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(54) Title: CLEANING METHODS

(57) Abstract: This invention relates to a method of removing, or inhibiting the formation of, residues from an agrochemical composition on the internal surface of an agrochemical tank, comprising applying a dialkylamide to said surface. Further embodiments of the present invention also include uses of a dialkylamide in agrochemical tank cleaning.

CLEANING METHODS

This invention relates to methods of cleaning residues from agricultural tanks, comprising the application of dialkylamides to their internal surface. The present invention also relates to the use of dialkylamides for cleaning agricultural tanks.

It is essential that agricultural tanks be cleaned thoroughly between applications of different agrochemical to a crop. If residues from the agrochemical previously contained in the tank are allowed to contaminate the next agrochemical to be applied, irreversible crop damage can be caused, and a harvest ruined as a result.

Present methods of cleaning agricultural tanks include the use of ammonia, chlorine bleach, kerosene or expensive proprietary cleansing agents. Ammonia solution, a commonly recommended cleaning agent, requires careful handling with protective equipment and respiratory apparatus, and if used inappropriately, can even be deadly. Chlorine bleach can combine with fertilizers containing ammonia to form deadly chlorine gas, which at low concentrations is irritating to the eyes, nose, throat, and lungs, and at high concentrations, fatal. Kerosene can be used to remove oil-soluble herbicides, but requires a detergent rinse to remove the oily residue. Once residue has been removed from the agricultural tank, the resulting solution must be disposed of in an environmentally-friendly way, at great expense to the farmer.

For the above reasons, the burden to the modern day farmer of tank cleaning and solvent disposal cannot be overstated, and a more cost-effective, environmentally-friendly, and safer tank cleaning method would be of great benefit to farmer's livelihoods, worldwide.

It has been found that the application of dialkylamides to the internal surface of an agrochemical tank, results in a surprisingly clean tank, and with the environmentally-friendly properties of dialkylamides, the farmer's conscience is left equally clean.

Dimethyl lactamide is disclosed in DE 41 12 873 A1.

Certain lactamides are disclosed in Ratchford, W. P. and Fisher, C. H., Journal of Organic Chemistry, 1950, 15, 317-325; Ratchford, W. P., Journal of Organic Chemistry, 1950, 15, 326-332; Fein, M.L. and Filachione, E.M., Journal of the American Chemical Society, 1953, 75, 2097-2099; and US 4,143,159.

A "tank" for the purposes of this disclosure is a large receptacle for storing agricultural liquids, optionally able to act as a reservoir to feed a crop-spraying apparatus.

Accordingly, the present invention provides a method of removing, or inhibiting the formation of, residues on the internal surface of an agrochemical tank from an agrochemical composition, comprising applying a dialkylamide to said surface.

Preferably, the dialkylamide is of formula (I)

$CH_3CH(OH)C(=O)NR^1R^2$ (I)

where R^1 and R^2 are each independently hydrogen; or C_1-C_6 alkyl, C_2-C_6 alkenyl or C_3-C_6 cycloalkyl, each of which is optionally substituted by up to three substituents independently selected from phenyl, hydroxy, C_1-C_5 alkoxy, morpholinyl and NR^3R^4 where R^3 and R^4 are each independently C_1-C_3 alkyl; or phenyl optionally substituted by up to three substituents independently selected from C_1-C_3 alkyl; or R^1 and R^2 together with the nitrogen atom to which they are attached form a morpholinyl, pyrrolidinyl, piperidinyl or azepanyl ring, each of which is optionally substituted by up to three substituents independently selected from C_1-C_3 alkyl.

Even more preferably, the compound of formula (I) R^1 is not hydrogen, methyl, ethyl, propyl, *n*-butyl, *sec*-butyl, *iso*-butyl, *n* amyl, *iso* amyl, *iso*-butylenyl, *n*-hexyl, 1-3-dimethylbutyl, allyl, CH_2CH_2OH, 2 hydroxypropyl, 2- hydroxy-isobutyl, 1,3-dihydroxy-2-methyl-2-propyl, tris-hydroxy-methyl-methyl, $CH_2CH_2OCH_3$, cyclohexyl, phenyl, benzyl, α-methylbenzyl, β-phenylethyl, 3-hydroxypropyl or 1-hydroxy-2-butyl when R^2 is hydrogen;
R^1 is not methyl, allyl or phenyl when R^2 is methyl;
R^1 is not ethyl when R^2 is ethyl;
R^1 is not *n*-butyl when R^2 is *n*-butyl;

R^1 is not *iso*-butyl when R^2 is *iso*-butyl;

R^1 is not *n*-amyl when R^2 is *n*-amyl;

R^1 is not *iso*-amyl when R^2 is *iso*-amyl;

R^1 is not *n*-hexyl when R^2 is *n*-hexyl;

R^1 is not allyl when R^2 is allyl;

R^1 is not butyl or phenyl when R^2 is phenyl;

R^1 is not benzyl when R^2 is benzyl;

R^1 is not CH_2CH_2OH or ethyl when R^2 is CH_2CH_2OH;

R^1 is not 2-hydroxypropyl when R^2 is 2-hydroxypropyl; and

R^1 and R^2 together with the nitrogen atom to which they are attached do not form a morpholinyl, pyrrolidinyl or piperidinyl unsubstituted ring.

Most preferably the dialkylamide is dimethyl lactamide.

In one embodiment of the invention, the agrochemical is selected from the group consisting of PPGO inhibitors or sulfonyl ureas. In a further embodiment of the invention, the agrochemical is selected from difenoconazole or cyflufenamid.

In a further embodiment of the invention, the method includes the application of an agrochemical in the form of an emulsion concentrate (EC) or dispersion concentrate (DC).

EC formulations conventionally contain an active ingredient, one or more surfactants which act as emulsifiers upon dilution of the EC with water and a water immiscible solvent. Typical solvents for conventional EC formulations are aromatic hydrocarbons. These solvents have very low solubilities in water and a high capability of dissolving a wide range of active ingredients.

In a further embodiment, the method of the present invention may further comprise the addition of one or more active ingredients (AIs) to the dialkylamide. Suitable AIs include, but are not limited to, herbicides, insecticides, growth regulators, fungicides, miticides and acaricides. The dialkylamide may also be combined with fertilizers, plant nutritionals, micronutrients, agrochemicals, paraffinic mineral oil, methylated seed oils (i.e. methylsoyate or methylcanolate), vegetable oils (such as soybean oil and canola oil), water conditioning agents such as Choice® (Loveland Industries, Greeley, CO) and Quest (Helena Chemical,

Collierville, TN), modified clays such as Surround® (Englehard Corp.,), foam control agents, adjuvants, surfactants, wetting agents, dispersants, emulsifiers, deposition aids, antidrift components, and water.

Claims

1. A method of removing, or inhibiting the formation of, residues on the internal surface of an agrochemical tank from an agrochemical composition, comprising applying a dialkylamide to said surface.

2. A method according to claim 1 wherein the dialkylamide is applied as a composition further comprising an agrochemical.

3. A method according to claim 2, wherein the agrochemical is selected from the group consisting of difenoconazole, cyflufenamid, PPGO inhibitors or sulfonyl ureas.

4. A method according to any preceding claim, which comprises the simultaneous application to the internal surface, of a further solvent selected from the group consisting of aliphatic solvents; straight or branched chain paraffins; cyclic hydrocarbons; aromatic solvents; phosphorus containing solvents; sulphur containing solvents; nitrogen containing solvents; aliphatic mono, di or triesters; aromatic mono and di esters; cyclic esters; cyclic, aliphatic and aromatic ketones; alkyl cyclohexanones, dialkyl ketones, acetoacetates, benzyl ketones,; acetophenone; alcohols; cycloalcohols; glycols; glycol ethers and their polymers; propylene glycols; glycol ether acetates; aromatic alcohols; carbonates; ethers and halogenated solvents.

5. A method according to claim 4, wherein the further solvent is selected from the group consisting of white oil; decalin; mono, di or tri alkylated benzenes; Solvesso 100 or 200ND (t); tributyl phosphate or tris-2-ethylhexylphosphate;methyl oleate;linoleic acid;linolenic acid;oleic acid;dimethyl decanoamide; tetramethyl sulphone; dimethyl sulphoxide;alkyl ureas; alkanolamines; morpholines; amides; alkyl alkanoates, lactates and acetoacetates; fumarates; succinates; adipates; maleates; glycerol and

citric acid esters;alkyl benzoates; benzyl alkanoates; alkyl salicylates; phthalates and dibenzoates; gamma butyrolactone; caprolactone; terpene fenchone; cyclohexanone; alkyl cyclohexanones; 2-ethylhexanol; cyclohexanol; tetrahydrofurfuryl alcohol; ethylene and propylene glycol and their polymers; dipropylene glycol; monomethyl or monobutyl ether; dipropylene glycol diacetate, or tripropylene glycol monobutyl ether; benzyl alcohol; propylene or butylene carbonate; dimethyl isosorbide; alkoxyalkanols; diphenyl ether; chlorobenzene and the chloroalkanes.

6. A method according to any one of claims 2 or 3, wherein composition is formulated as a dispersion concentrate (DC) or emulsion concentrate (EC).

7. A method according to any preceding claim, in which the dialkylamide is of formula (I)

$CH_3CH(OH)C(=O)NR^1R^2$ (I)

where R^1 and R^2 are each independently hydrogen; or C_1-C_6 alkyl, C_2-C_6 alkenyl or C_3-C_6 cycloalkyl, each of which is optionally substituted by up to three substituents independently selected from phenyl, hydroxy, C_1-C_5 alkoxy, morpholinyl and NR^3R^4 where R^3 and R^4 are each independently C_1-C_3 alkyl; or phenyl optionally substituted by up to three substituents independently selected from C_1-C_3 alkyl; or R^1 and R^2 together with the nitrogen atom to which they are attached form a morpholinyl, pyrrolidinyl, piperidinyl or azepanyl ring, each of which is optionally substituted by up to three substituents independently selected from C_1-C_3 alkyl.

8. A method according to claim 7, wherein in the compound of formula (I) R^1 is not hydrogen, methyl, ethyl, propyl, *n*-butyl, *sec*-butyl, *iso*-butyl, *n* amyl, *iso* amyl, *iso*-butylenyl, *n*-hexyl, 1-3-dimethylbutyl, allyl, CH_2CH_2OH, 2 hydroxypropyl, 2-hydroxy-isobutyl, 1,3-dihydroxy-2-methyl-2-propyl, tris-hydroxy-methyl-methyl, $CH_2CH_2OCH_3$, cyclohexyl, phenyl, benzyl, α-methylbenzyl, β-phenylethyl, 3-hydroxypropyl or 1-hydroxy-2-butyl when R^2 is hydrogen;
R^1 is not methyl, allyl or phenyl when R^2 is methyl;
R^1 is not ethyl when R^2 is ethyl;

R^1 is not *n*-butyl when R^2 is *n*-butyl;
R^1 is not *iso*-butyl when R^2 is *iso*-butyl;
R^1 is not *n*-amyl when R^2 is *n*-amyl;
R^1 is not *iso*-amyl when R^2 is *iso*-amyl;
R^1 is not *n*-hexyl when R^2 is *n*-hexyl;
R^1 is not allyl when R^2 is allyl;
R^1 is not butyl or phenyl when R^2 is phenyl;
R^1 is not benzyl when R^2 is benzyl;
R^1 is not CH_2CH_2OH or ethyl when R^2 is CH_2CH_2OH;
R^1 is not 2-hydroxypropyl when R^2 is 2-hydroxypropyl; and
R^1 and R^2 together with the nitrogen atom to which they are attached do not form a morpholinyl, pyrrolidinyl or piperidinyl unsubstituted ring.

9. A method according to any preceding claim, in which the dialkylamide is selected from the group consisting of dimethyl lactamide...

10. Use of a dialkylamide to clean an agricultural tank.

11. Use of a dialkylamide according to claim 10, wherein the dialkylamide is of formula (I)

$CH_3CH(OH)C(=O)NR^1R^2$ (I)

where R^1 and R^2 are each independently hydrogen; or C_1-C_6 alkyl, C_2-C_6 alkenyl or C_3-C_6 cycloalkyl, each of which is optionally substituted by up to three substituents independently selected from phenyl, hydroxy, C_1-C_5 alkoxy, morpholinyl and NR^3R^4 where R^3 and R^4 are each independently C_1-C_3 alkyl; or phenyl optionally substituted by up to three substituents independently selected from C_1-C_3 alkyl; or R^1 and R^2 together with the nitrogen atom to which they are attached form a morpholinyl, pyrrolidinyl, piperidinyl or azepanyl ring, each of which is optionally substituted by up to three substituents independently selected from C_1-C_3 alkyl.

12. Use of a dialkylamide according to claim 11, wherein in the compound of formula (I)
R^1 is not hydrogen, methyl, ethyl, propyl, *n*-butyl, *sec*-butyl, *iso*-butyl, *n* amyl, *iso* amyl, *iso*-butylenyl, *n*-hexyl, 1-3-dimethylbutyl, allyl, CH_2CH_2OH, 2 hydroxypropyl, 2- hydroxy-isobutyl, 1,3-dihydroxy-2-methyl-2-propyl, tris-hydroxy-methyl-methyl, $CH_2CH_2OCH_3$, cyclohexyl, phenyl, benzyl, α-methylbenzyl, β-phenylethyl, 3-hydroxypropyl or 1-hydroxy-2-butyl when R^2 is hydrogen;
R^1 is not methyl, allyl or phenyl when R^2 is methyl;
R^1 is not ethyl when R^2 is ethyl;
R^1 is not *n*-butyl when R^2 is *n*-butyl;
R^1 is not *iso*-butyl when R^2 is *iso*-butyl;
R^1 is not *n*-amyl when R^2 is *n*-amyl;
R^1 is not *iso*-amyl when R^2 is *iso*-amyl;
R^1 is not *n*-hexyl when R^2 is *n*-hexyl;
R^1 is not allyl when R^2 is allyl;
R^1 is not butyl or phenyl when R^2 is phenyl;
R^1 is not benzyl when R^2 is benzyl;
R^1 is not CH_2CH_2OH or ethyl when R^2 is CH_2CH_2OH;
R^1 is not 2-hydroxypropyl when R^2 is 2-hydroxypropyl; and
R^1 and R^2 together with the nitrogen atom to which they are attached do not form a morpholinyl, pyrrolidinyl or piperidinyl unsubstituted ring.

13. Use of a dialkylamide according to any one of claims 10, 11 or 12 wherein the dialkylamide is selected from the group consisting of dimethyl lactamide...

14. A dialkylamide, agrochemical, or agricultural tank as defined in any preceding claim, when present in a method according to claim 1.