URETHANE POLYMER FOAM
COMPOSITES WITH CONTROLLED
RELEASE OF AGENTS AND ADDITIVES
HAVING ABRASIVE QUALITIES

Inventors: Paul F. Hermann, Dover, NH (US);
Wayne Celia, Paramus, NJ (US)

Assignee: H.H. Brown Shoe Technologies, Inc.
d/b/a Dicon Technologies, Fair Lawn, NJ

Correspondence Address:
Lerner, David, Littenberg,
Krumholz & Mentlik
600 South Avenue West
Westfield, NJ 07090 (US)

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ABSTRACT

Urethane polymer foam products with controlled release of agents are formed from the reaction products of an aqueous formulation of a limited quantity of superabsorbent polymer, an agent or agents from the group of detergents, abrasives, waxes, polishes, drugs, cosmetics, biologicals, volatiles, odor absorbing compositions, water soluble chemicals and optionally additives, and water in a predetermined ratio with hydrophilic urethane prepolymer to provide a polymerizing mixture. The agents, and additives if any, are incorporated directly into the matrix of the formed foam to increase the number of times that the formed foam products can be used. The products include hose with an abrasive material uniformly dispersed therein and/or formed on at least one exterior face of the products, and the methods include the formulating and making of the formed foam products with uniformly dispersed abrasive materials and/or with abrasive materials on at least one exterior face.
URETHANE POLYMER FOAM COMPOSITES WITH CONTROLLED RELEASE OF AGENTS AND ADDITIVES HAVING ABRASIVE QUALITIES

CROSS-REFERENCE TO RELATED APPLICATIONS


BACKGROUND OF THE INVENTION

[0002] The present invention relates generally to hydrophilic polyurethane foam compositions used for various types of industrial, commercial, residential, personal care, cleaning and other products, and more particularly for pads, sheets or molded shapes made of hydrophilic polyurethane foam which contains limited quantities of surfactant polymers to control the release of an agent or agents such as detergents, soaps, waxes, polishes, drugs, cosmetics, biologicals, volatiles and chemicals during the use thereof. Selectively abrasives can also be agent or can be applied onto at least one surface of the formed product for additional applications and uses.

[0003] When an aqueous formulation of the present invention including surfactant polymer, agents and adequate water is mixed with a hydrophilic urethane prepolymer, as described in U.S. Pat. No. 5,976,847, the reaction produces polymerization and forms a hydrophilic polyurethane foam composite.

[0004] Conventional prior art urethane polymer foam is mostly resistant and non-permeable to water. Some compositions have been treated with or had a surfactant added in the formulation to render the resultant formed urethane polymer foam more acceptable to water. This surfactant-treated urethane polymer foam will allow water to run along the supporting and intercellular gap structure but still disallows penetration of moisture into the urethane backbone of strands and interconnected fibers of the formed foam.

[0005] Conventional prior art urethane polymer foams require a stoichiometric balance of water to isocyanate, normally below approximately 0.05% addition of water or water-bearing agent in the formulation. This limits the amount of moisture containing agent in the final composite of formed urethane polymer foam. A further limitation of agent addition is the starting viscosity of conventional polyol components of the formula. Most additions of agent are added to the polyol component based on the high reactivity of the isocyanate component. The polyol component is typically relatively high in viscosity prior to any agent addition. Increasing its viscosity further by addition of agent quickly renders the resultant viscosity too high to pump and disallows the processing requirements of metering machinery. In addition, a composite urethane polymer foam product made with water resistant or water impermeable urethane polymer will coat or block the agent from its intended contact with an aqueous effluent. This defeats the original effort and purpose of adding the agent to the composite. The agent was added and intended to be available to interact with moisture bearing effluents during use of the urethane polymer foam product.

[0006] Hydrophilic urethane foam products and methods in accordance with the prior art are described in U.S. Pat. Nos. 4,137,200; 4,339,550; 5,976,847 and others, as well as in Polyurethane’s Chemistry and Technology by Saunders and Frisch, Volume XVI Part 2, High Polymer Systems. The primary departure from conventional prior art non-hydrophilic urethane foam is in the polyol component. Utilizing a hydrophilic polyol reacted with isocyanate provides a hydrophilic prepolymer. Mixing this hydrophilic prepolymer with water results in a hydrophilic urethane foam. Adding an agent into the water results in the formulation of hydrophilic urethane polymer foam bearing the agent. If this formed hydrophilic urethane polymer foam composite including agent is subsequently contacted with an outside aqueous-based effluent, the agent can interact with the effluent for an intended purpose. In this prior art hydrophilic foam composite technology, the contact between the agent and the effluent, or the expression of agent into effluent, is controlled by the inherent hydrophilicity of the urethane foam carrier.

[0007] For these reasons, there has been a long felt need to improve the controlled release of agents from a formed hydrophilic urethane polymer foam product to sustain or improve the contact of agents added to form composite with the aqueous effluent and thus to obtain multiple uses of the formed composite product.

[0008] It has been discovered that an improved controlled release urethane foam product in accordance with the present invention can be formed or obtained by combining an aqueous formulation consisting of a limited amount of superabsorbent polymer or copolymer, an agent or agents, optionally and selectively additives and adequate water with a hydrophilic urethane prepolymer. The agent or agents include, without limitation, detergents, soaps, waxes, polishes, abrasives, cosmetics, and biologicals, volatiles germicides and chemicals. This improved controlled release urethane foam product in accordance with the present invention slows and gradually releases such agent or agents when exposed to an aqueous effluent to a much greater extent than the known prior art products, when the pads, sheets and shaped products such as sponges formed from such formulations are placed into use for cleaning, scrubbing, abrasion, waxing, polishing, coating, and absorption purposes, applications and other uses.

[0009] Further, the controlled release foam products in accordance with the present invention are easily distinguished from non-hydrophilic prior art products and characterized by improved water absorption capabilities in that these products, when exposed to water or an aqueous effluent, will swell to one hundred fifty percent (150%) of their dry volume.

[0010] Additionally, the scrubbing and abrasive characteristic of such controlled release urethane foam products in accordance with the present invention can be designed or materially enhanced by adding abrasive particles or cut fibers as the agent or agents to the aqueous phase during formulation of any of these products to improve the integral strength of the formed foam product.

[0011] Alternatively, an abrasive characteristic for the controlled release urethane foam product can also be obtained by forming on or laminating or adhesively bonding abrasive material to at least one exterior surface of the formed controlled release urethane foam product. The abrasive may be any composition or component that is more abrasive than the formed controlled release urethane foam...
Such laminated or adhesively bonded formed controlled release urethane foam products are particularly useful in formed foam products with a detergent agent that are used to clean hard surfaces such as pots and pans.

SUMMARY OF THE INVENTION

[0012] Thus, in one aspect, the present invention covers hydrophilic polyurethane foam products with agents such as detergents, soaps, abrasives, waxes, polishes, drugs, cosmetics, biologicals, volatiles, chemicals and the like and optionally and selectively additives, formed into shaped and sized products, pads and sheets in which the agents and/or additives, if any, are incorporated generally uniformly into the matrix or supporting structure of the foam to provide a controlled release urethane foam product formed from the reaction product obtained by combining an aqueous formulation having a limited quantity of a superabsorbent polymer or copolymer, an agent or agents and optionally and selectively additives and adequate water with a hydrophilic urethane prepolymer which polymerizes into a formed hydrophilic polyurethane foam product having unique properties such that, when wetted, the formed hydrophilic polyurethane foam product will act to slow the release of the agent or agents, and any selected additive if any, with the wetting effluent to enable the formed product to provide extra and additional applications or more intimate mass transfer of the agents, and the selected additives if any, during use than those presently obtainable from similar products now known in the prior art.

[0013] It is another aspect of the present invention to provide a method for formulating and forming such controlled release urethane foam products including the steps of:

[0014] a) metering and mixing an aqueous formulation having at least a limited quantity of superabsorbent polymer, an agent or agents and adequate water, with a predetermined ratio of hydrophilic urethane prepolymer to provide a polymerizing mixture for forming the controlled release urethane foam product;

[0015] b) depositing the polymerizing mixture on releasable bottom paper disposed on a movable carrier and covering the upper surface of the polymerizing mixture with releasable top paper as the polymerizing mixture is moved with the carrier;

[0016] c) advancing the polymerizing mixture in the top and bottom release paper by moving the carrier;

[0017] d) sequentially removing the top and bottom releasable paper while simultaneously drying the sized and formed product to remove residual moisture; and

[0018] e) passing the formed controlled release urethane foam product to secondary operations such as die cutting, to provide shaped and sized products for particular applications and uses.

[0019] In another aspect of the present invention to provide a method for formulating and forming the controlled release urethane product step, all the steps are the same except that step c is modified as follows:

[0020] c) advancing the polymerizing mixture in the top and bottom release paper by moving the carrier and sizing the foam layer being formed to the desired layer until it is tack free;

[0021] It is another aspect of the present invention to provide a method for formulating and forming such controlled release urethane foam products particularly adapted for fabricating a molded product including the steps of:

[0022] a) metering and mixing an aqueous formulation having at least a quantity of superabsorbent polymer, an agent or agents and adequate water, with a predetermined ratio of hydrophilic urethane prepolymer to provide a polymerizing mixture for forming the controlled release urethane foam product;

[0023] b) dispensing a predetermined quantity of the polymerizing formulation into at least one releasable mold to form a shaped and sized controlled release urethane foam product;

[0024] c) applying a cover onto the releasable mold to control the expansion of the polymerizing mixture; and

[0025] d) removing the molded controlled release urethane foam product from the at least one mold and removing a predetermined quantity of the residual moisture therefrom.

[0026] It is another aspect of the present invention to provide formed shaped and sized controlled release urethane foam products with abrasive characteristics from a polymerized combination of an aqueous mixture having, a limited quantity of a superabsorbent polymer, agents from the group of detergents and/or soaps, a sized quantity of abrasive particles and adequate water with a predetermined quantity of hydrophilic urethane prepolymer, in which the agent or agents including the abrasive particles are incorporated into the matrix or supporting or intercellular structure of the formed foam to provide unique properties for improving cleaning and scrubbing characteristics for the formed controlled release urethane foam product.

[0027] It is another aspect of the present invention to provide a method for formulating and forming such controlled release urethane foam products with abrasive particles homogeneously dispersed therethrough including the steps of:

[0028] a) metering and mixing an aqueous formulation having at least a quantity of superabsorbent polymer, an agent or agents, a sized quantity of abrasive particles and adequate water with a predetermined ratio of hydrophilic urethane prepolymer to provide a polymerizing mixture for forming the controlled release urethane foam product with abrasive characteristics;

[0029] b) depositing the polymerizing mixture on releasable bottom paper disposed on a movable carrier and covering the upper surface of the polymerizing mixture with releasable top paper as the polymerizing mixture is moved with the carrier;

[0030] c) advancing the polymerizing mixture in the top and bottom release paper by moving the carrier.
and sizing the foam layer being formed to the desired thickness until it is tack free;

[0031] d) sequentially removing the top and bottom releasable paper while simultaneously drying the sized and formed product to remove residual moisture; and

[0032] e) passing the formed controlled release urethane foam product with abrasive characteristics to secondary operations such as die cutting, to provide shaped and sized products for particular applications and uses.

[0033] Alternatively, as another aspect of the present invention, the method for formulating and forming such controlled release urethane foam product with abrasive particle homogeneously dispersed in the formed matrix thereof may also be obtained by dispensing a predetermined quantity of the polymerizing mixture into a sized and shaped releasable mold, as above set forth, for providing molded controlled release urethane foam products.

[0034] It is another aspect of the present invention to provide formed shaped and sized controlled release urethane foam products with abrasive characteristics on at least one exterior surface of a polymerized combination of an aqueous mixture having, a limited quantity of a superabsorbent polymer, agents from the group of detergents and/or soaps, and adequate water with a predetermined quantity of hydrophilic urethane prepolymer so that the agents are incorporated into the foam matrix during polymerization, and on at least one exterior surface of the formed foam product, an integral abrasive exterior is formed to improve cleaning and scrubbing characteristics of the formed product.

[0035] It is another aspect of the present invention to provide a method for formulating and forming such controlled release urethane foam products with an integral abrasive layer on at least one exterior surface including the steps of:

[0036] a) metering and mixing an aqueous mixture having, at least a limited quantity of superabsorbent polymer and an agent from the group detergents, and/or soaps and adequate water, with a predetermined ratio of hydrophilic urethane prepolymer to provide a polymerizing mixture for forming the foam layer of the formed product;

[0037] b) depositing the polymerizing mixture onto an abrasive medium coated on and movable with releasable bottom paper disposed on a movable carrier and covering the upper surface of the polymerizing mixture with releasable top paper as the polymerizing mixture is moved with the carrier;

[0038] c) advancing the polymerizing mixture on the abrasive medium in the top and bottom release paper by moving the carrier and sizing the foam layer being formed to the desired thickness until it is tack free;

[0039] d) sequentially removing the top and bottom releasable paper and removing residual moisture; and

[0040] e) passing the formed controlled release urethane foam product with the abrasive layer integral with at least one exterior surface to the secondary step of die cutting, to provide products with enhanced cleaning and scrubbing characteristics.

[0041] It is another aspect of the present invention to provide a further method for formulating and forming such controlled release urethane foam products with an integral abrasive layer on at least one exterior surface including the steps of:

[0042] a) metering and mixing an aqueous mixture having, at least a limited quantity of superabsorbent polymer and an agent from the group detergents, and/or soaps and adequate water, with a predetermined ratio of hydrophilic urethane prepolymer to provide a polymerizing mixture of the composite material;

[0043] b) dispensing a predetermined quantity of the polymerizing mixture so as to partially fill a sized and shaped mold cavity;

[0044] c) die cutting a sized layer of non-woven abrasive material to the shape of the mold cavity;

[0045] d) bringing the shaped non-woven abrasive material into intimate contact with and covering the polymerizing mixture;

[0046] e) placing a cover member on the shaped mold to limit the polymerization to provide the controlled release urethane foam product in the size and shape of the mold cavity; and

[0047] f) removing the sized and shaped controlled release urethane foam product with an integral abrasive material on at least one exterior face and removing a predetermined amount of the residual moisture therefrom.

[0048] It is another aspect of the present invention to provide a method for formulating and forming such controlled release urethane foam products with an integral abrasive layer, either laminated or adhered on at least one exterior surface, including the steps of:

[0049] a) metering and mixing an aqueous formulation having at least a limited quantity of superabsorbent polymer, an agent or agents and adequate water, with a predetermined ratio of hydrophilic urethane prepolymer to provide a polymerizing mixture for forming the controlled release urethane foam product;

[0050] b) depositing the polymerizing mixture on releasable bottom paper disposed on a movable carrier and covering the upper surface of the polymerizing mixture with releasable top paper as the polymerizing mixture is moved with the carrier;

[0051] c) advancing the polymerizing mixture in the top and bottom release paper by moving the carrier;

[0052] d) sequentially removing the top and bottom releasable paper while simultaneously drying the sized and formed product to remove residual moisture;

[0053] e) laminating or adhering an integral abrasive layer onto at least one exterior face of the formed controlled release urethane foam product; and
1) passing the formed controlled release urethane foam product with the abrasive layer on at least one exterior surface to the secondary steps of die cutting to provide products with enhanced cleaning and scrubbing characteristics.

DETAILED DESCRIPTION

Controlled release urethane foam products in accordance with the present invention take various forms because of the myriad of agents that can be embodied into the matrix or supporting structure of the formed foam product and the multiplicity of applications and uses to which such products can be applied or adapted.

One basic form of the controlled release urethane foam products in accordance with the present invention is formulated and formed, as hereinafter more fully described, by combining an aqueous mixture of a limited quantity of superabsorbent polymer, one or more agents from the group, detergents, soaps, abrasives, waxes, polishes, biologicals, volatiles and the like materials, and additionally, optionally and selectively additives, if any, with a predetermined ratio of a hydrophilic urethane prepolymer to provide a polymerizing mixture so that during polymerization the agent or agents and any additive, if any, will be incorporated and bound into the matrix or supporting structure of the formed urethane foam product.

The superabsorbent polymers in such formulations are preferably sodium polyacrylate/polyalcohol polymers and co-polymer sorbents described in U.S. Pat. Nos. 5,763,335 and 4,914,170. One such solid superabsorbent is identified as Superabsorbent HE-80 STOCKHAUSEN which is purchasable in the commercial marketplace. An alternative and equally functional commercial superabsorbent is made “in situ” PD-2072 product of H. B. Fuller Co. A third superabsorbent made and tested in the formulation of products in accordance with the present invention is the granulated form of the hydrophilic urethane prepolymer.

Therefore, superabsorbent, as used herein, is any limited quantity of absorbent when combined with the selected agent or agents, and optionally selected additives, if any, when admixed with water and the hydrophilic urethane prepolymer forms a foam matrix for a composition that slows the release from the formed foam of the agent or agents when the composite foam product is subjected to an aqueous effluent.

The detergent agents used in the formulation of the controlled release urethane foam products are those surfactant chemicals commonly available and known to those skilled in the art to satisfy hard surface cleansing, skin cleansing, rug cleansing and other cleaning tasks such as in detergents sold as “LYSOL APC, SIMPLE GREEN, 409, MR. CLEAN, SOFT-SCRUB, RESOLVE CARPET CLEANSER”, etc., all registered trademarks. In some cases more than one agent may be utilized as a function of the application or use for the controlled release urethane foam product.

The abrasive agents used in the formulation of the controlled release urethane foam products are classified into at least two groups. The first group would be particles that have (a) low abrasive qualities such as diatomaceous earth, (b) medium abrasive qualities such as feldspar, and (c) high-abrasive qualities such as silica. The second group would be sheet stock abrasives in the form of (a) non-woven fiber such as those commercially available as Scotchbrite®, floor cleaning pads and Buf-Fuffle; (b) woven or paper adhesively bonded sheets such as sandpaper; and (c) naturally occurring abrasive materials such as Loofah, Apricot Seed, crushed Walnut shell, crushed Jojoba shell and the like. Abrasives will function to polish, abrade or remove substrate materials over which the foam composite is rubbed.

The wax agents used in the formulations of the controlled release urethane foam products are materials which impart a shine on a secondary surface with which they are brought in contact and include crystalline waxes, paraffin waxes, wax emulsions and silicone fluids such as:

<table>
<thead>
<tr>
<th>POLISHING APPLICATION</th>
<th>Vinyl</th>
<th>Furniture</th>
<th>Metal</th>
<th>Shoe</th>
<th>Auto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystalline wax</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paraffin wax</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Wax emulsions</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Silicone fluids</td>
<td>X</td>
<td>X</td>
<td></td>
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</tbody>
</table>

The cosmetic agents used in the formulation of the controlled release urethane foam products are those chemical materials established to alter the external appearance, feel or smell of a human or animal body such as, by way of illustration and not limitation, skin conditioners, hair color dyes, hair shampoos, fragrances, lip glosses, nail polishes, aqueous dispersible body powders and liquid emulsions, etc.

<table>
<thead>
<tr>
<th>COSMETIC AGENT</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium laurel sarcosinate</td>
<td>maximizes suds</td>
</tr>
<tr>
<td>Sodium laureth sulphate</td>
<td>copious suds</td>
</tr>
<tr>
<td>Anionic surfactants</td>
<td>skin cleaning</td>
</tr>
<tr>
<td>Citric acid</td>
<td>pH modifier</td>
</tr>
<tr>
<td>Isothionate</td>
<td>skin softener</td>
</tr>
</tbody>
</table>

The chemical agents used in the formulation of the controlled release urethane foam products not specifically embodied in the agents as above identified include materials intended to enable a secondary reaction when the formed foam product is contacted by an aqueous effluent such, for example, as follows:

<table>
<thead>
<tr>
<th>THE AGENT OR ADDITIVE</th>
<th>APPLICATION OR USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Blood</td>
<td>Absorb oxygen from water</td>
</tr>
<tr>
<td>Odor Absorbent</td>
<td>Destroy noxious odor materials</td>
</tr>
<tr>
<td>Phase Change Agents</td>
<td>Absorb and release BTUs</td>
</tr>
<tr>
<td>Baking Soda Agents</td>
<td>Alkalize acid solutions</td>
</tr>
<tr>
<td>Cellulose Fibers</td>
<td>Absorption and tensile strength</td>
</tr>
</tbody>
</table>

Any of the agents from the groups enumerated may first be formed in an aqueous premix solution with a typical surfactant material and then added to the aqueous mixture to be combined with the hydrophilic urethane prepolymer.
Surfactants may be used with the agents in the aqueous mixture to increase the concentration of the selected agent or agents in the aqueous mixture. The surfactants are preferably present in amounts of about 0.5% to about 3.5% by weight of the aqueous mixture. The surfactants may be prepared from anionic polyoxyethylene and polyoxypropylene oxides such as BASF surfactant, available under the trademark “PIURONIC”. Other surfactants known as anionics, cationics and or zwitterionics, singularly or in combination, can be added to the formulation, as known by those skilled in the art, to satisfy specific needs.

[0065] The aqueous mixture may further consist of various combinations of other selected additives without departing from the scope of the present invention, including, for example, germicides, bactericides and fungicides. Such products are provided in the commercial marketplace by a myriad of suppliers for controlling germs, or bacterial and fungal growth. One preferred material available in the commercial marketplace is supplied by Lauricidin Co. of Galena, Ill. 61036, under the trademark “LAURICIDIN”.

[0066] In those applications desiring biocidal protection, the selected agent is added into the aqueous phase at the proper rate so as to function yet be safe to handle. A typical additive of such agent is less than 1% by weight of the aqueous phase.

[0067] In addition, volatile agents and volatile additives may be used in the formulation of the controlled release urethane foam products in accordance with the present invention. Such volatiles are materials having a low boiling or subliming temperature at atmospheric pressure that vaporize to produce a secondary reaction as is the case with fragrances and solvents.

[0068] Thus, an agent or agents, when used herein, are any active ingredients added to the composite foam product prior to polymerization that will provide a desired end result for the application and use of the formed controlled release urethane foam products. Accordingly, the agents as set forth above are only by way of illustration and not limitation of the formed controlled release urethane foam products in accordance with the present invention.

[0069] During polymerization, the selected agents and the selected additives, if any, are incorporated homogeneously into the matrix or supporting structure of the formed foam pads layers, sheets of the composite products and remain there until the formed foam pads, layers and sheets of the composite products are wetted or contacted by sufficient moisture to activate the agents in such formed composite foam products, at which time one or more of the agents are slowly released from the matrix or supporting strands or fibers of the formed foam and diffuse toward the surface, where they can be put to use for cleaning, scrubbing, waxing, polishing, controlling noxious odors, etc., as the case may be, for a given agent or agents, and the selected additive if any, for a given application or use. It is to be noted that in some cases the agent may be added to the prepolymer rather than the aqueous phase, particularly when the agent is anhydrous or oil-based.

[0070] The formation of such formed controlled release urethane foam products in accordance with the present invention is achieved in accordance with the following steps:

[0071] Step a) First, is the metering and mixing of an aqueous mixture including a limited quantity of superabsorbent polymer, at least one agent from the enumerated group of agents for the specific application or use and adequate water with a predetermined ratio of hydrophilic prepolymer to provide a polymerizing mixture;

[0072] This aqueous mixture is prepared by conventional batch mixing processes incorporating the selected agent or agents in a volume to satisfy the intended application and use. Thus the water is added first, the agent is blended in or emulsified in with a surfactant, then the superabsorbent polymer is added and the aqueous mixture is intimately blended.

[0073] This aqueous mixture includes the superabsorbent polymer in a range from 0.05% to 10% by weight, and preferably about 0.6% by weight, at least one or more of the group of agents from 0.1 to 15% by weight and preferably 6% by weight, water in a range from 15% to 85% by weight and preferably about 30% by weight with hydrophilic urethane prepolymer in a range from 0.25% to 80% by weight and preferably 30% by weight.

[0074] Hydrophilic urethane prepolymer available in the commercial marketplace is a water reactive 10,000-20,000 cps liquid which must be intimately mixed with the above described aqueous mixture of a limited quantity of superabsorbent polymer, agent or agents, and optionally selected additives to initiate polymerization.

[0075] Suitable hydrophilic urethane prepolymer for use in the present invention are known and will be readily recognized by those of ordinary skill in the art from U.S. Pat. Nos. 5,763,335; 4,209,605; 4,160,076; 4,137,200; 3,805,532; 2,999,013; and general procedures for the preparation and formation of such prepolymers can be found in Polyurethane’s Chemistry and Technology by J. H. Saunders and K. C. Frisch published by John Wiley & Sons, New York, N.Y.; at vol. XVI Part 2. High Polymer Series. “Foam Systems”, pages 7-26, and “Procedures for the Preparation of Polyureters”, pages 26 et seq. One preferred prepolymer for use in the present invention is sold under the trademark BIPOL 6 by Mace Adhesives and Coatings. Another prepolymer suitable for use in the present invention is sold under the trademark HYPOL by The Dow Chemical Company. Still another prepolymer for use in the present invention is sold under the trademark PREPOL by Lendall Manufacturing Incorporated. These prepolymers are suitable for the present invention because of their strong hydrophilic characteristic and reasonable cost.

[0076] Admixing the aqueous mixture with a predetermined ratio of precise amounts of the hydrophilic urethane prepolymer initiates polymerization. The physical characteristics such as density and tensile strength are controlled by the ratio of prepolymer in the aqueous mixture to produce a sized and shaped controlled release urethane foam product in accordance with the present invention. Contacting the polymerized foam product with a moisture bearing effluent will expose the homogeneously incorporated agent to effluent.

[0077] Step b) The combined polymerizing aqueous mixture is deposited on a sheet of releasable bottom paper disposed on a movable carrier and a sheet of
releasable top paper is applied to cover the upper surface of the polymerizing aqueous mixture;

(0078) Step c) This polymerizing aqueous mixture in the top and bottom releasable paper is then advanced by moving the carrier, and optionally the forming foam layer can be sized to a desired thickness and either air dried or oven dried until it becomes tacky;

(0079) Step d) Next, the top releasable paper covering and the bottom releasable paper are sequentially removed, and the formed controlled release urethane foam product can be further dried in any suitable manner to remove the residual moisture; and

(0080) Steps b, c and d for forming a hydrophilic urethane foam product are well known in the art and therefore will not be more fully described.

(0081) Step e) Now the formed controlled release urethane foam products is next passed to secondary operations such as die cutting and molding, as may be required to shape and size the formed foam product for the particular application and use.

(0082) Such secondary operations are also well known in the art and accordingly will not be more fully described.

(0083) Adding abrasive materials to the controlled release urethane foam products to provide a formed foam product with abrasive qualities may be established by several methods depending on the nature of the product required for a particular application or use.

(0084) Thus, in one form of controlled release urethane foam products with abrasive qualities, the abrasive can be uniformly and homogeneously dispersed throughout the matrix or supporting structure of the formed foam product by premixing the selected abrasive particles into the batch mixing of step a) for forming the aqueous mixture before it is combined with the hydrophilic urethane prepolymer to start polymerization, as is set forth above, for formulating the basic controlled release urethane foam products.

(0085) By combining this aqueous mixture with the hydrophilic urethane prepolymer, the abrasive particles will be uniformly and homogeneously dispersed throughout the formed foam product and will act to maintain the integrity and strength of the formed foam product for the applications and uses requiring a controlled release urethane foam product with abrasive qualities.

(0086) The controlled release urethane foam product can be formed having an abrasive material formed integrally on at least one exterior surface. This method requires the steps of:

(0087) a) metering and mixing of an aqueous formulation including a limited quantity of superabsorbent polymer, at least one agent from the enumerated group of agents for the specific application or use and adequate water with a predetermined ratio of hydrophilic prepolymer to provide a polymerizing mixture;

(0088) b) dispensing a predetermined quantity by weight of the polymerizing mixture into a shaped mold cavity so as to partially fill the cavity;

(0089) c) forming a separate die cut of non-woven abrasive material shaped to fit into the mold cavity and placing one surface of the die-cut non-woven abrasive material into engagement with the surface of the polymerizing mixture before polymerization is complete; and

(0090) d) placing a top cover on the mold cavity to define and size the polymerizing mixture and to bond the die-cut abrasive non-woven layer into the formed controlled release urethane foam product.

(0091) In still another method, the controlled release urethane foam product can be formed having an abrasive material formed integrally on at least one exterior surface. This method requires the steps of:

(0092) a) metering and mixing of an aqueous formulation including a limited quantity of superabsorbent polymer, at least one agent from the enumerated group of agents for the specific application or use and adequate water with a predetermined ratio of hydrophilic prepolymer to provide a polymerizing mixture;

(0093) b) sequentially depositing the desired abrasive material such as non-woven or fabric-backed sandpaper on releasable bottom paper disposed on a movable carrier and then dispensing the polymerizing mixture onto the abrasive medium;

(0094) c) covering the exposed upper surface of the polymerizing mixture with releasable top paper;

(0095) d) advancing the polymerizing mixture on the abrasive medium in the top and bottom releasable paper by moving the carrier and sizing the foam layer being formed to the desired thickness until it is tack free;

(0096) e) sequentially removing the top and bottom releasable paper and removing residual moisture; and

(0097) f) passing the formed foam product for secondary operations such as die cutting to provide the product for the given applications and uses.

(0098) And, in still another method, the controlled release urethane foam product can be formed having an abrasive layer applied to at least one exterior surface of the formed foam product, utilizing all the steps for forming the basic controlled release urethane foam product as above described and then adding in the secondary step having the abrasive layer laminated or adhered to at least one exterior surface of the formed foam product.

(0099) Thus, the method for forming a controlled release urethane foam product with an abrasive layer applied to at least one exterior surface includes the steps of:

(0100) a) metering and mixing of an aqueous formulation including a limited quantity of superabsorbent polymer, at least one agent from the enumerated group of agents for the specific application or use and adequate water with a predetermined ratio of hydrophilic urethane prepolymer to form a polymerizing mixture;

(0101) b) dispensing the polymerizing mixture onto a releasable bottom paper disposed on a movable carrier;
[0102] c) covering the upper surface of the polymerizing mixture with releasable top paper;

[0103] d) advancing the polymerizing mixture in the top and bottom releasable paper by moving the carrier until it is tack free and optionally sizing the formed foam layer to the desired thickness;

[0104] e) sequentially removing the top and bottom releasable paper and removing residual moisture;

[0105] f) passing the formed foam product to the secondary operation of laminating or adhesively attaching, a layer of abrasive material from the group of abrasive non-woven sheets, abrasive woven sheets and natural abrasives, to at least one exterior face of the formed controlled release urethane foam product; and

[0106] g) die cutting and shaping and sizing the formed controlled release urethane foam product with an abrasive layer on at least one exterior face for the given application and use.

[0107] As will be appreciated by those skilled in the art, the formed foam products or pads of the present invention can be fabricated to have any desired thickness and shape.

[0108] The following examples will aid in demonstrating controlled release urethane foam products in accordance with the present invention.

EXAMPLE 1

[0109] A controlled release urethane polymer foam sponge product with abrasive qualities for dishwashing was prepared by combining an aqueous mixture containing the following ingredients by weight:

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>PERCENT BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>26.5 g</td>
</tr>
<tr>
<td>Feldspar abrasive 200 mesh</td>
<td>24.63 g</td>
</tr>
<tr>
<td>A 1120 Silane Union Carbide</td>
<td>2 g</td>
</tr>
<tr>
<td>Launilude DEA Chemon</td>
<td>1.29 g</td>
</tr>
<tr>
<td>Sodium Ether Sulphonate Chem</td>
<td>6.66 g</td>
</tr>
<tr>
<td>Alpha Olefin Sulphonate 40% Pilot</td>
<td>5.46 g</td>
</tr>
<tr>
<td>Pluronic F88 BASF</td>
<td>.8 g</td>
</tr>
<tr>
<td>Gernaben 2 Sutton Labs</td>
<td>.02 g</td>
</tr>
<tr>
<td>Citric Acid</td>
<td>.05 g</td>
</tr>
<tr>
<td>Color</td>
<td>.10 g</td>
</tr>
<tr>
<td>Fragrance</td>
<td>.30 g</td>
</tr>
<tr>
<td>with Hydrophilic Urethane Prepolymer</td>
<td>33.3 g</td>
</tr>
</tbody>
</table>

[0110] to provide a polymerization aqueous mixture.

[0111] The aqueous mixture was blended with high shear mixing in a conventional mixing machine. The aqueous mixture was then combined with the hydrophilic urethane prepolymer to form a polymerizing composition. The polymerizing composition was sequentially deposited on a bottom releasable paper disposed on a movable carrier, and a top releasable paper was applied to the upper surface of the moving polymerizing mixture. This polymerizing composition was sized for thickness and advanced by the movable carrier until it became tack free. The top and bottom paper was removed, and the sized sheet of moist formed urethane polymer composite foam product was advanced to a die cut station where the sheet was cut into a plurality of shaped sponge products with an integral abrasive agent dispersed generally uniformly in the foam matrix.

[0112] In use when a sponge was immersed in water, the detergent was released by squeezing the sponge against the surface of the dish to be cleaned. Further, by reason of the abrasive in the sponge, whenever it was necessary, the surface of the dish could be scrubbed to get the surface clean. Testing these sponge products under controlled laboratory protocol resulted in six dishes cleaned with the detergent remaining.

EXAMPLE 2

[0113] A controlled release urethane polymer foam sponge product with abrasive qualities for dishwashing was prepared by combining an aqueous mixture containing the following ingredients by weight:

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>PERCENT BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>26.5 g</td>
</tr>
<tr>
<td>Feldspar abrasive 200 mesh</td>
<td>24.63 g</td>
</tr>
<tr>
<td>A 1120 Silane Union Carbide</td>
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</tr>
<tr>
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<tr>
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</tr>
<tr>
<td>Pluronic F88 BASF</td>
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</tr>
<tr>
<td>Gernaben 2 Sutton Labs</td>
<td>.02 g</td>
</tr>
<tr>
<td>Citric Acid</td>
<td>.05 g</td>
</tr>
<tr>
<td>Color</td>
<td>.10 g</td>
</tr>
<tr>
<td>Fragrance</td>
<td>.30 g</td>
</tr>
<tr>
<td>with Superabsorbent HS-80 Stockhausen</td>
<td>.1 g</td>
</tr>
<tr>
<td>with Hydrophilic Urethane Prepolymer</td>
<td>33.3 g</td>
</tr>
</tbody>
</table>

[0114] to provide a polymerization mixture.

[0115] The fabrication process used in EXAMPLE 1 was repeated, and use test results showed a doubling of the number of uses on the test items capable of being washed. It was concluded that the retention capacity of the superabsorbent in combination with the hydrophilicity of the foam polymer/detergent slows down the expression of the water-soluble phase when the sponge is used.

EXAMPLE 3

[0116] A controlled release urethane polymer foam product for dishwashing with an abrasive non-woven fiber material on at least one exterior surface was fabricated in accordance with the method for forming a layer of abrasive material integral with such external surface as above described with the same ingredients as set forth in EXAMPLE 2 except that the superabsorbent H. B. Stockhausen powder product was replaced by the following ingredients by weight:

<table>
<thead>
<tr>
<th>REPLACEMENT INGREDIENTS</th>
<th>PERCENT BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superabsorbent (made in situ)</td>
<td>0.5%</td>
</tr>
<tr>
<td>(H. B. Fuller PD-2072 with 4.78% by weight of Magnesium Electrons Baycoat 20)</td>
<td></td>
</tr>
</tbody>
</table>
[0117] This superabsorbent differs from the H. B. Stockhausen superabsorbent in that it prevents the viscosity of the aqueous mixture from building up too fast, as occurs when the Stockhausen superabsorbent is added to the aqueous mixture, described in EXAMPLE 2.

[0118] The formed hydrophilic urethane polymer foam composite with the abrasive layer on at least one exterior surface was tested. The results of the tests were at least equal to or greater than those achieved by the molded foam product in EXAMPLE 2.

[0119] It was concluded that the controlled release urethane polymer foam product made with this superabsorbent added to the detergent aqueous mixture as in EXAMPLE 2 produced superior results for the cleaning and scrubbing of items such as dishes and kitchenware.

EXAMPLE 4

[0120] A controlled release urethane polymer foam shaped abrasive product with an abrasive non-woven fiber material on at least one exterior surface was prepared by combining an aqueous mixture containing the following ingredients by weight:

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
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<tbody>
<tr>
<td>Water</td>
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<td>24.63</td>
</tr>
<tr>
<td>A 1120 Silane OSI</td>
<td>.2</td>
</tr>
<tr>
<td>Laurimide DEA Chemron</td>
<td>1.29</td>
</tr>
<tr>
<td>Sodium Ether Sulphonate Chemron</td>
<td>6.66</td>
</tr>
<tr>
<td>Alpha Olefin Sulphonate 40% Pilot</td>
<td>5.46</td>
</tr>
<tr>
<td>Pluronic F88 BASF</td>
<td>.8</td>
</tr>
<tr>
<td>Geranben 2 Sutton Labs</td>
<td>.62</td>
</tr>
<tr>
<td>Citric Acid</td>
<td>.05</td>
</tr>
<tr>
<td>Color</td>
<td>.10</td>
</tr>
<tr>
<td>Fragrance</td>
<td>.1</td>
</tr>
<tr>
<td>Superabsorbent HS-80 Stockhausen</td>
<td>.1</td>
</tr>
<tr>
<td>Isethionate skin softener Rhodia</td>
<td>2.0</td>
</tr>
<tr>
<td>with Hydrophilic Urethane Prepolymer</td>
<td>31.29</td>
</tr>
</tbody>
</table>

[0121] to provide a polymerizing composition.

[0122] The aqueous mixture was blended with high-shear mixing in a conventional metering machine, and 22 grams were dispensed into an open mold configuring the liquid mass to a defined shape. As polymerizing mass starts to rise, and prior to full rise in mold, a separate die-cut piece of abrasive non-woven fiber is placed on top of the rising foam within the mold. A cover is applied to the top of the mold and engages the upper face of the abrasive non-woven fiber to limit the expansion of the polymerizing mass to the shape of the mold. The polymerization continues with cross-linking of the urethane prepolymer into solid foam mechanically bonded to the non-woven. The final solidified product is removed from the mold and now contains the detergent system of the formula including bactericide, color and fragrance. All agents and additives are homogeneously dispersed within the strands and fibers of the matrix for the foam product.

[0123] In use, the dishwashing pad is immersed in water, and the detergent is released by squeezing of pad in contact with a dish surface. If scrubbing is desired, turning the pad over and squeezing the abrasive non-woven surface on the items being cleaned also dispenses suds.

[0124] Testing the pads under controlled lab protocol resulted in six dishes washed with suds remaining.

EXAMPLE 5

[0125] A controlled release urethane polymer foam product for use as a body cleansing pad was prepared by combining an aqueous mixture containing the ingredients, including a skin moisturizing and softening material by weight, as follows:

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>PERCENT BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
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</tr>
<tr>
<td>Feldspar abrasive 200 mesh</td>
<td>24.63</td>
</tr>
<tr>
<td>A 1120 Silane OSI</td>
<td>.2</td>
</tr>
<tr>
<td>Laurimide DEA Chemron</td>
<td>1.29</td>
</tr>
<tr>
<td>Sodium Ether Sulphonate Chemron</td>
<td>6.66</td>
</tr>
<tr>
<td>Alpha Olefin Sulphonate 40% Pilot</td>
<td>5.46</td>
</tr>
<tr>
<td>Pluronic F88 BASF</td>
<td>.8</td>
</tr>
<tr>
<td>Geranben 2 Sutton Labs</td>
<td>.62</td>
</tr>
<tr>
<td>Citric Acid</td>
<td>.05</td>
</tr>
<tr>
<td>Color</td>
<td>.10</td>
</tr>
<tr>
<td>Fragrance</td>
<td>.1</td>
</tr>
<tr>
<td>Superabsorbent HS-80 Stockhausen</td>
<td>.1</td>
</tr>
<tr>
<td>Isethionate skin softener Rhodia</td>
<td>2.0</td>
</tr>
<tr>
<td>with Hydrophilic Urethane Prepolymer</td>
<td>31.29</td>
</tr>
</tbody>
</table>

[0126] The aqueous mixture was blended with high-shear mixing with a conventional metering machine, and the polymerizing mass was deposited onto non-woven roll goods on a releasable paper disposed in a movable carrier. A top releasable paper was applied to the upper surface of the moving polymerizing mixture.

[0127] Polymerizing continued as the polymerizing mass advanced by the movable carrier until the polymerizing mass became tack-free. The top and bottom paper was removed and the sheet of moist formed foam product was advanced to a die-cut station where the sheet was cut into undivided shaped product and packaged.

[0128] Tests made on the shaped and sized formed foam product confirmed that the pads provided additional uses than similar products made without the superabsorbent ingredient.

EXAMPLE 6

[0129] A controlled release urethane polymer composite foam product with abrasive qualities for the washing and waxing of an automobile was prepared from a formulation comprising:

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>PERCENT BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>26.39</td>
</tr>
<tr>
<td>Wollastonite Abrasive NYCO filler</td>
<td>13.20</td>
</tr>
<tr>
<td>Silane coupling agent A1120 OSI</td>
<td>.13</td>
</tr>
<tr>
<td>F88 Pluronic surfactant BASF</td>
<td>.30</td>
</tr>
</tbody>
</table>
The process of EXAMPLE 4 was followed without the addition of the non-woven insert in mold. The resultant 60 gram molded part cleaned an automobile 10 times with the superabsorbent versus less than 5 times without such superabsorbent. It was noted that the resulting finish maintained a gloss shine due to the silicone emulsion and wax components within the Maui proprietary blend.

The examples described above should provide adequate details of the invention. However, it should be noted by those skilled in the art that the disclosures herein are exemplary only and that various other alternatives adaptations and modifications may be made within the scope of the present invention. Accordingly, the present invention is not limited by the specific examples as illustrated. It is therefore to be understood that numerous modifications may be made to the illustrated examples and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

1. A controlled release urethane polymer foam product comprising the reaction composition of an aqueous formulation including, at least less than 0.5% by weight of a superabsorbent polymer, at least one agent from the group of detergents, soaps, waxes, polishes, abrasives, drugs, cosmetics, biologicals, volatiles, odor absorbing and controlling compositions, water soluble chemicals, water emulsions, water mixtures with solid particles in an amount from 0.5% to about 40% by weight of the aqueous formulation and water in an amount of 15% to 80% by weight of the aqueous formulation with a hydrophilic urethane prepolymer in a predetermined ratio in a range from 0.25% to 80% of the aqueous formulation whereby the at least one agent is dispersed throughout the matrix of the formed controlled release urethane foam product and slowly released on contact with an aqueous effluent.

2. The controlled release urethane polymer foam product as in claim 1, wherein the aqueous mixture includes at least one surfactant in an amount from 0.5% to 15% by weight of the aqueous mixture.

3. The controlled release urethane polymer foam product as in claim 1, wherein the surfactant is from the group of anionic, cationic, nonionic and zwitterionic surfactants.

4. The controlled release urethane polymer foam product in claims 1, 2 or 3 including, optionally and selectively, at least one additive from the group of bacteria, live cells, plant cells, viruses, algae, fungi, cellulose fibers, phase change materials, fragrances, vaccines, spremicides, coloring and dyes.

5. The controlled release urethane polymer foam product as in claims 1, 2 or 3, wherein the wax is from the group of crystalline wax, paraffin wax, wax emulsions and silicone fluids.

6. The controlled release urethane polymer foam product as in claims 1, 2 or 3, wherein the polish is from the group of light mineral abrasives less than 3 on the moh hardness scale and less than 20 micron particle size.

7. The controlled release urethane polymer foam product as in claims 1, 2 or 3, wherein the drugs are from the group of typical over-the-counter medicaments including topical skin treatments, wound care, anti-inflammatories, decongestants, disinfectants and/or insecticides.

8. The controlled release urethane polymer foam product as in claims 1, 2 or 3, wherein the cosmetics are from the group of materials made to improve or enhance the appearance such as vitamin E, retinol, aloe vera, hair conditioners, bath oils, suntan oils and U.V. protectants.

9. The controlled release urethane polymer foam product as in claims 1, 2 or 3, wherein the biologicals are from the group of plants, enzymes, bacteria and yeasts.

10. The controlled release urethane polymer foam product as in claims 1, 2 or 3, wherein the volatiles are from the group of fragrances, decongestants, insecticides and solvents.

11. The controlled release urethane polymer foam product as in claims 1, 2 or 3, wherein the odor absorbing and controlling compositions are from the group of odor neutralizers, enzymatic reactive, fragrances and anti-microbials.

12. A controlled release urethane polymer foam product comprising:

a. the reaction composition of an aqueous formulation including, a limited quantity of superabsorbent polymer, at least one agent from the group of detergents, soaps, waxes, polishes, drugs, cosmetics, biologicals, volatiles, odor absorbing and controlling compositions, water soluble chemicals, water emulsions and adequate water with a predetermined ratio of hydrophilic urethane prepolymer whereby the at least one agent is generally dispersed uniformly throughout the matrix of the formed controlled release urethane foam product and slowly released on contact with a water effluent; and

b. at least one surface of the formed controlled release urethane foam product having a layer of abrasive material.

13. A controlled release urethane foam as in claim 12, wherein the aqueous mixture includes at least one surfactant in an amount from 0.5% to about 15% by weight of the aqueous mixture.

14. The controlled release urethane polymer foam product as in claim 12, wherein the surfactant is from the group of anionic, cationic, nonionic and zwitterionic surfactants.

15. The controlled release urethane foam product in claim 12, including, optionally and selectively, at least one additive from the group of bacteria, live cells, plant cells, viruses, algae, fungi, cellulose fibers, phase change materials, fragrances, vaccines, spermicides, coloring and dyes.

16. The controlled release urethane foam product as in claims 12, 13 or 14, wherein the abrasive layer is formed integral with the at least one surface of the formed foam product.

17. The controlled release urethane foam product as in claims 12, 13 or 14, wherein the abrasive layer is adhered to one surface of the formed foam product.

18. The controlled release urethane foam product as in claims 12, 13 or 14, wherein the abrasive layer is adhered to the one surface of the formed foam product.

-continued

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>PERCENT BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maui Wash + Wax soap Chem-Quest</td>
<td>26.66</td>
</tr>
<tr>
<td>Superabsorbent A1120 OSI</td>
<td>20</td>
</tr>
<tr>
<td>with Hydrophilic Urethane Prepolymer</td>
<td>33.12</td>
</tr>
</tbody>
</table>
19. The controlled release urethane foam product as in claims 12, 13, 14, 15, 16 or 17, wherein the abrasive layer is a non-woven abrasive material.

20. The controlled release urethane foam product as in claims 12, 13, 14, 15, 16 or 17, wherein the abrasive layer is a woven fabric material.

21. A controlled release urethane foam product comprising:
   a. the reaction composition of an aqueous formulation including, at least less than 0.5% by weight of a superabsorbent polymer, at least one agent from the group detergents, soaps, waxes, polishes, abrasives, drugs, cosmetics, biologicals, volatiles, odor absorbing and controlling compositions, water soluble chemicals, water emulsions, water mixtures with solid particles in an amount from 0.5% to about 40% by weight of the aqueous formulation and water in an amount of 15% to 80% by weight of the aqueous formulation with a hydrophilic urethane prepolymer in a predetermined ratio in a range from 0.25% to 80% of the aqueous formulation whereby the at least one agent is dispersed throughout the matrix of the formed controlled release urethane foam product and slowly released on contact with a water effluent; and
   b. at least one surface of the formed controlled release urethane foam product having a layer of abrasive material.

22. The controlled release urethane foam product as in claim 21, wherein the abrasive layer is formed integral with the one surface of the formed foam product.

23. The controlled release urethane foam product as in claim 21, wherein the abrasive layer is adhered to the one surface of the formed foam product.

24. The controlled release urethane foam product as in claim 21, wherein the abrasive layer is adhered to the one surface of the formed foam product.

25. The controlled release urethane foam product as in claims 21, 22, 23 or 24, wherein the abrasive layer is a non-woven abrasive material.

26. The controlled release urethane foam product as in claims 21, 22, 23 or 24, wherein the abrasive layer is a woven fabric material.

27. The method for forming controlled release urethane foam products comprising the steps of:
   a. metering and mixing an aqueous formulation having at least a limited quantity of superabsorbent polymer, at least one agent from the group detergents, soaps, abrasives, waxes, polishes, abrasives, drugs, cosmetics, biologicals, volatiles, odor absorbing and controlling compositions, water soluble chemicals, water emulsions, water mixture with solid particles and adequate water with a predetermined ratio of hydrophilic urethane prepolymer to provide a polymerizing mixture for forming the controlled release urethane foam product;
   b. depositing the polymerizing mixture on releasable bottom paper disposed on a movable carrier;
   c. covering the upper surface of the polymerizing mixture with releasable top paper as the polymerizing mixture is moved with the carrier;
   d. advancing the polymerizing mixture in the top and bottom release paper by moving the carrier and sizing the foam layer being formed to the desired thickness until it is tack free;
   e. sequentially removing the top and bottom release paper while simultaneously drying the formed foam product to remove residual moisture; and
   f. passing the formed controlled release urethane foam product to secondary operations such as die cutting and molding to provide shaped and sized products for particular applications and uses.

28. The method for forming a molded controlled release urethane polymer foam product with abrasives comprising the steps of:
   a. metering and mixing an aqueous formulation having at least a limited quantity of superabsorbent polymer, at least one agent from the group detergents, soaps, abrasives, waxes, polishes, drugs, cosmetics, biologicals, volatiles, odor absorbing and controlling compositions, water soluble chemicals, water emulsions, water mixture with solid abrasive particles and adequate water with a predetermined ratio of hydrophilic urethane prepolymer to provide a polymerizing mixture for forming the controlled release urethane polymer foam product;
   b. dispensing a predetermined quantity of the polymerizing aqueous mixture into a shaped and sized mold; and
   c. placing a cover on the mold for to control the size and shape of the formed controlled release urethane polymer foam product.

29. In the method for forming a molded controlled release urethane polymer foam product as in claim 28, wherein in the water mixture with solid abrasive particles are from the group of abrasives including non-woven abrasive materials, woven materials and natural abrasive materials.

30. The method for forming controlled release urethane polymer foam products having an abrasive layer formed integrally with one exterior face comprising the steps of:
   a. metering and mixing an aqueous formulation having at least a limited quantity of superabsorbent polymer, at least one agent from the group detergents, soaps, abrasives, waxes, polishes, drugs, cosmetics, biologicals, volatiles, odor absorbing and controlling compositions, water soluble chemicals, water emulsions, water mixture with solid particles and adequate water with a predetermined ratio of hydrophilic urethane prepolymer to provide a polymerizing mixture for forming the controlled release urethane polymer foam product;
   b. dispensing a predetermined quantity of the polymerizing aqueous mixture into a shaped and sized mold;
   c. cutting a sized and shaped piece of abrasive non-woven material and fitting it into the mold for contact with the surface of the polymerizing mixture;
   d. placing a cover on the mold to control the size of the polymerizing mixture; and
   e. removing the formed controlled release urethane polymer foam product with the abrasive non-woven mate-
rial affixed to at least one exterior face and removing excess moisture from the formed foam product.

31. The method for forming controlled release urethane polymer foam products having an abrasive layer formed on one exterior face comprising the steps of:

a. metering and mixing an aqueous formulation having at least a limited quantity of superabsorbent polymer, at least one agent from the group of detergents, soaps, abrasives, waxes, polishes, drugs, cosmetics, biologicals, volatiles, odor absorbing and controlling compositions, water soluble chemicals, water emulsions, water mixture with solid particles and adequate water with a predetermined ratio of hydrophilic urethane prepolymer to provide a polymerizing mixture for forming the controlled release urethane polymer foam product;

b. dispensing a predetermined quantity of the polymerizing aqueous mixture into a shaped and sized mold;

c. placing a cover on the mold for contact with the surface of the shaped polymerizing mixture to control the size thereof and removing the sized and shaped and formed controlled release urethane polymer foam product from the mold;

d. removing residual moisture from the formed controlled release urethane foam product;

e. cutting a piece of abrasive non-woven material in the shape of the mold; and

f. laminating the abrasive non-woven material to the matching shaped surface of the formed controlled release urethane polymer foam product.

32. The method for forming controlled release urethane polymer foam products having an abrasive layer formed on one exterior face comprising the steps of:

a. metering and mixing an aqueous formulation having at least a limited quantity of superabsorbent polymer, at least one agent from the group of detergents, soaps, abrasives, waxes, polishes, drugs, cosmetics, biologicals, volatiles, odor absorbing and controlling compositions, water soluble chemicals, water emulsions, water mixture with solid particles and adequate water with a predetermined ratio of hydrophilic urethane prepolymer to provide a polymerizing mixture for forming the controlled release urethane polymer foam product;

b. dispensing a predetermined quantity of the polymerizing aqueous mixture into a shaped and sized mold;

c. placing a cover on the mold for contact with the surface of the shaped abrasive non-woven material;

d. cutting a piece of abrasive non-woven material in the shape of the mold; and

e. adhering the abrasive non-woven material to the matching shaped surface of the molded controlled release urethane polymer foam product.

    *    *    *    *    *