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## FUMIGATION PROCESS

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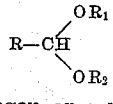
This invention relates to improved methods for checking the growth of and destroying pests such as bacteria, insects and mice and more particularly to methods for fumigation. In the milling industries, for example, millions of dollars are lost annually due to the damage to the grain or flour by the presence of insects and other pests. Perhaps the more common method of combating insects in mills is by means of fumigation with methyl bromide, which is of course an extremely dangerous fumigant to handle, particularly since it does not have such a strong odor as to warn the layman of its presence.

It is therefore an object of the present invention to provide an improved process of fumigation.

It is a further object of the present invention to provide an improved process for fumigating grain without injuring the grain.

It is a further object of the present invention to provide an improved process of fumigation, utilizing a compound which has a noticeable odor, thus warning people of its presence.

These and other objects of the present invention are attained by the improved process which comprises evaporating in the air surrounding the pests a compound having the following general formula:



wherein R is hydrogen or a methyl group, $R_1$ is ethyl, chloroethyl or a propenyl group, and $R_2$ is a chloroethyl, propenyl or alkyl group.

Examples of the compounds found effective as fumigants include the following:

*Table I*

| R | $R_1$ | $R_2$ |
|---|---|---|
| H— | $-CH_2CH_2Cl$ | $-CH_2CH_2Cl$. |
| $CH_3$— | $-CH_2CH_2Cl$ | $-CH_3$. |
| | $-CH_2CH_2Cl$ | $-CH_2CH_2Cl$. |
| $CH_3$— | $-C_2H_5$ | $-C_4H_9$ (tert.). |
| | $-CH_2CH:CH_2$ | $-CH_2CH:CH_2$. |
| $CH_3$— | $-C_2H_5$ | $-C_{12}H_{25}$. |

The following example illustrates the results of tests on certain of these compounds on the most destructive of the insects commonly found in flour mills which is the confused flour beetle.

EXAMPLE

Thirty-three mg. of bis(2-chloroethyl) acetal of acetaldehyde was pipetted into a 22-liter round

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bottom flask, and the flask was closed with a rubber stopper, from which was suspended a small wire-screen cage containing 50 confused flour beetles (*tribolium confusum*). The beetles were exposed to the vapors of the compound for 5 hours at about 25° C., after which time they were withdrawn from the flask, transferred to clean beakers, and supplied with a small amount of whole wheat flour as food. A mortality of 96% was observed in seven days.

By varying the concentration of compounds tested according to the above procedure, dosage-mortality curves were plotted, and from them the following data were obtained:

*Table II*

| Compound | Concentration in mg./l. to kill 50% of the beetles |
|---|---|
| Formaldehyde, bis(2-chloroethyl)acetal | 0.9 |
| Acetaldehyde, bis(2-chloroethyl)acetal | 0.7 |
| Acetaldehyde, 2-chloroethyl methyl acetal | 1.7 |
| Acetaldehyde, diallyl acetal | 37 |
| Dichloroethyl ether-Standard | 2.0 |
| Carbon disulfide-Standard | 60 |

It will be seen from the above table that the fumigants compare very favorably with the last two standard fumigants.

These acetals may be used to kill insects other than the confused flour beetles, such as the other insects commonly found in flour mills, grain elevators, etc., as well as household insects, insects attacking storing products, insects infesting clothing, upholstered furniture, furs, carpets, insects in warehouses, etc. In addition, mites and rodents such as mice are killed by the fumigant and growth of fungi and bacteria is inhibited thereby. The fumigant is generally effective in any location where vapors of the compounds may be confined for a definite period of time.

The acetals may also be used in combination with other insecticides and fumigants, such as dichloroethyl ether, methyl bromide, carbon disulfide, ethylene oxide, ethylene dichloride, and the like.

Furthermore, they may be applied by spraying into the confining area, with or without such volatile solvents as carbon tetrachloride and the like; and may be used as aerosols in conjunction with compounds which are gaseous at ordinary temperatures and atmospheric pressure, such as Freon-11 and Freon-12. One method which may be used to form the fumigant is passing air over a heated vessel of the compounds.

The above examples are illustrative of preferred embodiments of the present invention and various modifications thereof will suggest themselves to those skilled in the art.

I claim:

1. A process for destroying pests comprising evaporating in the air surrounding the pests a compound selected from the group consisting of formaldehyde bis (2-chloro-ethyl) acetal and acetaldehyde bis(2-chloro-ethyl) acetal.

2. A process for destroying insects comprising evaporating formaldehyde bis (2-chloroethyl) acetal in the air surrounding the insects.

3. A process for destroying insects comprising evaporating acetaldehyde bis (2-chloroethyl) acetal in the air surrounding the insects.

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