

PATENT SPECIFICATION

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(54) AN IMPROVED METHOD FOR THE REMOVAL OF SOOT AND OTHER DEPOSITS FORMED AS A RESULT OF THE COMBUSTION OF GASEOUS LIQUID AND SOLID FUELS

(71) We, POLAR CHEMICALS LIMITED, a British Company, of Lee House, London Wall, London E.C.2, do hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to an improved method for the removal of soot and other deposits formed as a result of the combustion of gaseous, liquid and solid fuels. In particular the invention relates to a method for the removal of soot and other deposits formed on surfaces such as boiler and economiser tubes, and in turbo-compressors or other equipment.

By the term "deposits" as used throughout this specification is meant the deposits formed by the combustion of gaseous, liquid and solid fuels. The deposits may consist of carbon, in the form of soot, or may comprise sulphur and/or sulphur compounds or the ash of fuels, which are generally argillaceous compounds when coal or its products are the fuels, and vanadium compounds when the fuel is an oil.

The deposits are generally hard and adherent. When deposits are formed on steel or other metals, then because the thermal conductivity of the deposits is low compared with that of the steel or other metal, the rate of heat transmission from the flame or hot gases to the water or other fluid which is being heated is reduced, thereby reducing the efficiency of the equipment.

The deposits may also increase the corrosion of metal surfaces by trapping corrosive agents, such as acid sulphates, therein. At high temperatures, in the absence of liquid water, these sulphur compounds do not normally cause corrosion and it is usual to maintain the combustion gases at a temperature above that temperature (the "dew point") at which liquid can form. However, when there is a deposit on a metal surface the temperature at the metal surface itself may be below the "dew point" whilst the temperature of the gases is

above the "dew point". The deposit thus increases the risk of corrosion.

Chemical agents for the removal of soot and other deposits are known which consist of the chlorides of alkali metals and ammonium or copper chloride. The use of metal nitrates mixed with sulphur and/or organic materials such as coal in such a proportion that the oxygen released on decomposition of the nitrate is more than that needed to burn or combine with the sulphur and/or organic matter is also known.

The present invention provides an improved method for the removal of deposits (as hereinafter defined) from surfaces, which method comprises applying to a heated surface, an agent which comprises a mixture of ammonium nitrate and at least one nitrate of an alkali metal, an alkaline earth metal, copper, zinc or an organic base, said agent not including therein an oxidisable organic material, sulphur or a sulphur compound.

Nitrates of organic bases such as monoethanolamine are suitable for use in the invention.

The agent may be applied to the surface to be treated either manually or automatically. For example a boiler or like equipment may be provided with automatic injection means, the agent being either continuously or periodically brought into contact with the surface to be treated. Such boilers are often referred to as "self-cleaning".

The present invention thus includes within its scope a method of cleaning a boiler or like equipment which method comprises bringing the said agent into contact with the surface to be treated.

The agent may be applied to the surface to be treated either in solid or liquid form for example by dispersal in the flame, hot gases or hot combustion space of the boiler or similar equipment. The deposits are either caused to disintegrate or to be softened sufficiently that they may be readily removed by mechanical means.

[Price 25p]

Price 33p

The surface to be treated will generally be a metal surface, although it will be understood that fibreglass surfaces may be treated in similar manner.

- 5 It has been found that the agents used in the method of the present invention are safer to store and to use than conventional soot removal agents, because of the absence of oxidisable organic matter and of sulphur and sulphur compounds.

- 10 Preferably the agent in solid form comprises up to 90 percent by weight of potassium nitrate and from 10 to 25 percent by weight of ammonium nitrate. The agent in solid form may of course be dissolved in water to give a liquid composition.

- 15 The agent preferably also contains up to 10 percent by weight based on the weight of the solid ingredients of one or more corrosion inhibitors. In solid form magnesium carbonate and calcium carbonate are the preferred corrosion inhibitors. In the liquid form composition ammonium carbonate and hexamethylene tetramine are preferably used as corrosion inhibitors.

25 The following Examples further illustrate the invention:

EXAMPLE I

- 30 A soot removal agent in solid form was prepared by mixing the following ingredients:

Potassium Nitrate	78 percent by weight
Ammonium Nitrate	17 percent by weight
Basic Magnesium Carbonate	5 percent by weight

- 35 The mixture was produced in a free-flowing fire sand-like form which was applied to a boiler by injecting it into the flame or the hot combustion space either mechanically or pneumatically, in an air current. The magnesium carbonate acted as a corrosion inhibitor and also retained the free flowing properties of the composition. The deposits adhering to the boiler were completely removed.

EXAMPLE II

- 45 A liquid agent was prepared as an aqueous solution of the following ingredients:

Potassium Nitrate	150 grams
Ammonium Nitrate	100 grams
Hexamethylene Tetramine	5 grams
Ammonium Carbonate	5 grams
Water	to 1 litre

The liquid was sprayed or atomised into the flame or combustion gases of a boiler which was to be treated.

The deposits adhering to the boiler were completely removed.

It will be understood that the invention is not limited to the details of the foregoing Examples.

WHAT WE CLAIM IS:—

1. A method for the removal of deposits (as hereinbefore defined) from surfaces, which method comprises applying to a heated surface an agent which comprises a mixture of ammonium nitrate and at least one nitrate of an alkali metal, an alkaline earth metal, copper, zinc or an organic base, said agent not including therein an oxidisable organic material, sulphur or a sulphur compound.

2. A method as claimed in claim 1 wherein the said agent contains a nitrate of ethanolamine.

3. A method as claimed in claim 1 wherein the said agent is in solid form.

4. A method as claimed in claim 3 wherein the agent comprises from 10 to 25 percent by weight of ammonium nitrate and up to 90 percent by weight of potassium nitrate.

5. A method as claimed in claim 3 or claim 4 wherein the agent additionally comprises up to 10 per cent by weight based on the weight of the solid ingredients of one or more corrosion inhibitors.

6. A method as claimed in claim 5 wherein the corrosion inhibitor is magnesium carbonate or calcium carbonate.

7. A method as claimed in claim 1 wherein the said agent is in liquid form.

8. A method as claimed in claim 7 wherein the liquid agent is formed by dissolving an agent as claimed in any one of claims 3 to 5 in water.

9. A method as claimed in claim 8 wherein the liquid agent comprises as a corrosion inhibitor ammonium carbonate or hexamethylene tetramine.

10. A method of cleaning a boiler or like equipment which method comprises bringing an agent as defined in claim 1 into contact with the heated surface to be treated.

11. A method as claimed in claim 10 wherein the boiler or like equipment is provided with automatic injection means in order to bring the agent either continuously or periodically into contact with the surface to be treated.

12. A method as claimed in claim 10 wherein the said agent is dispersed in the flame, hot gases or hot combustion space of the boiler or like equipment.

13. A method as claimed in claim 1 substantially as hereinbefore described with reference to either of the Examples.

14. A surface whenever treated by a method as claimed in any one of claims 1 to 9, or claim 3.

The surface to be treated will generally be a metal surface, although it will be understood that fibreglass surfaces may be treated in similar manner.

5 It has been found that the agents used in the method of the present invention are safer to store and to use than conventional soot removal agents, because of the absence of oxidisable organic matter and of sulphur and sulphur compounds.

10 Preferably the agent in solid form comprises up to 90 percent by weight of potassium nitrate and from 10 to 25 percent by weight of ammonium nitrate. The agent in solid form may of course be dissolved in water to give a liquid composition.

15 The agent preferably also contains up to 10 percent by weight based on the weight of the solid ingredients of one or more corrosion inhibitors. In solid form magnesium carbonate and calcium carbonate are the preferred corrosion inhibitors. In the liquid form composition ammonium carbonate and hexamethylene tetramine are preferably used as corrosion inhibitors.

25 The following Examples further illustrate the invention:

EXAMPLE I

30 A soot removal agent in solid form was prepared by mixing the following ingredients:

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35 The mixture was produced in a free-flowing fire sand-like form which was applied to a boiler by injecting it into the flame or the hot combustion space either mechanically or pneumatically, in an air current. The magnesium carbonate acted as a corrosion inhibitor and also retained the free flowing properties of the composition. The deposits adhering to the boiler were completely removed.

EXAMPLE II

45 A liquid agent was prepared as an aqueous solution of the following ingredients:

Potassium Nitrate	150 grams
Ammonium Nitrate	100 grams
Hexamethylene Tetramine	5 grams
50 Ammonium Carbonate	5 grams
Water	to 1 litre

The liquid was sprayed or atomised into the flame or combustion gases of a boiler which was to be treated.

The deposits adhering to the boiler were 55 completely removed.

It will be understood that the invention is not limited to the details of the foregoing Examples.

WHAT WE CLAIM IS:—

60 1. A method for the removal of deposits (as hereinbefore defined) from surfaces, which method comprises applying to a heated surface an agent which comprises a mixture of ammonium nitrate and at least one nitrate of an alkali metal, an alkaline earth metal, copper, zinc or an organic base, said agent not including therein an oxidisable organic material, sulphur or a sulphur compound.

2. A method as claimed in claim 1 wherein the said agent contains a nitrate of ethanolamine.

3. A method as claimed in claim 1 wherein the said agent is in solid form.

4. A method as claimed in claim 3 wherein the agent comprises from 10 to 25 percent by weight of ammonium nitrate and up to 90 percent by weight of potassium nitrate.

5. A method as claimed in claim 3 or claim 4 wherein the agent additionally comprises up to 10 per cent by weight based on the weight of the solid ingredients of one or more corrosion inhibitors.

6. A method as claimed in claim 5 wherein the corrosion inhibitor is magnesium carbonate or calcium carbonate.

7. A method as claimed in claim 1 wherein the said agent is in liquid form.

8. A method as claimed in claim 7 wherein the liquid agent is formed by dissolving an agent as claimed in any one of claims 3 to 5 in water.

9. A method as claimed in claim 8 wherein the liquid agent comprises as a corrosion inhibitor ammonium carbonate or hexamethylene tetramine.

10. A method of cleaning a boiler or like equipment which method comprises bringing an agent as defined in claim 1 into contact with the heated surface to be treated.

11. A method as claimed in claim 10 wherein the boiler or like equipment is provided with automatic injection means in order to bring the agent either continuously or periodically into contact with the surface to be treated.

12. A method as claimed in claim 10 wherein the said agent is dispersed in the flame, hot gases or hot combustion space of the boiler or like equipment.

13. A method as claimed in claim 1 substantially as hereinbefore described with reference to either of the Examples.

14. A surface whenever treated by a method as claimed in any one of claims 1 to 9, or claim 3.

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15. A boiler or like equipment whenever cleaned by a method as claimed in any one of claims 10 to 12.

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