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## MINE STERILIZATION BY MEANS OF A DELIQUESCENT ADDITIVE

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13 Claims

### ABSTRACT OF THE DISCLOSURE

Self-sterilization capability is imparted to a chemically oriented mine by the incorporation into the active explosive of a material which is hygroscopic and deliquescent. The latter material absorbs moisture from the atmosphere and deliquesces into an aqueous solution which reacts with the active explosive rendering it less sensitive and ultimately sterilized and safe to handle.

The invention described herein may be manufactured, used and licensed by or for the Government for governmental purposes without the payment to use of any royalties thereon.

Broadly, this invention relates to the sterilization of a chemically oriented mine.

More particularly, this invention relates to a chemically oriented mine having means for use in the sterilization of such mine over a predetermined period of time.

The success of a military offensive within a specified zone or sector of a battlefield requires a relatively high mobility and this in the last analysis dictates some type of movement by the infantry within the zone in issue. It is therefore a military requirement of the defending forces to impede or hinder this movement thereby retarding the full use of the resources of the enemy and hopefully the success of their mission. In modern times, this is accomplished within a specified zone or sector by the mass sowing of items of destruction such as mines and the like.

However, after a time, in order for the defending forces to have access and mobility of their own within the sector, there must be some provision for the deactivation of such items of destruction in a comparatively safe manner. In the past, there were numerous mechanical adaptations placed on mines for the express purpose of sterilization but none of these expedients were readily acceptable due to a loss of reliability of the mine, clumsiness of construction of the sterilizing device itself, and/or prohibitive cost. In particular, these mechanical adaptations were not readily adaptable to the pressure-sensitive low-cost chemically oriented mines of the lead azide variety.

The subject invention answers the needs of the art as heretofore described with special emphasis on the sterilization of a chemically oriented mine with facility over a predetermined duration of time.

It is therefore an object of this invention to provide an improved means for the sterilization of a chemically oriented mine.

Another object is to provide a chemically oriented mine adapted with means for desensitization and subsequent sterilization over a predetermined period of time.

A further object is to provide a pressure-sensitive chemically oriented mine of the lead azide variety with

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means for use in the self-sterilization of said mines over a predetermined period of time.

A still further object is to provide the aforesaid means having low fabrication and maintenance cost and being operative over a wide variety of service conditions in many different chemically oriented mines.

Other objects and many of the attendant advantages of this invention will become better understood upon a reading of the following detailed specification wherein:

10 This invention broadly encompasses the desensitization and ultimate sterilization of a chemically oriented mine containing a primary explosive, such as for example lead azide and other metallic azides and lead styphnate, by the incorporation into such explosive material of a hygroscopic additive which will ultimately deliquesce to solvate 15 and react with such explosive material, thereby rendering it substantially inactive and ultimately inert over a predetermined period of time.

20 More specifically, this invention essentially encompasses the incorporation of an additive into the primary explosive ingredients of a mine of the lead azide variety which absorbs moisture from the atmosphere and deliquesces, thereby resulting in a chemical solution which reacts with such explosive ingredients to render them 25 sterilized and safe to handle.

This invention is particularly advantageous with respect to a chemical or chemically oriented mine of the lead azide variety which is used for anti-personnel action.

30 The materials or additives which may be utilized to desensitize and ultimately sterilize the primary explosive ingredients of a mine include calcium chloride, lithium chloride, magnesium chloride, sodium sulfate sodium hydroxide, and potassium hydroxide.

35 The additive in the substantially anhydrous form is placed, either as loose powder or in pellet form, into a housing or bag which is water repellent but permeable to water vapor. Water vapor is extracted from the atmosphere by the hygroscopic additive, which deliquesces, thereby spreading a solution of the additive throughout the explosive mixture in the bag rendering it substantially less sensitive to impact. Lithium chloride is especially useful for this purpose due to its ability to deliquesce at relatively low humidity. Furthermore, the additive in solution form will react with the primary explosive component, thereby sterilizing the mine. The 40 hygroscopic additives of this invention are also effective for desensitizing organic azides; e.g., cyanuric triazide. Thus, anti-personnel mines containing an organic azide as the primary explosive can be desensitized by the aqueous hygroscopic additive to such a degree that the mine is no longer sensitive to personnel action. However, owing to their poor solubility in aqueous media, such organic azides will react slowly with the aqueous hygroscopic additive and ultimate complete sterilization of the mine will be 45 extremely slow if not impractical.

50 To insure further sterilization of the explosive ingredients, the tetrasodium salt of ethylenediamine tetraacetic acid is added in powder form to the lithium chloride additive. In this manner, the metal, such as lead, is extracted from the primary explosive material by the aforementioned salt of tetraacetic acid thereby insuring sterilization.

55 The rate of absorption and deliquescence is based on the surface area exposed to the ambient air which is also a function of the particle size distribution of the additive. A preferred embodiment in pellet form which

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has been found to be highly satisfactory is set forth in Example I which follows:

## EXAMPLE

## Physical characteristics:

- (a) Wt. of pellet—3.000 grams  $\pm$  0.362 gram, max.
- (b) Dimension:  
Diameter—.840  $\pm$  .007 in.  
Thickness—.220 in. max.
- (c) Density—1.64 gm./cc. min.
- (d) Composition:  
Anhydrous lithium chloride—6.62  $\pm$  3 %  
The tetra sodium salt of ethylenediaminetetraacetic acid—33.1  $\pm$  3 %  
Graphite—0.7 max.

In operation.—When the mine is exposed to the ambient atmosphere, the anhydrous lithium chloride component of the pellet extracts moisture from the atmosphere. Over a period of time, the pellet extracts enough water to cause itself to deliquesce. The resulting aqueous solution chemically reacts with the primary explosive; e.g., lead azide in the mine thereby sterilizing the same.

The composition of the aforescribed pellet is such that the active life of the mine is predictable. Furthermore, the tolerances with respect to dimensions, density and composition of the pellet are such that the actual sterilization times will fall within the predicted sterilization times for a given set of temperature and humidity conditions.

The invention as heretofore described provides an entirely new capability for the military. Previously, mines once emplaced were a permanent threat to future movement of friendly forces attempting to pass through an area which they themselves had mined. This invention has provided a new capability in mines and a definite tactical advantage to such friendly forces. The mines which have been adapted with the means of this invention will automatically become sterilized after a known period of time and after that will not impede the mobility of such forces.

## We claim:

1. In a pressure-sensitive chemical mine containing a primary explosive selected from the group consisting of metal azides and lead styphnate, the combination therewith of a deliquescent additive selected from the group consisting of alkali metal and alkaline earth metal chlorides, hydroxides, and sulfates, said deliquescent additive forming an aqueous solution reactive with said primary explosive, thereby desensitizing and sterilizing said mine.

2. The chemical mine of claim 1 wherein said additive is selected from the group consisting of lithium chloride, calcium chloride, magnesium chloride, sodium sulfate, sodium hydroxide and potassium hydroxide.

3. The chemical mine of claim 2 wherein said additive is calcium chloride.

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4. The chemical mine of claim 2 wherein said additive is magnesium chloride.

5. The chemical mine of claim 2 wherein said additive is sodium sulfate.

6. The chemical mine of claim 2 wherein said additive is sodium hydroxide.

7. The chemical mine of claim 2 wherein said additive is lithium chloride.

8. The chemical mine of claim 7, wherein ethylene diamine tetra-acetic acid tetrasodium salt is incorporated.

9. The chemical mine of claim 8 wherein said lithium chloride is present in an amount of between about 63.2 and 69.2 percent and said tetrasodium salt of ethylenediamine tetraacetic acid is present in an amount between about 30.1 and 36.1 percent, both in combination with up to about 0.7 percent graphite, all said percentages being by weight.

10. The chemical mine of claim 9 wherein said lithium chloride is present in an amount of about 66.2 percent, and said tetrasodium salt of ethylenediamine tetraacetic acid is present in an amount of about 33.1 percent, and said graphite is present in an amount of about 0.7 percent.

11. The chemical mine of claim 1, wherein the primary explosive is lead azide.

12. A pellet for use in the sterilization of a chemical mine containing lithium chloride in an amount between about 63.2 and 69.2 percent and the tetrasodium salt of ethylenediamine tetraacetic acid in an amount between about 30.1 and 36.1 percent, and up to about 0.7 percent graphite, all said percentages being by weight.

13. The pellet of claim 12 wherein the total weight represents about 66.2 percent lithium chloride, about 33.1 percent tetrasodium salt of ethylenediamine tetraacetic acid and about 0.7 percent graphite.

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