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CRYSTALLINE MENAPHTHYL QUATERNARY AMMONIUM SALTS

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This invention relates to the preparation of a new class of quaternary ammonium organic compounds. More particularly, it concerns novel crystalline germicides which are quaternary ammonium chlorides.

The need for crystalline germicides possessing high bacteriological activity has long been recognized, but a satisfactory material has not heretofore been developed. Useful germicides of such a type must possess many special properties, which up to now have not been found together in one product. The material should first and foremost be crystalline; anhydrous powders are most easily, safely and cheaply packaged and handled. Such a product should also be water-soluble and non-hygroscopic; germicides are normally employed in aqueous systems, but at the same time they should not readily pick up moisture during storage and shipment. A germicide must also, very obviously, have high bacteriological activity, generally measured by its phenol coefficient. For safety's sake, too, it is particularly desirable to have the material non-irritant to the skin, eyes, mucous membranes, etc. Lack of odor and color are also advantageous. Further, to be commercially practicable a germicide should be easily prepared from readily available and comparatively inexpensive raw materials.

There is in effect only one solid quaternary ammonium germicide currently enjoying some commercial use: an isooctylphenoxyethoxyethyl benzyl ammonium chloride. This has the advantage of being solid, of course. Too, it has a fairly satisfactory phenol coefficient, although considerably lower than that of conventional non-solid germicides (i. e. about 325 with *S. Aureus* and 200 with *Sal. typhosa*). However, it is hygroscopic and markedly irritating to mucous membranes. Another type of solid quaternary ammonium compounds is known, namely certain bromides. However, these are so hygroscopic that they are most difficult to obtain in solid form, they are so expensive that they do not compete with standard germicides, and finally their germicidal activity is in fact too low to render them of interest in the field.

A novel class of quaternary ammonium products has now been prepared which obviate the above and other disadvantages of hitherto known compounds. This new class comprises crystalline, non-hygroscopic, bacteriologically active n-alkyl dimethyl alpha-menaphthyl ammonium chlorides wherein the alkyl group contains substantially between ten and fourteen carbon atoms. Such products are readily prepared as anhydrous

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powders, suitable for relatively cheap packaging, long storage, and safe handling. Particularly good examples of this class are the n-decyl, lauryl (n-dodecyl) and n-tetradecyl compounds. Of these, lauryl dimethyl alpha-menaphthyl ammonium chloride is especially preferred by reason of its unusually high phenol coefficient and its ease of preparation.

Representative bacteriological activity of some of these materials in relation to two standard microorganisms is as follows: (According to the method given by the U. S. Department of Agriculture Bulletin No. 198.)

Alkyl group	Phenol Coefficient at 20° C.	
	S. aureus	*Sal. typhosa*
n-Decyl	125	250
Lauryl (tech. n-dodecyl)	500–750	625–1,000
tech. n-tetradecyl	333	250

The peak of efficiency in this series is thus reached by the lauryl compound.

The unique character of the new germicides is further shown by the fact that closely related quaternary ammonium compounds do not exhibit at all similar properties. Peculiarly enough, even isomers or homologues of the products have been obtained only as very hygroscopic, syrupy materials, non-crystalline in character and most difficult to handle. This is true, for instance, of lauryl dimethyl beta-menaphthyl ammonium chloride, lauryl dimethyl (beta-methyl alpha-menaphthyl) ammonium chloride, and lauryl dimethyl (tetrahydro alpha-menaphthyl) ammonium chloride.

The process whereby the valuable products of this invention are obtained broadly comprises heating together in an inert liquid system alpha-chloromethyl naphthalene and a n-alkyl dimethyl amine wherein the alkyl group contains substantially between ten and fourteen carbon atoms, e. g. n-decyl dimethyl amine, n-dodecyl dimethyl amine, n-tetradecyl dimethyl amine, mixtures thereof or the like. The liquid system may comprise certain organic solvents in which the reactants are soluble, such as alcohol, dioxane, acetone, benzene, ethyl acetate, carbon tetrachloride, etc. However, this is not necessary and the system may be one, like water, in which the reactants themselves are insoluble but the reaction product is appreciably soluble. Preferably, of course, the product is soluble in the particular liquid system only at the elevated temperatures achieved by the

reaction, and grows appreciably insoluble therein as the mass is thereafter cooled, say to merely room temperature or to an easily obtainable lower temperature. Rapid crystallization of the product from solution is thereby achieved. When reaction occurs between the two organic constituents a solution is formed in the system, which is then cooled. The resulting precipitate of crystalline n-alkyl dimethyl alpha-menaphthyl ammonium chloride is finally recovered.

According to a preferred embodiment of this process, alpha-chloromethyl naphthalene is heated in an aqueous medium with a n-alkyl dimethyl amine, such as lauryl dimethyl amine (the lauryl group originating from cocoanut fatty acids). Although not essential, it is obviously best for complete reaction and optimum efficiency to employ stoichiometric equivalents of the two reactants. The mixture is stirred mechanically for intimate contact while being heated. When the temperature has risen sufficiently (to about 50° C. in the case of the lauryl compound) the reaction becomes exothermic and the constituents dissolve in the medium to form a clear solution. The operation may be stopped at this point, if desired. However, to insure full utilization of the reactants and adequate product yields, it is preferable to keep the temperature at just below the boiling point of the system for some additional time, say ½ to 3 hours. The time required for complete reaction is readily determined, inter alia, by titrating a sample of the solution with silver nitrate to indicate when the available chlorine has been converted to the chloride ion. One skilled in the art can thus easily establish the time best suited for a given reaction, depending upon the particular reactants and system employed, the temperature, and such interdependent operating conditions.

When the reaction has terminated, the quaternary ammonium product may be recovered from solution by substantially any desired means, e. g. by simple evaporation of the solvent, cooling until the precipitate begins to salt out, seeding with crystals of preformed product, or a combination of these techniques. An especially satisfactory method is to raise the temperature to the boiling point of the system, so that the mixture is first concentrated. Steam-distillation is frequently employed, whereby byproducts and any unreacted materials, as well as the solvent, may be removed. The residue is finally allowed to cool, and the product begins to crystallize out. This cooling may be simply to room temperature or, to speed the precipitation, the mass may be refrigerated at below room temperatures, e. g. 0° to 15° C. To speed crystallization still more, previously obtained crystals of the same quaternary ammonium compound may be used to seed the solution.

The precipitated crystals of the new germicide may finally be recovered from the mother liquor by any desired means. Filtration is particularly easy and rapid, especially in an aqueous system, although sometimes the filtrate may foam considerably. The crystals may finally be washed or otherwise further purified and/or recrystallized, if thought desirable. A free flowing, anhydrous, non-hygroscopic powder is obtained.

As already mentioned, the new products of this invention have a number of distinctive advantages not heretofore contemplated in germicides. Among these may be mentioned especially the facts that they are:

1. Easily prepared from commercially available and relatively inexpensive raw materials.

2. Easily isolated in solid, crystalline form.

3. Non-hygroscopic, water-soluble and non-irritant.

4. Generally colorless and odorless.

5. Bacteriologically active, being actually superior in this property to most commercially available germicides.

The following examples are given simply to illustrate this invention and not in any way to limit its scope. Indeed, as many apparently widely different embodiments of this invention may be made without departing from the spirit and scope hereof, it is to be understood that the above invention is not limited except as defined in the appended claims.

Example

One hundred and seventy-four grams (1.0 mol) of alpha chloromethyl naphthalene and 242 grams (1.0 mol) of lauryl dimethyl amine were mixed with 1230 grams of water, and the milky mixture was heated under reflux with mechanical stirring. When the temperature reached 50° C., the reaction became exothermic and a clear solution was formed. Heating was continued for one hour at 60°–65°. After this period, titration with silver nitrate indicated that the available chlorine had been quantitatively converted to chloride ion. One thousand grams of water were added, and the temperature of the mixture was raised to the boiling point. Steam distillation removed a small but significant amount of oil. The residual solution was allowed to cool to room temperature and seeded with a few crystals of lauryl dimethyl alpha-menaphthyl ammonium chloride, to accelerate crystallization. A white solid began to form. The mass was further cooled in a refrigerator (at about 15° C. for six hours, and the precipitate was then filtered on a Buchner funnel and dried. Filtration was very easy and rapid, except for considerable foaming of the filtrate.

Crystals of lauryl dimethyl alpha-menaphthyl ammonium chloride were thus obtained as a free-flowing white powder, practically odorless and non-hygroscopic. This product contained the calculated amount of titratable chloride (8.4% as Cl^-) and melted at 77°–80° C. The yield was 564 grams, or 90% of the theoretical. Titration of the filtrate indicated that the aqueous solution (presumably saturated) contained 3% dissolved product, thus accounting for a further 8% of the theoretical yield, and bringing the total recovery up to 98% of the theory. The new crystalline quaternary ammonium germicide exhibited the following solubility characteristics.

Solvent	Room Temp.	At B. P.
Ethanol	sol	very sol.
Dioxane	insol	very sol.
Carbon tetrachloride	sol	very sol.
Acetone	sl. sol	very sol.
Ethyl acetate	sl. sol	very sol.
Benzene	sl. sol	very sol.
Ethyl ether	insol	insol.
Water	2-3%	very sol.

Water solutions prepared at elevated temperature and containing 5–25% by weight of the compound, readily deposited crystals on cooling; but more concentrated and viscous solutions crystallized more slowly and seeding was often especially desirable to initiate crystal-formation.

What is claimed is:

1. Crystalline, non-hygroscopic, bacteriologi-

cally active n-alkyl dimethyl alpha-menaphthyl ammonium chlorides wherein the alkyl group contains between 10 and 14 carbon atoms.

2. Crystalline, non-hygroscopic, bacteriologically active lauryl dimethyl alpha-menaphthyl ammonium chloride.

3. A process which comprises heating together in a liquid system alpha-chloromethyl naphthalene and a n-alkyl dimethyl amine wherein the alkyl group contains between 10 and 14 carbon atoms, cooling the system, and recovering the resulting precipitate of crystalline n-alkyl dimethyl alpha-menaphthyl ammonium chloride.

4. A process which comprises heating an aqueous mixture of equimolar proportions of alpha-chloromethyl naphthalene and lauryl dimethyl amine at least until a clear solution is obtained, steam-distilling the solution, cooling the resulting concentrate to at least room temperature, and recovering the crystalline lauryl dimethyl alpha-

menaphthyl ammonium chloride thereby precipitated.

5. Crystalline, non-hygroscopic, bacteriologically active n-decyl dimethyl alpha-menaphthyl ammonium chloride.

6. Crystalline, non-hygroscopic, bacteriologically active n-tetradecyl dimethyl alpha-menaphthyl ammonium chloride.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,309,592	Hueter	Jan. 26, 1943

OTHER REFERENCES

Baltzly: "J. A. C. S.," vol. 64, Sept. 1942, p. 2231.

Braun: "Ber. deut. Chem.," vol. 56 (1923), p. 2171.

Winternitz et al.: "Bull. Soc. Chim. Biol.," vol. 33 (1951), p. 374.