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RECIRCULATING TOILET SUMP FLUID

William F. Hamilton, Altadena, Calif., assignor to Lockheed Aircraft Corporation, Burbank, Calif.

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This invention pertains to the disposal of human wastes in vehicles such as aircraft, busses, trailers, boats, and the like, having chemical toilets where it is either dangerous, impractical or not possible to jettison the waste material which must consequently be stored for convenient periodic disposition. Specifically, the object of this invention is to provide a fluid composition for the sump of a chemical toilet which will serve to abate odor, destroy bacteria, and which can be used to flush residual waste matter from the sides of the toilet bowl or horn, and also to provide a method of rapidly producing large volumes of foams stable during toilet flushing operations.

The commonly used facility for human waste disposal consists of a toilet seat, a bowl or horn, and a receptacle or tank beneath for the collection and storage of the deposits. It is conventional to charge the sump of such a toilet with a suitable amount of fluid for odor and bacterial control, but at the present time there is usually no provision for washing the waste matter from the bowl. This often causes objectionable appearance and odor, and if the sump itself is visible, it also usually has a displeasing appearance.

Conventional sump fluid compositions vary widely, but they are almost always water solutions or emulsions containing phenols or cresols, caustic soda or lime, chlorinated hydrocarbons, pine oil disinfectants, quaternary ammonium salts or soaps, covering or neutralizing aromatics, and/or other materials selected from a wide variety of available germicides, perfumes and emulsifying agents. All of these compositions become progressively more highly colored as wastes are added to them and are consequently not aesthetically suitable for recirculating flushing purposes.

An improved mechanical type of toilet recently developed makes use of an electric pump to remove a portion of the sump fluid which is filtered and pumped around the toilet bowl or horn, flushing residual waste matter into the sump. The appearance of the sump fluid which is used for flushing in a toilet of this type is very important, as yellow, brown, red or amber colors have undesirable associations in the minds of the users. Dyes added to the sump fluid fail to produce pleasing colors; pigments suspended in the fluid fail to mask the brown color completely and tend to separate and settle out; oils or soaps emulsified in the fluid discolor relatively easily.

However, in accordance with the present invention, a pleasing appearance can be obtained by use of a foaming agent which permits the emulsification of air in the liquid, and gives the fluid a clean, nearly white, soapy aspect during the flushing operations. Bleed air is either admitted to the intake of the pump, or may be actually supplied from solution in the sump fluid by cavitation in the circulating pump or by entrapment during the flushing cycle. The foamy circulating fluid returned to the sump forms a blanket of white suds on the top of the tank. This not only improves the appearance of the sump fluid but also forms a blanket of foam for the abatement of odors. Under some conditions the sump fluid may not make complete contact with solid waste matter added, or contact may be delayed. In such conditions, bacterial action may occur, and undesirable odors be produced in relatively small quantities. These may be masked or covered by an aromatic material such as musk, and an additional aromatic material may be used as a reodorant.

such as lemon oil, oil of cashmere, or oil of rose or pine.

Germicidal action may be acquired by the use of relatively small quantities of one or more materials suitable for such purposes. Quaternary ammonium salts such as "Hyamine 1622" (p-diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride monohydrate) may be used for this purpose. Because no single agent is effective against all organisms, it may be desirable to include more than one in the sump fluid. Boric acid, which is a relatively weak bacterial growth inhibitor may be used in conjunction with the quaternary ammonium compound. In the sump fluid it not only serves to inhibit the growth of micro-organisms, but it buffers the material to a pH approximating 5, and protects the quaternary compound by helping to prevent its precipitation by soap or anionic type wetting agents which may be introduced into the sump.

A certain amount of dissolved air is present in water and in a circulating system the water entrains quantities of air, particularly during a pumping operation. It is a well known phenomenon that when water is subjected to a pressure greater than atmospheric or ambient pressure and then suddenly released to atmospheric pressure as by pumping water at a moderate velocity, the entrained air expands and the dissolved air is released by the water to expand causing appreciable amounts of transient foam to form and collect on the surface of the fluid. This action can be enhanced in the case of pumping water by bleeding air into the water prior to pumping to increase the amount of air entrained and dissolved by the water. Also cavitation (partial vacuum in the fluid caused by the rotating impeller) and agitation in a centrifugal pump will be a temporary pressure differential sufficient to cause some foaming prior to pressure release of the pressure pumped fluid.

This phenomenon is utilized in the present invention to create a method of producing a non-objectionable appearing liquid foam in a recirculating toilet. In accordance with the present invention, a pleasing appearance can be imparted to the sump fluid by use of a foaming agent in the sump fluid which permits the entrapment of the expanding air in the liquid to form large quantities of lasting foam to give the fluid a clean, nearly white, soapy aspect during the flushing operation.

The quaternary ammonium compounds in water are also effective in producing foam and in wetting the materials introduced.

These compounds are generally inexpensive and are only required in relatively small quantities for antibacterial action. In very low concentrations they may not be sufficiently strong in their foaming action to give the desired soapy effect in the flushing operation. The addition of a modicum of a very strong foaming agent or foam stabilizer such as saponin will materially increase the ease of foaming and the permanence of the foam. This foaming agent must be added in carefully proportioned amount to avoid the formation of too much foam as the liquid is circulated.

For use in aircraft, it is essential that the weight of the sanitary facilities be minimized. The volume of the sump fluid must be as small as possible and extra tanks such as separate reservoirs for flushing liquid must be eliminated. In accordance with this invention, the sump acts as both waste storage and flushing fluid reservoir, and the sump fluid serves to control waste odor, bacteria and appearance, as well as to operate acceptably for flushing purposes. The combination of agents for odor and bacterial control with emulsified air or gaseous foam for control of the appearance makes adequate flushing and sanitation practical with a minimum of equipment and weight.

Example 1

A preferred formulation for the flushable toilet sump fluid is (to 50 ml. of water, add and dissolve):

p-Diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride monohydrate	grams	30
Saponin	do	5
Formaldehyde, 40% aqueous	ml	150
Oil of musk	ml	2
Oil of cashmere	ml	2

Filter to clarify the solution and package in a ½ pint bottle.

This charge is formulated for addition to 3 gallons of sump water in an aircraft flushable toilet. In some cases it may be desirable to place as much as about 450 grams of boric acid crystals in the sump, or in the water added. The liquid concentrate addition prepares the flushable toilet for use.

In use, the volume of sump fluid may be increased to twelve gallons or more. The final concentration of the quaternary salts is safely over 1:2000, and at this concentration it is bactericidal to most micro-organisms. Formaldehyde odor is not readily detectable in the sump fluid, but it is useful as an auxiliary germicide and fungicide as well as for additional odor masking to supplement the musk. Its final concentration is less than 1:1000 because of evaporation, and some of it is used in the precipitation of the protein. The musk oil is the primary odor masking aromatic. If present in too great a concentration it is mildly unpleasant; if too little is used it does not mask the undesirable odors. The boric acid is compatible with the quaternary compound, and it serves as a protective agent to aid in preventing precipitation of the latter in case soap or anionic wetting agents are introduced into the system. Being a mild disinfectant, it also serves to inhibit growth of bacteria in the solution. Its use in the fluid is optional; other buffering agents may be utilized. The oil of cashmere is used for re-odoring purposes, and gives the sump fluid a pleasant clean aroma which is often associated with soap.

When pumped through the filter from the sump, foam is generated in the centrifugal pump, and if an insufficient amount is produced by cavitation in the pump, or if the fluid does not contain enough dissolved gas for adequate foaming, bleed air is admitted into the suction line. The foamed liquid from the pump, circulated around the bowl or horn, has a white or very light creamy soapy appearance.

This flushable toilet may be used without recharging for a week or more, or until the sump becomes filled. Bacterial cultures taken at intervals during use are either negative or very low in count. In our experience growth of pathogens has not been encountered in sump fluid cultures. Users of this flushable toilet have consistently reported the odor as "imperceptible" or "mild" with the scent of the reodorant predominant.

The amount of quaternary ammonium salt used should be sufficient to assure good antibacterial action and yet not raise the cost of the charge excessively. Amounts between approximately twenty and seventy grams are effective, but any substantial increase may cause gelling of the concentrate if cold. Boric acid may vary from nothing to about one pound, the limit of its solubility in the three gallon charge. The saponin content of the concentrate, if below about 2 grams gives too little foam and above about 10 grams may cause overflow of excess foam after repeated flushing. The proportion of musk oil, as previously indicated, is somewhat critical and should not be more than about three milliliters. The amount of oil of cashmere is not critical, and the mixture may be scented to taste using from none to about three milliliters. The formaldehyde may be omitted or it may be used up to the proportion required for faint discernibility in the three gallon charge, about 200 milliliters. Above this amount it may be irritating to sensitive individuals.

The half pint concentrate for the three gallon sump charge in the toilet, suitable for dilution to twelve or fifteen gallons with waste matter should accordingly contain approximately:

Quaternary ammonium salt	grams	20–70
Formaldehyde, 40% solution	ml	0–200
Saponin	grams	2–10
Oil of musk	ml	0–3
Oil of cashmere	ml	0–3
Water	ml	20–200

From 0–1 lb. of boric acid may be added to the sump fluid if additional antibacterial protection is desired.

The solution, if proportioned and handled as indicated, will cause the flushing fluid to appear soapy white, or slightly creamy, and it will be relatively safe against infection or irritation in case of accidental splash or spillage during use or handling. It is also important that it will not cause corrosion of metals or materials with which it may come in contact. If boric acid is used, and in sufficient quantity, the mildly acidic buffering is favorable to retarding bacterial growth.

Example 2

Mix and dissolve:

Benzalkonium chloride	grams	50
Saponin	do	4
Water	gallons	3

and use this charge as a sump fluid in a flushable circulating toilet. This mixture foams strongly when agitated with air and pumped for flushing purposes from the sump around the bowl. It is suitable for handling up to about 12 gallons of added waste materials.

Example 3

To about 3 gallons of water, add and dissolve:

	Grams
p-Diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride monohydrate	70
Saponin	3
Boric acid	500

This solution may be diluted as much as five times with waste material in a toilet sump and when mixed with a small amount of air gives a pleasing sudsy appearance as a flushing fluid. Bacterial growth has not been experienced with its use, and little or no odor occurs with it during use.

Example 4

Alkyl (C_9–C_{15}) tolyl methyl trimethyl ammonium chlorides, 10% aqueous solution	300 ml.
Pine oil	5 ml.
Protein hydrolysate	Sufficient to produce suitable foaming.

Add and dissolve in about 3 gallons of water and use in toilet sump. For flushing, filter into the circulating system with a small amount of bleed air. The amount of foaming agent required will vary with the concentration and type of protein hydrolysate used, as different manufacturers produce hydrolysates from various proteins. Satisfactory results can be obtained with dilutions up to about 12 gallons.

Example 5

Another preferred formulation for flushable toilet sump fluid is the following single package alkaline concentrate:

p-Diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride mono-hydrate	grams	30
Saponin	do	5
Water	ml	250
Formaldehyde, 40% aqueous	ml	150
Trisodium phosphate	grams	100
Oil of musk	ml	2
Oil of cashmere	ml	2

Dissolve in the order given, and filter if desired.

This concentrate, when added to three gallons of sump water, is suitable for controlling up to nine to twelve gallons of waste material. The pH of the final diluted fluid approximates 9–10, and the germicide is more effective in alkaline than acid solutions. Instead of the trisodium phosphate, sodium dihydrogen phosphate, sodium carbonate, or other salts compatible with the quaternary compounds may be used.

The examples given are illustrative of the invention only insofar as they include suitable germicides and foaming agents. Any quaternary ammonium salt which is effective against bacterial growth may be used without detracting from the scope of this invention, and similarly any compatible foaming agent may also be used. The foaming agent may be chosen from a very wide variety of substances ranging from saponins to polypeptides, albumins, protein-hydrolysates, water-soluble cellulose derivatives and so forth. Soaps or anionic foaming agents are not usually compatible with the germicidal quaternary salts and are unsuitable for use, particularly in the acidic sump fluid. Iodine or iodophors are not suitable because they are dark red and color the foam undesirably yellow to brown even though they may be highly effective germicides at low pH. The use of covering odors, reodorants, buffers and/or a plurality of germicides is optional, and while preferred, is not essential to the operation of this invention.

It is to be understood that the foregoing description is by way of illustration, and that changes, omissions, additions, substitutions and/or modifications may be made within the scope of the claims without departing from the spirit of the invention.

I claim:

1. A recirculating sump fluid for a flushable toilet capable of treating approximately 12 gallons of sewage when said fluid is aerated consisting essentially of from 20 to 70 grams of a quaternary ammonium anti-bacterial salt from the group consisting of p-diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride monohydrate, benzalkonium chloride, and alkyl C_9–C_{15} tolyl methyl trimethyl ammonium chloride, from 2 to 10 grams of saponin and water to form approximately 3 gallons of total solution.

2. The recirculating sump fluid of claim 1, in which the final concentration of the quaternary salt is over 1:2000.

3. The recirculating sump fluid of claim 1 having an amount of boric acid within the solubility range of the about 3 gallon charge.

4. The recirculating sump fluid of claim 1 having less than approximately 200 ml. of a 40% aqueous solution of formaldehyde.

5. The recirculating sump fluid of claim 1 in which the amount of saponin is 5 grams.

6. The recirculating sump fluid of claim 4 having less than about 3 ml. of oil of musk and less than about 3 ml. of oil of cashmere.

7. The recirculating sump fluid of claim 4 having an amount of boric acid within the solubility range of the about 3 gallon charge.

8. The recirculating sump fluid of claim 4 in which the final concentration of the quaternary salt is over 1:2000.

9. A recirculating sump fluid for a flushable toilet capable of treating approximately 12 gallons of sewage when said fluid is aerated comprising 30 grams of p-diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride mono-hydrate, 5 grams of saponin, 250 ml. water, 150 ml. of a 40% aqueous solution of formaldehyde, 100 grams of salt from the group consisting of trisodium phosphate, sodium dihydrogen phosphate, and sodium carbonate, 2 ml. of oil of musk, 2 ml. of oil of cashmere and about 3 gallons of water.

10. The recirculating sump fluid of claim 9 having an amount of boric acid within the solubility range of the about 3 gallon charge.

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