agent, such as the dry bland soap, which may contain a bactericidal agent, is incorporated into the cell wall structure. If a cleansing agent particle is large enough to be a major portion of the cross section of an interconnecting strand, the strand is weakened, and a large number of weakened strands weakens the sponge structure. A few percent of weakened strands is acceptable.

Here the cleansing agent particles are much smaller than the diameter of the interconnecting strands, and the sponge maintains strength and integrity even if the loading is from 25 to 110 percent of the polyurethane foam weight.

Additionally, some of the cleansing agent particles are totally covered, which delays the release rate to further assure that the rate of cleansing agent release is such that the sponges deliver a sudsing foam during a 10 minute surgical scrub.

With surgical scrub sponges, the individual strands are conveniently of a diameter in the order of 50 to 250 microns, and with cleansing agent particles below 50 microns, and predominantly in the 5 to 20 micron size, adequate strength is retained even after the cleansing agent is exhausted.

The dry bland soap forming the cleansing agent is dispersed in the polyester component by high shear techniques. Such include, but are not limited to the use of a 3-roller paint mill, on a larger scale, or a mortar and pestle on a small scale. The polyester is very viscous, and requires a powerful high shear system, such as a 3-roller paint mill to grind and intimately admix the composition. The dry soap is best milled until effectively dispersed in particles smaller than about 50 microns in maximum dimension and preferably until most of the dispersed phase is in particle size smaller than about 15 microns. Particles smaller than 5 microns are acceptable but it is not necessary to grind an appreciable fraction below 5 microns, although the material may be so ground, and gives excellent results.

Germicides to provide the antimicrobial action include hexachlorophene and/or one of the germicidally active compounds known as "iodophors." These iodophors are iodine complexes which are capable of liberating iodine when in contact with water. The term is applied to any product in which surface active agents (such as nonyl

phenoxy polyethoxy ethanol) or poly(vinyl pyrrolidone) act as carriers and solubilizing agents for iodine. An iodophor usually enhances the bacterial activity of iodine and reduces its vapor pressure and odor. Staining is almost nonexistent and wide dilution with water is possible. An example of their preparation is given in U.S. Pat. 2,710,277. Iodophors are effective at acid pH so that if the germicidal agent is an iodophor, an acidic material may be added to the composition as a stabilizer. Among such acidic materials are citric acid, ascorbic acid, tartaric acid, phosphoric acid, etc. Generally, if the cleansing agent contains about 0.5 to 2.0% of iodine content, effective germicidal activity is obtained.

One of the most important advantages of the present invention is that the sponges can be impregnated with combinations of materials which are generally incompatible under moist conditions. Thus, for example, surgical scrub sponges prepared by the conventional liquid impregnation method known heretofore, could not contain a combination of hexachlorophene and an iodophor since these materials react with each other under moist conditions. Thus, after a short period, the two materials would cancel each other out and no germicidal activity would remain. The combination of the hexachlorophene and an iodophor is much more useful germicidally than either alone since hexachlorophene is generally active against gram-positive microorganisms and the iodophors are generally active against the gram-negative microorganisms. Where both types of pathogens are present, neither germicide alone is as effective as a combination.

Advantageously, sponges containing both hexachlorophene and an iodophor can be prepared by this invention since the small amount of water which is present in the polyurethane reaction mixture does not remain in contact with the germicides for a sufficiently long period to cause the inactivation of either material. It may be desirable when using a mixture of hexachlorophene and an iodophor to add these materials to the reaction mixture only shortly before polymerization is initiated in order to reduce the amount of time in which the materials are in contact with water. At any rate, once the polymerization reaction has been completed the water which was necessary for the formation of the foam is no longer present and the germicidal materials can thereafter remain stable during long periods of storage.

The sponges of the present invention

The process by which the polyurethane sponges of this invention are prepared, although involving the incorporation of the cleansing agent into the polymerizable reaction mixture, does not result in the chemical bonding of the additive to the polyurethane. The cleansing agents completely dispersed throughout the sponge material and very intimately associated with the cellular structure. When a sponge product of this invention is examined by dark field and bright field polarized light techniques it is observed that the additive particles are uniformly distributed throughout, and predominantly in the particle size range of 5 to 15 microns. Particles of surfactant were found on the windows and struts or strands of the sponge cells. Thus the cleansing agent is present in very intimate association in the sponge structure in a manner which is definitely distinct from the type of association resulting when a liquid soap or detergent is impregnated by the conventional liquid impregnation methods. Much more cleansing agent can be held by the sponge than is the case when conventional impregnation procedures are employed. Moreover, since the amount of impregnant which is added to the sponge is not dependent upon the ability of a liquid impregnation medium to hold the impregnant in a dispersed state, the amount of impregnant which can be incorporated into the sponge is not dependent upon the amount which can remain stably suspended in a liquid medium. These facts make possible the

production of sponges with very high concentrations of cleansing agent.

The sponges of the present invention after being formed are cut to size and wrapped either individually or in a package containing several together. The wrapping need not be waterproof or have any special quality since the contents are substantially dry. Preferably, when the sponge is to be used in hospital antiseptic procedures, the wrapping material is one which prevents the penetration of microorganisms while at the same time permitting the passage of cold sterilizing agents such as ethylene oxide gas or is transparent to radiation when sterilization is to be by radiation. So long as these characteristics are present the particular composition of the wrapper is not of any particular concern to the present invention except of course that obviously it must not be something that is either itself toxic or which is capable of adverse reaction with the sponge or the impregnated functional additive.

The following examples are presented to further illustrate the present invention.

EXAMPLE 1

This example illustrates the preparation of a preferred antiseptic cleansing sponge in accordance with the present invention. The following compositions were prepared.

(A)

Polyester-soap mix:	G.
Polyester -----	1,000
Hexachlorophene -----	40
Bland soap powder -----	1,000

(B)

Activator mix:	G.
Water (DI) -----	35
N'-ethyl-morpholine -----	5
N'-coco-morpholine -----	5

(C)

80/20 isomeric mixture of 2,4/2,6 toluene diisocyanate.

The polyester used in component (A) is the reaction product of adipic acid, ethylene glycol and glycerol with a molecular weight of 2,500; an acid number of less than 1.5; viscosity of 17,000-22,000 centipoises; Brookfield Model LVF, Spindle No. 4 (12 r.p.m.) and a s.p. 1.18 to 1.20 at 25° C.

134 g. of (A) and 46 g. of (C) were mixed thoroughly. Six g. of (B) was added with vigorous stirring and the reaction mixture was poured as it began to heat up, into a cardboard mold. It was cured at room temperature for 30 minutes. The product was removed from the mold, a piece was cut away and it was used for scrubbing hands. The sponge sudsed copiously as soon as it was wetted and continued to do so during a ten-minute scrub.

EXAMPLE 2

A mixture was prepared of:

	Parts
Polyester resin -----	100.0
Silicone resin -----	1.5
Bland neutral soap powder containing 3% hexachlorophene -----	25.0

these components were blended in a mortar and pestle until the soap was predominantly in the particle size range of 4½ to 14 microns. A few aggregates existed but photomicrographs show no aggregates more than 50 microns in the largest dimension.

To this mixture was added 46 parts of an 80/20 isomeric mixture of 2,4/2,6 toluene diisocyanate. The components were blended in a high speed blender until uniformly mixed and thereto added 6 parts of a mixture of deionized water and N-ethyl morpholine in the ratio of 35/10 parts by weight. This catalyst mixture was added to the vigorously stirred mixture and as soon as the mixture started to react, as shown by an exothermic reaction, the contents were poured into a cardboard mold and left

to cure. After 30 minutes the product was sufficiently cured to be removed from the mold and used. A section 1 inch by 2 inch by 3 inch was cut from the molded product and used as a sponge for scrubbing the hands in accordance with surgical techniques. The sponge released suds copiously as soon as it was wetted and continued to do so during the entire duration of a 10 minute surgical scrub.

The polyester component was the reaction product of adipic acid ethylene glycol, and glycerol with a molecular weight of about 2,500, an acid number of less than 1.5 and a viscosity of approximately 22,000 centipoises measured on a Brookfield Model LVF, No. 4 spindle at 12 r.p.m. A commercial source of such resin is Witco Fomrez-50.

The silicon resin is a dimethylsiloxane resin used as a liquid surfactant to aid in pore size control. The use of the silicon resin permits fine pore size sponges to be obtained with less intense and vigorous mixing than would otherwise be required. A more intense mixing can be used instead of or in addition to the silicon resin depending upon the pore size of product which is desired.

Whereas the sponge produced in this sample had a range of about 60 to 100 pores per inch, the mixing speed can be controlled to modify the sponge pore size if desired.

EXAMPLE 3

The procedure set forth in Example 2 was followed except that 100 parts of the bland neutral soap powder containing 3% hexachlorophene was added to the mixture. The processing was the same and the product found to be a soft textured adaptable sponge, which released suds in greater quantity and for a longer time than the product of Example 2.

Copious suds were still being released after a 15 minute scrub.

As the suds release rate bears certain of the characteristics of exponential decay, a sharp end point to sudsing is not obtained. Products are best rated by a comparative test with a single user using a particular type and temperature tap water under controlled conditions. As with most other uses of soap, hard water inhibits the formation of foams. Even in tap water, as it is used for scrubbing in most hospitals, copious suds are released for at least 10 minutes of vigorous scrubbing.

EXAMPLE 4

A sudsing mixture used as the cleansing agent was prepared by blending 94.3 parts by weight of the sodium salt of an 85%, tallow 15% coconut oil soap powder to which was added 2 parts of alkyl arylsulfonate, 0.7 part of glycerine and 3.0 parts of hexachlorophene. Of this mixture, 25 parts were combined with 100 parts of the polyester resin of Example 2 and 1.5 parts of silicon resin. A large size batch was used. The soap was intimately dispersed to predominantly less than 15 microns particles size in a 3 roller paint mill. The same techniques as pigment grinding apply. A heavy shear breaks up and disperses the cleansing agent. To the well dispersed mixture was added 46 parts of 80/20 isomeric 2,4/2,6 toluene diisocyanate and 6 parts of the 35/10 deionized water N-ethyl morpholine catalyst system. The polyester composition and the toluene diisocyanate were well mixed in a high speed blender prior to the addition of the catalyst, and after the addition of the catalyst as the mixture started to heat up, it was poured into molds from which it could be cut into scrub sponge size blocks. A 30 minute cure is adequate to permit cutting and packaging, although the blocks of foam can be stored for months before being cut into the sponge blocks, if production requirements indicate. A one by two by three inch block was found to be a readily handleable size, although larger or smaller could be used by individuals having larger or smaller hands, or for other scrub purposes.

The sponges so formed gave excellent sudsing during a 10 minute surgical scrub.

EXAMPLE 5

The above example was repeated using 100 parts of the same sudsing cleansing agent as in Example 4. A sponge having good texture, good body and good scrub characteristics was obtained.

The sponge was free from fragmentation during a typical 10 minute scrub by a surgeon. The additional quantity of soap gave insurance of adequate sudsing in hard water areas for prolonged periods of intense scrubbing.

EXAMPLE 6

To 100 parts of the polyester is added 1.5 parts of dimethylsiloxane and 25 parts of a bland neutral soap powder containing 3% of hexachlorophene. Additionally is added 15 parts of poly(vinyl pyrrolidone) iodophor containing about 10% iodine. After the mixture is intimately blended by milling on a 3 roller paint mill until the particle size is essentially smaller than 15 microns, the mixture has added thereto 46 parts of an 80/20 isomeric mixture of 2,4/2,6 toluene diisocyanate and the mixture is blended until intimately mixed, than 6 parts of the 35/10 water N-ethyl morpholine catalyst are added and as reaction causes an exotherm, the mixture is poured into a mold and permitted to foam.

This composition is particularly effective in that it has both an iodine and hexachlorophene bactericidal agent present with the iodophor acting against gram-negative microorganisms and the hexachlorophene against gram-positive microorganisms.

In accordance with conventional procedures, in large scale operations, the foams may be formed on foaming machines to which two or more lines are connected with the resin-water-coupling agent and cleansing agent mixed and metered through one line and toluene diisocyanate through the other. Also foaming machines may be used in which the resin containing the cleansing agent is fed through one line, the toluene diisocyanate a second and the activator solution, water and catalyst, is metered through a third line. The one shot or continuous mixing systems are advantageously used in large scale production in which the foam is continuously produced on moving belts, the size and movement of the mass being such as to accomplish the production objectives of a particular operation. Many thousands of cubic feet a day of cleansing agent containing foam can be produced on a single moving belt machine.

Other formulations may be used adjusting the type and ratios of resins and toluene diisocyanate isomers to achieve harder or softer resins. Conventional techniques are used to modify to a type desired.

For instance if the isomeric toluene diisocyanate ratio is changed from 80/20 of the 2,4/2,6 isomer to a ratio of 65/35, a foam of higher density, and compression modulus is obtained.

The rate of stirring at the time of the catalyzation has an effect on the size of the pores as does the use of the silicone resin.

For a strong readily handleable sponge which may be used for scrubbing and which still maintains its integrity after a 10 minute scrub, it is essential that the cleansing agent be sufficiently dispersed by high shear techniques that the individual particles of the cleansing agent be sufficiently smaller than the cell wall structure that the cell wall structure is not unduly weakened. A few larger particles which would result in the rupture of a few cell walls can be tolerated. For example a rupture of one percent of the cell walls which would result in a one percent weakening of the foam would be minimal. If many large particles of cleansing agent are present, the sponge is so apt to crumble that an effective sponge is not obtained.

Whereas a wide range of proportions in the ratio of cleansing agent in the sponge are effective, as a surgical scrub sponge, the quantity of cleansing agent must be such that a one by two by three inch scrub sponge releases suds

copiously for at least 10 minutes in hard water. An unduly high ratio of cleansing agent unnecessarily adds to the cost of the sponge. About 25 to 110% based on the weight of polyurethane in the foam gives good results.

Having thus set forth the description of the present invention, the invention itself is defined by the following claims in which all parts are by weight unless otherwise clearly indicated.

I claim:

1. The process of preparing a surgical scrub sponge which releases suds for at least ten minutes during a surgical scrub which comprises:

- (a) forming a polyester mixture containing 100 parts of a hydroxy terminated polyester resin of a molecular weight of 2,000 to 6,000, a hydroxy number of 40 to 80 and an acid number of less than 2, adding 1.5 parts silicone resin and 25 parts of a mixture of 94.3 parts of a soap powder which is the sodium salt of 85% tallow, 15% coconut oil, 2 parts alkyl arylsulfonate, 0.7 part glycerine, and 3 parts hexachlorophene
- (b) grinding in a 3 roller paint mill until the soap mixture is dispersed to predominantly less than 15 microns particle size
- (c) adding 46 parts of 80/20 isomeric 2,4/2,6 toluene diisocyanate and 6 parts of a 35/10 deionized water/N-ethyl morpholine catalyst and
- (d) mixing well, thereby reacting the diisocyanate, the

polyester and water under conditions such that a polyurethane and carbon dioxide are concurrently formed whereby the polyurethane is caused to expand and foam to thereby give a polyurethane sponge having uniform pore size and at least about 60 pores per inch having the said soap evenly dispersed therethrough, in particles smaller than than 15 microns.

References Cited

UNITED STATES PATENTS

3,002,937	10/1961	Parker et al.	252—91 X
3,007,883	11/1961	Schmidt et al.	260—2.5
3,396,419	8/1968	Richter et al.	15—104.93
3,619,843	11/1971	Richter et al.	252—91 X
3,283,357	11/1966	Decker et al.	252—91 X
3,447,181	6/1969	Coker et al.	252—91 X
3,488,219	1/1970	Moroni	252—91 X

OTHER REFERENCES

Schwartz et al.: Surface Active Agents, 1949, pp. 180—182.

HERBERT B. GUYNN, Primary Examiner

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15—104.93; 260—2.5 AG