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(54) Method for combating corrosion of hydrocarbon containers and liquid hydrocarbons having corrosion inhibiting properties.

(57) The invention relates to a method for combating corrosion of fuel tanks by microorganisms in the presence of water; the method involves the introduction of a pyrocarbonic diester, preferably a lower alkyl pyrocarbonate into the fuel tank, in a concentration range of 0,1-5 grams per liter of liquid fuel.

The invention also realates to liquid fuels, particularly aviation fuels, containing pyrocarbonic diesters as corrosion inhibiting aditives.

EP 0 306 108 A2

Method for combating corrosion of hydrocarbon containers and Liquid hydrocarbons having corrosion inhibiting properties.

The invention relates to a method for combating corrosion in containers of liquids containing hydrocarbons.

Corrosion of fuel tanks is in most cases due to the presence of microorganisms, such as bacteria and moulds. In the low-oxygen medium of hydrocarbons, anaerobic bacteria, for example, are ultimately able to form hydrogen and/or acids which attack metals and other materials of which fuel tanks are composed. The basic requirements for the growth of such organisms are the presence of nutrients, such as substances containing carbon, nitrogen, phosphorous, sulphur etc., and the presence of water; in practice, these requirements are virtually always fulfilled in liquid hydrocarbons and especially in kerosene.

As a possible solution, consideration has been given to the use of biocides (agents which combat microorganisms), such as organic borates, inorganic chromates and ethylene glycol monomethyl ether, possibly in combination with measures such as tapping off settled water, the application of protective layers to materials susceptible to corrosion and the further purification of the fuel. The biocide to be used must fulfil a number of requirements, such as effectiveness, safety, handleability, compatibility with the materials used and with the combustion system and the like. Of the known biocides, not one fulfils these requirements to an adequate extent.

A method has now been found with which the existing problems can be solved and in which an agent which kills microorganisms is used and which at the same time chemically removes any water present.

The method according to the invention is characterized in that at least one pyrocarbonic acid diester is introduced into the containers for liquids containing hydrocarbons.

Pyrocarbonic acid diesters are effective agents for combating microorganisms. In water in a minimum concentration of 30-500 mg/l, dimethyl pyrocarbonate, for example, is lethal to diverse yeasts, moulds and bacteria. A minimum concentration of 100 mg/l. for example, is necessary to exterminate the bacterium Pseudomonas aeruginosa which frequently occurs in fuel tanks.

Pyrocarbonic acid diesters are harmless, at least in dissolved form, to human beings and other mammals. They do not react with hydrocarbons and do not react, or virtually do not react, with the common fuel additives; they are inert with respect to the materials of which tanks are composed.

Provided measures are taken against moisture, the pyrocarbonic acid diesters can readily be handled and have long-term stability. They can be prepared relatively simply from cheap basic materials (for example, chloroformates and alkali-metal carbonate monoesters) in a known manner.

Pyrocarbonic acid diesters are readily soluble in hydrocarbons and moderately soluble in water. They react readily with water (dimethyl pyrocarbonate, for example, has a half-life of approximately 15 minutes in water at 20 °C) to form alcohols and carbon dioxide. Neither of the decomposition products adversely affects the fuel quality or impedes the combustion. The carbon dioxide produced on reaction with water can be removed simply by good ventilation.

As a result, said esters scavenge water dissolved in the hydrocarbon, also react with settled water and combat microorganisms both in the hydrocarbon phase and in the aqueous phase. Since microorganisms require water for their metabolism, the pyrocarbonic acid esters do not only act as straightforward biocides but also as agents which render further development of microorganisms impossible because they remove the water necessary for said development.

Any concentration of the pyrocarbonic acid diesters in hydrocarbons has a positive effect as regards the combating of corrosion; the overall effect will be greater if greater quantities are used. To scavenge water dissolved in aviation fuel, approximately 100-500 mg of pyrocarbonate per litre is necessary, for example, in the temperature range from -20 °C to +30 °C. The concentration or quantity to be chosen to combat corrosion depends on the type and composition of the liquid, on the desired effect and on the circumstances. For practical applications a concentration of 0.1-5 g/1 is used.

Any pyrocarbonic acid diester containing alcohol radicals which yield relatively harmless alcohols after hydrolysis is in principle suitable for the method according to the invention.

The two alcohol radicals in the diester may be identical or different, for example, alkyl groups, such as methyl. ethyl. isopropyl, propyl, substituted alkyl groups, such as 2-methoxyethyl, alkenyl, cycloalkyl, aryl or aralkyl groups, or may be combined with each other to form cyclic compounds such as ethylene pyrocarbonate or to form linear oligomeric or polymeric compounds, such as poly-(alkylene pyrocarbonate).

In addition, one or more oxygen atoms in the pyrocarbonate group may be replaced by sulphur atoms or other heteroatoms and the pyrocarbonate

group may have one or more additionally carbonyloxy groups, as in dialkyltri- and -polycarbonates.

For economic reasons and in view of environmental requirements, pyrocarbonates (dicarbonates) containing small alkyl groups (C1-C4) and containing exclusively oxygen as heteroatom will be the most suitable. Preferably, dimethyl, methyl ethyl and diethyl pyrocarbonate are used. Other pyrocarbonates may offer particular advantages: thus, aryl and aralkyl esters simultaneously increase the aromatic content of the fuel which promotes the combustion properties and, if 2-methoxyethyl esters are used, ethylene glycol monomethyl ether, which is per se a biocide, is produced so that the microbe-killing action does not disappear with the decomposition of the pyrocarbonate.

In the method according to the invention, the pyrocarbonic acid diester may be added to the hydrocarbon-containing liquid, preferably after settled water has been removed therefrom. The diester may also be introduced first into the container to be protected against corrosion. The pyrocarbonic acid diester (monomer or polymer) may be used in homogeneous or heterogeneous form. If used in heterogeneous form, the diester may be bonded to a solid substrate or to the wall of the container in the form of a coating.

The use of pyrocarbonic acid diesters may, according to the invention, be combined with the use of other biocides, such as chromates and organic borates and other water-binding substances, such as imines, ketals and the like.

The invention also relates to liquids containing hydrocarbons and which contain at least one pyrocarbonic acid diester. Such liquids have a corrosion-suppressing action in the containers in which they are stored. Preferably, said liquids contain 0.1-5 g of pyrocarbonate per litre, but for particular applications or particular circumstances, concentrations outside said range may be suitable. Preferably, the pyrocarbonate is dimethyl, methyl ethyl or diethyl pyrocarbonate. In addition, said liquids may, of course, contain all the common additives and auxiliary substances ("dopes"). The liquids containing hydrocarbons may be mineral oils, fuels, lubricants and the like.

A particularly useful embodiment relates to aviation fuels which contain pyrocarbonic acid diesters.

Claims

1. Method for combating corrosion in containers of liquids containing hydrocarbons, characterized in that at least one pyrocarbonic acid diester is introduced into the containers.

2. Method according to Claim 1, characterized in that 0.1-5 g of pyrocarbonic acid diester is used per litre.

3. Method according to Claim 1 or 2, characterized in that dimethyl, methyl ethyl and/or diethyl pyrocarbonate is used.

4. Liquid containing hydrocarbons, characterized in that it contains at least one pyrocarbonic acid diester.

5. Liquid according to Claim 4, characterized in that it contains 0.1-5 g of pyrocarbonic acid diester per litre.

6. Liquid according to Claim 4 or 5, characterized in that it contains dimethyl, methyl ethyl or diethyl pyrocarbonate.

7. Liquid according to anyone of the Claims 4-6, characterized in that it is an aviation fuel.