Nov. 16, 1971 F. J. RICHTER ET AL 3,619,843

SPONGES WITH DRY IMPREGNANTS

Filed May 26, 1969

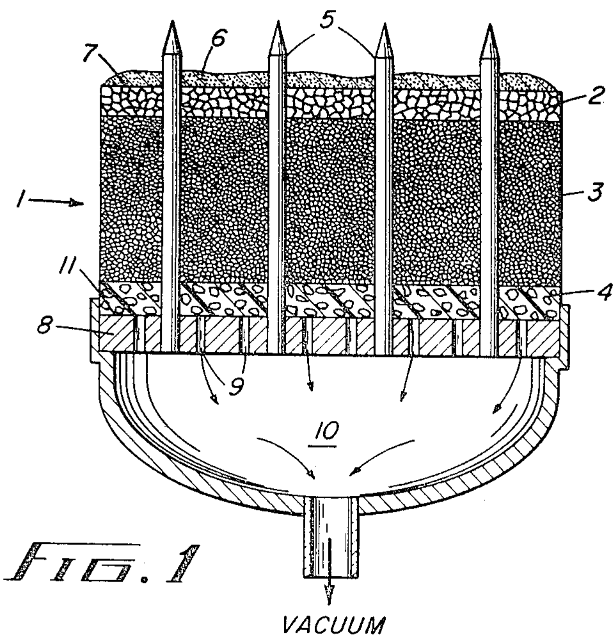

FIG. 1

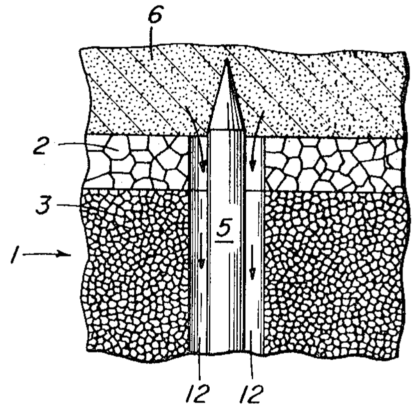

FIG. 2

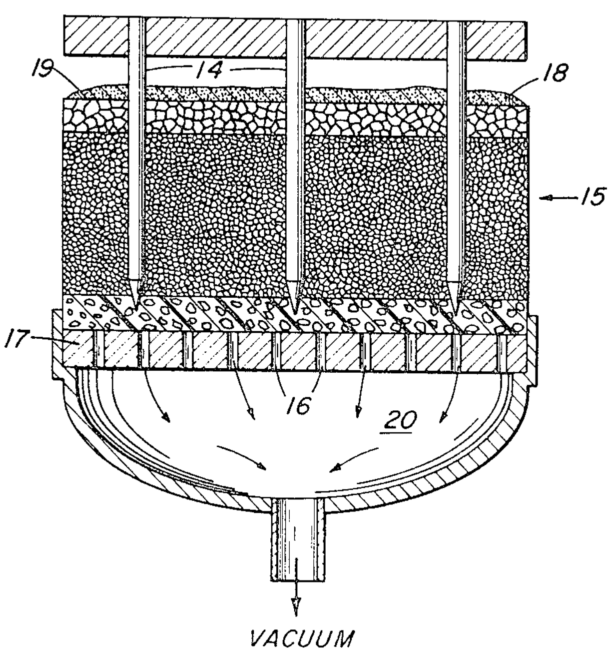

FIG. 4

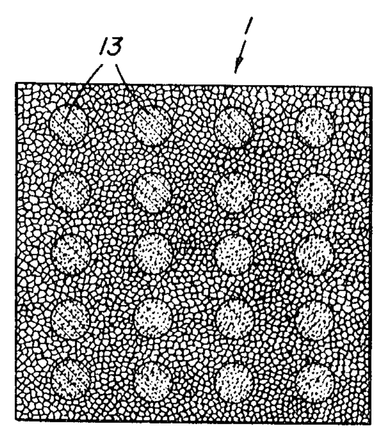

FIG. 3

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United States Patent Office 3,619,843 Patented Nov. 16, 1971

3,619,843

SPONGES WITH DRY IMPREGNANTS

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Filed May 26, 1969, Ser. No. 827,804
Int. Cl. A47l 13/17
U.S. Cl. 15—104.93 4 Claims

ABSTRACT OF THE DISCLOSURE

Impregnated sponges prepared by a process which comprises depositing particulate material on one surface of the sponge, piercing the sponge with at least one spike per square inch of sponge surface to form crevices between the sponge and outer surface of each spike, the spikes extending into the particulate material, drawing particulate material into each crevice, and removing the sponge from the spikes after the crevices are substantially filled with particulate material.

FIELD OF INVENTION

This invention relates to sponges impregnated with dry compositions and to methods for preparing the same. It relates further to surgical scrub sponges and sponges for other sanitizing uses and to new means of obtaining the same.

BACKGROUND OF INVENTION

The ever-widening demand for "convenience" products coupled technological advances in the plastics field and in the manufacture of reasonably durable and economical sponges, have led to the commercial availability of disposable sponges impregnated with functional impregnants. These sponges function both as sponges and as the source for the active agent (e.g., a cleaning, waxing or abrasive material), which agent would otherwise have been obtained from a separate source, e.g., a container or a cake of soap. The user is thus required to bring only one thing, i.e., a sponge, and not both a sponge and the active agent, to the job. The convenience of these self-contained sponges is an important enough reason for their existence but there are other reasons.

The problem of eliminating bacteria and other microorganisms from the skin of a surgeon's hand or of a sterile nurse is a very serious one. It is standard practice in all hospitals for operating personnel to scrub their hands and forearms intensively before putting on sterile rubber gloves. Ordinarily, the scrub is conducted 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. This compound is normally referred to as "hexachlorophene." Other germicidal agents such as the "iodophors" have likewise been used to great advantage in surgical scrubs. While the germicidal agents are quite effective, there is a serious problem of contamination in the fact that 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 agent, the problem of cross-contamination from the soap dispenser is completely avoided. Thus, in 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 contamination from the otherwise necesary soap dispenser.

There are available at the present time sponges which are impregnated with materials such as abrasives, waxes, 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 removed from the sponge to leave the impregnant deposited throughout the sponge. While the presently available methods for impregnating the sponges are satisfactory in certain applications, they have inherent disadvantages resulting from the properties of the impregnating material or the sponge composition.

Most widely used sponge materials 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 polystyrene, polyalkenes, and polyesters of phthalic anhydride and nylon have also been used for sponge applications. The type of sponge material which is used will depend upon the particular application in which the sponge is put. Not all sponges are suitable for all applications. The type of sponge material which is used will depend upon the particular application to which the sponge is put. Thus, for example, ordinary regenerated cellulose sponges are not suitable for applications where the sponge should have scrubbing capabilities since the regenerated cellulose sponges are too soft to provide the abrasive action required for satisfactory scrubbing. Polyurethane sponges are widely used becaues they can be manufactured rather economically with varying degrees of porosity and rigidity to fit many requirements.

The general method for preparing impregnated sponges is to form a sponge web and immerse it in an aqueous suspension or solution of the impregnating materials until the impregnating material wets the entire sponge. The web is then removed from the impregnant bath and compressed to remove as much free liquid as possible and then dried to remove as much of the remaining liquid as is practicable. Drying is a difficult and time-consuming process and at best does not remove much of the water which is present in the sponge. The moisture-removing process must be accomplished at low temperatures since almost all available synthetic sponge material tends to degrade even under moderate heat. Thus, the drying process is a very lengthy one and at best is only partially effective. The partially dried sponge is then wrapped in a packaging material which is capable of resisting deterioration and remaining attractive even while in contact with its moist contents.

There are several disadvantages connected with the use of a liquid impregnation system for the preparation of disposable impregnated sponges. One is that the use of a liquid medium to disperse the impregnant requires additional manipulative steps associated with the liquid handling. Moreover, the use of liquid impregnating media requires that the impregnant be stable in the presence of water during the impregnation process and more importantly during the storage of the semi-wet sponge in its package. The removal of the liquid vehicle from the sponge after the impregnating process, as stated above, is a very time-consuming and costly factor in the preparation of the sponges. Where the demand is for relatively inexpensive disposable sponges, the cost of removing the liquid impregnating media from the sponge may make the use of disposable sponges economically unfeasible. Another limitation which is inherent in the disposable sponges produced by the liquid impregnating method is the need for the impregnant to be dispersable or soluble in the liquid impregnating material. In addition, the amount of material which can be impregnating in the sponge is dependent upon the amount which can be dispersed or solubilized in the dispersing liquid media.

One of the most important limitations connected with the liquid impregnation method for the preparation of disposable sponges is that many of the synethic sponge materials now available are not stable and tend to decompose when stored under moist conditions. This can severely limit the type of sponge which is to be used with the aqueous media and/or requires that substantially all the moisture be removed from the sponge prior to packaging. Since it is almost impossible to remove all the moisture from the sponge, there is a definite and critical problem of storage stability in connection with the sponges.

Thus, it can be seen that sponges prepared by liquid impregnation methods have very important limitations. It has been proposed to eliminate the use of water as a dispersing media for the impregnating material so that many of the disadvantages discussed above could be avoided. In one approach, a gel or a gel-forming material is used as the dispersing media. Such sponges are obtained by immersing a wet sponge in the gel or gel-forming composition, squeezing the wet sponge to release water and removing the pressure from the sponge to cause it to absorb the gel composition. This method is undesirable since the presence of the gel in the sponge reduces the ability of the sponge to absorb liquid and inhibits the release of the soap or detergent contained therein. Furthermore, the use of these added gel materials makes the sponges unnecessarily expensive since the gel and gel-forming components do not improve or assist the impregnating composition in its function.

An alternative approach to eliminating or reducing the use of water has been to impregnate the sponges with the impregnant in a melted form. This method is, of course, limited to materials which melt at temperatures that neither degrade the impregnant nor the sponge. In many instances such as when the impregnant is a wax or detergent composition, it is necessary to maintain the material above a temperature of about 200° F. At these temperatures there is a greatly increased tendency to destroy the cellulose structure of the sponge thereby reducing its efficiency as a sponge.

In the present state of the art there is no practical way of preparing impregnated disposable sponges without using the liquid impregnating method described above. Since the liquid impregnating method has severe limitations, it would be highly desirable to have a process whereby sponges could be impregnated without the need to use liquid, especially aqueous, dispersing media for the purpose of carrying the impregnant into the sponge structure. 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 an aqueous medium. 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 impregnant. It is a still further object of the present invention to provide means for impregnating a sponge material with a dry impregnant whereby the impregnant is rather evenly dispersed throughout the sponge and is retained therein without loss due to leakage of the solid impregnant from the cellular structure of the sponge. More particularly, it is an object of the present invention to provide a sponge which is impregnated with a sanitizing, wax, therapeutic or abrasive material in a manner whereby neither the impregnant nor the sponge tends to deteriorate even after long periods of storage. Still more particularly, it is an object of the present invention to provide a surgical scrub sponge which is capable of being stored for long periods of time without deterioration of either the impregnant or the sponge material. Further objects will be apparent from the ensuing description of this invention.

THE PRESENT INVENTION

The present invention accomplishes the foregoing objects in a surprisingly simple and efficient manner which involves depositing a supply of the finely-divided impregnant on a surface of the sponge and mechanically transferring the impregnant from the sponge surface to the interior of the sponge whereby the impregnant is held in position by the frictional forces between the sponge material and the impregnant. The manner in which this is done, the type of apparatus which can be used, the characteristics of the sponge material and the necessary characteristics of the impregnant will be described in greater detail below.

Impregnating process

In general the process of the present invention requires the creation of a path into the interior of the sponge so that the finely-divided impregnant can be conducted thereto. The path to the interior of the sponge must be large enough to permit the impregnant to penetrate into the interior of the sponge but not so large as to prevent the sponge from closing the path after impregnation has been accomplished. One way to make the interior of the sponge accessible to impregnant is to pierce the sponge with a network of spikes (or nails, needles, tines, or rods having either solid or hollow cores) so that there is penetration at least to the interior of the sponge and preferably through the opposite surface of the sponge. A layer of the powdered impregnant is established on a surface of the sponge. The impregnant may be present while the sponge is being pierced or it may be deposited after the piercing operation is completed. As the spike enters the sponge, crevices are formed around the spike surface and throughout the part of the sponge which is pierced. If the entire sponge is pierced, of course the crevice extends the entire thickness of the sponge. The powdered impregnant flows through the crevices thus formed into the interior of the sponge. After the spike is removed, the resiliency of the sponge material causes the crevices to close tight on the powdered material thereby holding it in the sponge structure. After removal of loose powder, as for example by tapping lightly, the sponge can be packaged by conventional means.

Normally, it is desired to impregnate sponges with rather large amounts of impregnant, although this is not always the case. Several approaches can be taken in accordance with the present invention to achieve high levels of impregnation. The impregnant should be deposited on the upper-most surface of the sponge web in sufficient depth to assure a constant supply of the impregnant around the hole which the spike makes in the sponge surface. Generally, if the powder is deposited in a layer which is at least 0.25 inch thick, sufficient powder will be available to avoid problems created by localized depletion. Thicker layers of impregnant may be maintained on the surface of the sponge without any disadvantage and indeed may be desirable in order to forestall any possibility of localized depletion of the impregnant. As a general rule, it will be found that a layer of powder which is at least about 10% and preferably about 20% of the thickness of the sponge, is adequate to assure a constant supply of the impregnant during the impregnation step.

The sponges can be pierced from the surface on which the impregnant is deposited or the opposite one. It may be desirable to simultaneously pierce the sponge from both directions. The spikes entering the sponge from the surface on which the impregnant deposit rests, tend to push the impregnant into the interior of the sponge. The spikes entering the sponge from the opposite surface and exiting into the powder deposit would tend to draw the powdered impregnant into the interior of the sponge as they are withdrawn from the sponge. The spikes entering opposite surfaces of the sponges can be positioned so that they slide by each other as they pierce through the sponge material and in this manner, each spike helps the other in forcing the powdered material into the sponge structure.

Size, shape and number of spikes may vary widely without departing from the process of the present invention. The spikes may be needle-like or they may be cylindrical, or they may have longitudinal or transverse striations which help to conduct more powder impregnant into the sponge interior. Thus, for example, a spike which has transverse striations will entrain more powdered impregnant as it is withdrawn from the sponge than a spike which has a very smooth exterior surface. The spikes should be sufficiently large to allow the powdered material to flow in the path which it creates as it enters or is withdrawn from the sponge. On the other hand, the spike should not be so large that it destroys the cellular nature of the sponge to the extent that the sponge cannot close the path which the spike creates as the spike is withdrawn. For most purposes the piercing means should be in the range of $1/32$ to about $1/4$ inch in diameter. Best results are obtained when spikes of $1/16$ to $1/8$ inch in diameter are used. There is no real limitation on the number of spikes which can be used to pierce the sponge. This depends upon the amount of material which it is desired to incorporate into the sponge, the porosity of the sponge, the particle size of the impregnant and the diameter of the piercing means. Since it is generally desirable to obtain rather even distribution of the impregnant over the entire sponge material, anywhere from 1 to 6 holes should be made in each square inch of sponge surface and accordingly, the corresponding number of piercing means should be used.

One particularly suitable method for impregnating the sponges in accordance with the present invention is to employ a combination of piercing means and vacuum to draw the impregnant into the sponge interior. This can be accomplished by establishing a layer of impregnant on the upper surface of the sponge while piercing the sponge from the lower surface in a manner such that the piercing means exits through the upper surface. A vacuum is applied to the sponge from the lower surface as the piercing means are currently withdrawn. As the piercing means leave the sponge, in combination with the vacuum force, powdered impregnant is drawn into the sponge interior. The vacuum which is applied should be sufficiently high to draw the particulate material into the sponge interior but not so high as to distort the sponge shape or close the cell and thereby inhibit the passage of particulate material into the sponge.

The impregnation process of the present invention can be accomplished either on an intermittent or continuous basis. Thus, for example, the sponge web can be brought across a bed of spikes and then impaled while the powdered impregnant is deposited on the upper surface of the web. Vacuum can be applied while the spikes are in place and/or as the spikes are withdrawn from the sponge. The thus impregnated sponge can be removed and a new untreated sponge put in its place. Alternatively, the process can be accomplished continuously by passing the sponge web across a slotted or perforated drum which is equipped with spikes extending outwardly from its surface. The web is pierced by the spikes and at the same a layer of powdered impregnant is deposited on the outer surface of the sponge. As the impaled sponge with the powdered impregnant is brought to a nearly horizontal position, a vacuum is applied from the interior of the perforated or slotted drum. The vacuum has the effect of drawing the powdered impregnant into the interior of the sponge. The application of the vacuum can be concurrent with the disimpalement of the sponge so that the powdered impregnant is drawn into the sponge by the combination of the exiting spikes and the vacuum. After disimpalement, the impregnated sponge is cut nito desired units and packaged for its intended use.

It may be desired to prevent any leakage of the powdered material from the sponge, both for reasons of aesthetics and function. This can be accomplished very easily by any of several means. The powdered impregnant can be very slightly moistened or admixed with a hydroscopic agent before the sponge is impregnated. Another method of preventing leakage is to coat the impregnated sponge with a material which seals the outer pores of the sponge without interfering with the sponge functions. Such a material in the case of a soap or detergent impregnated sponge could be a mixture of glycerin and water. The hydroscopic glycerin has the effect of binding the particles of impregnant to each other and to the sponge thereby obviating any problem of leakage. It should be understood that the amount of moisture which is involved in either of these two approaches to the problem of leakage, is infinitesimal compared to the amount of water which is used in the liquid impregnation of sponges. Thus, none of the problems associated with the liquid impregnation processes will follow from the employment of expedients.

The sponge materials

The process of this invention can be employed to impregnate any sponge material which can be impregnated by the conventional liquid impregnation process. It can, in addition, be employed to impregnate other sponge materials which would be adversely affected by the liquid impregnation process. Among the synthetic sponges which can be impregnated by the process of this invention are those prepared from polyurethanes, polyethylene, polyvinyl chloride, polystyrene and regenerated celluloses. Such materials are well known in the art and the choice of which one to use for any particular purpose does not constitute a part of the present invention. The sponge can be of uniform porosity, or else multi-layer sponges having layers of different pore size and distribution may be used. The sponge may have a reticulated or non-reticulated cellular structure.

While most sponge material can be used in the present invention, there are critical differences between various sponge materials with respect to the ability of the sponges to perform a function for which they are intended and to hold the powdered impregnant with a minimum amount of leakage. In cases where the sponge must be capable of providing a scrubbing action, it will be necessary to use sponges having the proper texture to provide the required scrubbing action, while at the same time having the capability of holding the powdered impregnant. In other cases such as where the sponge is to be used for polishing purposes, it may be desirable to have a sponge material which is of very fine texture so that the metal surface is not damaged by the rubbing action of the sponge. For many uses, it will be desirable to use a laminated sponge in which the various layers, by reason of their different texture, perform different functions.

For example, in the case of surgical scrub sponges, ordinary regenerated cellulose sponges are completely unsuitable. They can be impregnated with germicidal impregnants, but they do not have a texture permitting satisfactory scrubbing, and this is essential because a surgeon does not reduce the flora on his skin merely by the application of materials which, as hexachlorophene does, spread a thin film on his skin. It is also necessary to remove the major portion of the micro-organisms physically by washing off any good detergent lather, and this requires considerable mechanical scrubbing regardless of the nature of the detergent used. It is possible to utilize certain special, very expensive, fine-textured, regenerated cellulose sponges, and in its broadest aspect, such sponges are included in the present invention. However, it is preferred to use laminated sponges of polyester-based polyurethanes, such as those sold by the Foam Division of the Scott Paper Company under the designation of open-pore polyester polyurethane sponges. Preferably, these sponges are made in the form of a multi-layered sandwich with a relatively thick layer of fairly fine pores, for example, 60 pores to the inch, which retain the antiseptic soap solution and acts as a reservoir, maintaining sufficient material for a complete scrubbing ritual with, of course, a sufficient excess to provide a margin of safety. This thicker layer of fine pore polyurethane is softened by heat and one or more new layers of much coarser polyurethane foam are laminated on one or both sides using suitable pressure, such as can be exerted by squeeze rolls. Preferably, both sides of the relatively thicker fine pored polyurethane are laminated with the coarser layers, one layer optionally being considerably coarser than the other. For example, both coarse layers may have a 10–20 pores per inch or one may have 10 pores per inch and the other may have 20 pores per inch. Having two different degrees of pore size is a definite advantage because the coarser material is useful for removing greater amounts of dirt, for example, from the palm of the hand when a surgeon has been working outdoors over a weekend, and the finer fore parts of the hand which are more sensitive, such as the fingertips, or where the hands are less heavily soiled. The inner layer of the described laminate is constructed of polyurethane having a much finer texture, e.g., 60–100 pores per inch. In order to aid in preventing leakage of the powder from the central portion of the sponge, it may be desirable to form at least one of the outer laminates from sponge material which is non-reticulated. Of course, the other outer layer may be, although it does not need to be, reticulated to provide a passage for water into the center of the sponge and for lather to the outer surface of the sponge.

The pore size of the portion of the sponge which is intended to act as a reservoir for the impregnant should be considered in choosing the size of the spikes and in determining the state of subdivision of the finely-divided impregnant. It is preferable, though not absolutely essential, for the spikes to have a diameter which is at least as large and preferably larger than the average diameter of the pores in the reservoir portion of the sponge. This allows for the better penetration of the impregnant into the reservoir portion of the sponge.

However, the diameter of the spikes should not be so large as to damage a large percent of the cellular structure of the sponge. Since the sponge is prepared of a resilient material it can take a large amount of stretching without severe damage. Moreover, since the resiliency causes the sponge to close the hole formed by the spike, a certain amount of sponge cell damage can be tolerated without nullifying the ability of the sponge to retain the powdered impregnant or perform its ultimate function. However, it should be observed that extreme situations such as the use of spikes having a diameter of 0.25 inch with sponges having a pore size of 60 pores per inch should be avoided. Likewise, the state of subdivision of the impregnant should be governed to some extent by the pore size of the portion of the sponge which is to act as a reservoir for the impregnant. Thus, if the impregnant is a very free flowing, finely-divided powder, it is desirable to use sponge material whose pore configuration is suited to retaining such material. The pore size should be relatively small in order to minimize the amount of leakage. Leakage may also be minimized by using a sponge which is not fully reticulated. In most instances it is preferable to use as the reservoir segment of the sponge a sponge material whose pores have a diameter no greater than twice the number average diameter of the impregnant particles. It is most preferred that the impregnant particles have a larger diameter than the diameter of the pores in the reservoir segment of the sponge.

The impregnants

It will be obvious from the foregoing description of the present invention that there are certain limitations to the physical and chemical nature of the impregnants used herein. The first limitation is that the impregnant must be chemically inert to the sponge material when both are in a dry state. The second limitation is that the impregnant must be in a state of subdivision which permits it to be held in the sponge structure without undue leakage. As noted above, however, leakage can be minimized by applying a sealant to the surface of the sponge after it has been impregnated, which sealant does not interfere with the intended final use of the sponge. Once these requirements are met, the impregnant can be chosen from a multitude of materials. Among the most commonly used types of materials are cleaning compositions, abrasive compositions, and wax compositions as well as combinations of these materials.

Sponges can be impregnated with an abrasive material either alone or in combination with a soap or a detergent. Such impregnated sponges are capable of performing both a cleaning and polishing action when applied to a suitable surface. The abrasives can be such materials as pumice, kaolin, chromium oxide, iron oxide, and detergents such as the alkyl, aryl sulfonates, the fatty acid sulfates and the polyalkylene oxides can be used either alone or in combination with a fatty acid soap to provide the lathering action which is necessary for proper cleaning. The combination of the abrasive and the detergent can be granulated to a product with granules of narrow size distribution particularly suited to the pore size of the reservoir segment of the sponge. Where the detergent is a normally liquid material, granulation can be accomplished by adding a greater quantity of the finely-divided abrasive whereby a paste is formed which is capable of granulation. Many cleaning and polishing compositions which are suitable for impregnation in the sponges of the present invention are known in the art and any of these compositions may be used in the practice of the present invention.

Impregnating compositions for use herein can comprise a wax material in combination with an abrasive and/or a detergent whereby the impregnated sponge is capable of performing a cleaning, polishing and waxing action simultaneously. Among the useful impregnating compositions for this type of use are those disclosed in U.S. Pat. 3,088,158; U.S. Pat. 3,112,219 and U.S. Pat. 3,094,735. Where the wax component is inherently a paste or liquid material, it can be nevertheless used in the present invention by admixture of the same with a dry material to give a paste which is amendable to granulation. The dry material may be the detergent component or the abrasive component or a combination of both. Again it should be noted that any material which is capable of being impregnated by prior art liquid impregnation processes can also be impregnated by the process of this invention.

Combinations of soaps and/or detergents with germicides can be used to impregnate sponges intended for surgical scrub use. Impregnating compositions for this purpose should have a dry soap, preferably a bland toilet soap such as a fatty amide; and a detergent which may be of the nonionic, cationic or anionic type. In addition, the soap composition may contain a sequestering agent such as tetrasodium ethylene-diamine tetraacetic acid (EDTA). The combination of the detergent, the soap and the sequestering agent provides excellent cleaning action without being too harsh on the skin as would be the case if only detergent were used. In addition, preferred germicidal soaps contain a dry emollient which helps to replace skin oils removed during the scrubbing process. Among such dry emollients are ethoxylated lanolin and high molecular weight polyethylene glycols. The impregnating composition must additionally contain at least one germicide. As stated above, the most commonly employed germicide is hexachlorophene, and the impregnant should be comprised of 0.1 to about 4%, preferably 1–3% of this material. Germicidal activity may be supplied by a class of materials known as "iodophors." These materials 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 phenoxypolyethoxyethanol) act as carriers and solubilizing agents for the 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. They are commercially available from General Aniline and Film Corporation and West Laboratories Incorporated. Iodophors are generally effective at acid pH so that if the germicidal agent is an iodophor an acidic material should be added to the composition as a stabilizer. Among such acidic materials are citric acid, ascorbic acid, tartaric acid, etc. Generally, if the soap composition contains about 0.5 to 3.0% of the iodophor, effective germicidal activity will be provided.

One of the most important advantages of the present invention is that sponges can be impregnated with combinations of materials which are generally incompatible under moist conditions. Thus, for example, surgical scrub sponges prepared by the liquid impregnation methods described above 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 be provided by the scrub sponge. It would be considered highly desirable to obtain a surgical scrub sponge having a combination of hexachlorophene and an iodophor since hexachlorophene is generally active against gram positive microorganisms whereas the iodophors are generally active against the gram negative microorganisms. Where both pathogens are present neither germicide is completely effective by itself. It would thus be extremely desirable to combine both germicides to obtain a much broader spectrum of activity than could be obtained by either alone.

Advantageously, surgical scrub sponges containing both hexachlorophene and an iodophor can be prepared by this invention. Since the cleaning composition is in a substantially dry state both during the impregnation process and during storage of the sponge prior to use, there is no tendency for the germicidal activity to be reduced during storage. If both types of germicides are to be used together, a smaller amount of each can be used; but this is not necessary.

The sponges of the present invention after being impregnated are then cut to size and wrapped. The sponges can be wrapped individually or several can be wrapped together. The wrapping need not be waterproof or have any special quality since the contents are substantially dry. Preferably, however, a wrap is provided which should be of a nature to prevent the penetration by microorganisms while at the same time to permit passage of cold sterilizing agents such as ethylene oxide gas and/or be transparent to radiation when sterilization is 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 impregnant material.

THE DRAWINGS

The invention will be specifically discussed hereinafter with reference to the accompanying drawings.

FIG. 1 shows one means for applying vacuum to the sponge to draw powdered material into the interior thereof.

FIG. 2 is a detail view of FIG. 1 showing a crevice formed by the pierced sponge and a needle.

FIG. 3 is a sectioned view of an impregnated sponge obtained by the process of this invention.

FIG. 4 shows an alternative embodiment of the present invention wherein the needles extend only through a portion of the sponge thickness.

Referring now to FIG. 1, a multilayered sponge **1** comprising layers **2**, **3** and **4** is impaled on a plurality of needles **5** so that the needles **5** extend through the entire thickness of sponge **1**. A powdered material **6** is deposited on sponge surface **7**. The sponge **1** is contiguous to and supported by base **8** which is perforated through its thickness by a plurality of holes **9** which are in open communication with sponge **1** and a source of vacuum not shown. A plenum chamber **10** located below the base **8** permit application of the vacuum over the entire surface **11** of sponge **1**. The sponge layer **2** is formed from a reticulated polyurethane foam having a pore size of 10–20 p.p.i. The sponge layer **3** is comprised of a polyurethane foam having a pore size of 60–100 p.p.i. The sponge layer **4** is comprised of a non-reticulated polyurethane having a pore size of 10–20 p.p.i.

Referring to FIG. 2, a crevice **12** formed between the perimeter of cylindrical needle **5** and sponge **1** and is in open communication with a source of vacuum not shown. Responsive to the vacuum, the powder **6** is drawn into the crevice **12** toward the vacuum.

Referring to FIG. 3, a horizontal sectional view of an impregnated sponge after the needles have been removed therefrom. The particulate material is distributed in sponge **1** in a plurality of separate areas **13**, the arrangement and number of which correspond to the arrangement and number of needles employed to pierce the sponge. The concentration of powder is highest at the center of each area **13**.

Referring to FIG. 4, an alternative embodiment of the present invention is shown whereby the needles are introduced into the sponge from the surface where the powder is deposited. The needles **14** extend through only a portion of the thickness of the sponge **15** but through a sufficient portion of the sponge thickness so that the vacuum applied through the holes **16** of base **17** can draw the powder **18** deposited on sponge surface **19** into the crevices formed between the perimeter of the needles **14** and the sponge **15**. The source of vacuum not shown is applied to plenum chamber **20** in the manner discussed above with reference to FIG. 1.

SPECIFIC EMBODIMENTS OF THE PRESENT INVENTION

Example 1

A one-inch thick sponge of 60 pores per square inch polyurethane-polyester foam of the open-pore type was laminated first to a ⅛" thick sheet of 20-pore material and then to a $\frac{3}{16}$" thick sheet of 10-pore material by softening the 60-pore foam by heat, applying the coarser mesh material over the 60-pore foam and bonding the layers firmly by passing them through squeeze rolls. Sheets of laminated foam where then cut into 2" x 3" blocks by conventional means and then impaled on a tine-studded rotary drum. Approximately 3.0 grams of impregnant was deposited on the upper surface of the impaled sponge. Vacuum was applied to the sponge from below as shown in FIG. 1 and the sponge was slowly withdrawn from the spikes. During this impalement the powdered impregnant was drawn into the interior of the sponge forming an annular ring of powder throughout the entire sponge thickness. Although most of the powder was concentrated in the annular segment, there was some distribution in the immediately surrounding sponge area. When the impregnation was completed, vacuum was removed and the sponge tapped to remove excess powder. On inspection it was noted that the spike holes had closed together and were not apparent.

The impregnant which was used in this example was a germicidal detergent composition having a combination of hexachlorophene and an iodophor. It has the following formulation:

Component:	Wt. percent
50% tallow/50% coco-amide soap	86.5
Sodium lauryl sulfate	4.0
Glycerine	1.0
Emollient	4.0
Hexachlorophene	2.0
PVP iodophor	[1] 2.0
Citric acid, USP	0.5

[1] Available iodine.

The foregoing materials were dry blended, granulated and micronized to pass through a 200 mesh screen. The sponges were dry-impregnated with 3.0 grams of the above formulation.

Example 2

A sponge of the same type described in Example 1 was impregnated with the following detergent composition:

Component:	Wt. percent
50% tallow/.5% coco-amide soap	88.0
Sodium lauryl sulfate	4.0
Glycerine	1.0
Emollient	4.0
Hexachlorophene	1.0
Tribromosalocylanilide (2,4,5)	1.0
TCI trichlorocarbanilide	1.0

The impregnation process and formulation procedures were the same as described in Example 1.

Example 3

A sponge such as described in Example 1 was impregnated by the procedure of Example 1 with the following wax, abrasive, detergent combination:

Component:	Wt. percent
"Petrolite" microcrystalline wax	40
Sodium lauryl sulfate	40
Emersol 132 emulsifier	10
Piperazine	7
Borax	3

We claim:

1. A resilient polyurethane sponge impregnated with a finely divided, substantially dry, detergent and germicidal agent,

said sponge comprising at least one resilient polyurethane sponge reservoir layer having 50 to 100 pores per square inch,

and a plurality of columnar deposits of a powdered impregnant of dry detergent and germicidal agent extending through and resiliently compacted by said reservoir layer.

2. The sponge of claim **1** wherein the sponge is a multilayered structure having a coarser outer layer on each side of the inner reservoir layer.

3. The sponge of claim **2** in which the germicidal agent is hexachlorophene.

4. The sponge of claim **2** in which the germicidal agent is an iodophor.

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U.S. Cl. X.R.

15—118; 51—401; 252—91; 401—200; 424—150, 343