United States Patent Office 3,107,216 Patented Oct. 15, 1963

3,107,216

RE-CIRCULATING TOILET SUMP FOAMING COMPOSITIONS AND METHOD FOR PRODUCING THE FOAM UNDER TOILET OPERATION CONDITIONS

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

No Drawing. Original application Dec. 5, 1957, Ser. No. 700,755, now Patent No. 2,998,390, dated Aug. 29, 1961. Divided and this application Jan. 25, 1961, Ser. No. 84,763

4 Claims. (Cl. 210—60)

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 volume foams stable during toilet flushing operations.

This is a divisional application of copending application Serial Number 700,755, filed December 5, 1957, now U.S. Patent No. 2,998,390.

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 annd 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 very 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 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 re-circulating flushing purposes.

An improved mechanical type of toilet recently developed makes use of a 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.

The pump in the mechanical type toilet (i.e., re-circulating toilet) of course must develop sufficient differential pressure to circulate liquid from the sump to the strainer up into the toilet bowl in adequate volume and with a sufficiently rapid velocity to carry out the flushing operation. Further, in aircraft, the output of the pump must be sufficient to maintain proper circulation of fluid at all cabin conditions as well as an atmospheric operation at sea level. Manifestly, in operating thusly, the pump momentarily produces a pressure on the fluid passing through it to be discharged into the toilet bowl somewhat greater than the ambient pressure existing in the toilet bowl where the flushing liquid is released to flush the bowl.

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 and agitation in a centrifugal pump (partial vacuum in the fluid caused by the rotating impeller) 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 re-circulating 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.

In accordance with the present invention, a pleasing appearance can be imparted to the sump fluid by use of a foaming agent which permits the expanding air in the liquid to give 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 deodorant, such as lemon oil, oil of cashmere, or oil of rose or pine.

Germicidal action may be acquired by the use of relatively small quaintities of one or more materials suitable for such purpose. 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.

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 suf-

ficiently 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 gaseous foam for control of the appearance makes adequate flushing and sanitation practical with a minimum of equipment and weight.

Example I

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 by the centrifugal pump, and if an insufficient amount is produced by cavitation in the pump and release of pump pressure, 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 C9–C15 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 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 dilute 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, proteinhydrolysates, 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 fluid. Iodide 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.

What I claim is:

1. The method of producing a non-objectionable appearing liquid foam in a recirculating toilet having a sump and a pump which comprises the step of placing, a recirculating aqueous toilet sump composition including a water foaming agent in the toilet sump in a quantity sufficient to cause foaming of the sump liquid upon pumping the liquid and releasing same to the atmosphere, pumping the liquid from said sump through said pump thereby pressurizing the liquid, suddenly releasing the pressure on said liquid by passing it into an atmospherically open system, thereby releasing the dissolved gas in said solution to form foam, flushing said foamed liquid around the toilet bowl to clean said bowl and returning the flushing fluid into the sump for recirculation.

2. A method of operating a recirculating type toilet having a toilet bowl and a sump connected to said toilet bowl, said sump containing a liquid composition capable of forming a stable foam, which method includes the steps of:

a. separating liquid from the contents of said sump;

b. pressurizing the liquid separated from the contents of said sump;

c. releasing the pressurized liquid into the atmosphere so as to cause the formation of a foam by the release of pressure on any dissolved gas within the said liquid;

d. flushing said liquid and foam around the interior of said toilet bowl so as to clean said bowl; and

e. returning said liquid and foam to said sump, said foam remaining on the surface of material within said sump so as to cover the material located within said sump.

3. A method of operating a recirculating type toilet having a toilet bowl and a sump connected to said toilet bowl, said sump containing a liquid composition capable of forming a stable foam, which method includes the steps of:

a. separating liquid from the contents of said sump;

b. introducing a gas into the separated liquid;

c. pressurizing the liquid containing gas;

d. releasing the pressurized liquid into the interior of said toilet bowl so as to cause the formation of a foam by the release of pressure on the gas within said liquid to atmospheric pressure;

e. flushing said liquid and said foam around the interior of said toilet bowl so as to clean said bowl; and

f. returning said liquid and foam to said sump, said foam remaining on the surface of material within said sump so as to cover material located within said sump.

4. A method of operating a recirculating type toilet having a toilet bowl and a sump for receiving material from said toilet bowl connected to said toilet bowl, said sump containing a liquid composition capable of forming a stable foam, which method includes the steps of:

a. removing liquid from the interior of said sump;

b. applying pressure to the liquid removed from said sump while introducing air into said liquid;

c. releasing the pressurized liquid into the interior of said toilet bowl so as to cause the formation of a foam by the release of pressure on gases within said liquid to atmospheric pressure in such a manner as to cause said liquid and said foam to flush the interior of said toilet bowl and to flow from said bowl into said sump; and

d. retaining said liquid and foam and material from said toilet bowl within the interior of said sump, said foam remaining on the surface of material within said sump so as to cover material located within said sump.

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