

[54] **METHOD OF SEALING LEAKS IN CLOSED COOLING SYSTEMS**

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[22] Filed: **Sept. 26, 1972**

[21] Appl. No.: **293,641**

[30] **Foreign Application Priority Data**

Oct. 13, 1971 Switzerland..... 14846/71

[52] **U.S. Cl.**..... **117/2 R, 106/33, 252/72**

[51] **Int. Cl.**..... **C09k 3/12**

[58] **Field of Search** **252/72; 106/33; 117/2 R**

[56]

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[57]

ABSTRACT

Leaks in closed cooling systems using water as coolant can be sealed by having present in the coolant a chemical compound of a readily reducible metal, e.g., an oxide of copper, which precipitates a sealant upon addition to the coolant of an oxygen-yielding substance (e.g., air) and a complexing agent having an alkaline reaction (e.g., morpholin).

3 Claims, No Drawings

METHOD OF SEALING LEAKS IN CLOSED COOLING SYSTEMS

The invention concerns a procedure for sealing leaks in closed cooling systems containing an aqueous liquid as the working medium.

Sealants for sealing automobile radiators are known which sealants consist of a suspension of organic and inorganic substances. These sealants are added to the cooling water and gradually seal off the leak as the cooling water runs out. These substances have the disadvantage that they are successful only in high concentrations. They cannot therefore be used in cooling systems containing cooling pipes of small cross-sectional area, owing to the risk that the cooling pipes will become blocked.

An object of the present invention is to provide a procedure which permits the sealing of leaks in cooling systems having cooling pipes of small and large cross-sectional area and while the cooling system is in operation. This and other objects are achieved by ensuring that an easily reducible compound of a metal is produced in, or is present in or is added to, the water in the cooling system from which is precipitated a sealant without application of electric current. The term "easily reducible compound of a metal" here embraces compounds of copper, silver, gold, tin, nickel, cadmium, lead, cobalt, platinum, rhodium, iridium and palladium. In a preferred form of the invention the easily reducible compound is cupric oxide or cuprous oxide.

The applicability of the procedure of the invention is restricted to cooling systems containing no large quantities of base metals — such as aluminum, zinc, low-alloy steel and the like — which would cause cementation of the easily reducible metal compound and onto the base metal, thus making it impossible to hold the easily reducible metal compound in solution.

Since most cooling systems contain copper, this preferred form of the invention offers the advantage that corrosion products such as cupric oxide or cuprous oxide present in the cooling water can be employed as the easily reducible compound of a metal, thus rendering superfluous the further admixture of an easily reducible compound of a metal.

The use of easily reducible oxides of metals, such as cupric oxide or cuprous oxide, has the added advantage that the action of the reducing agent does not cause formation of salts which would increase the electrical conductivity of the cooling water, with the result that the procedure of the invention in this form is particularly suitable for sealing cooling systems in electric machines.

If the cooling system consists, for example, of glass or plastic material, then a compound of copper, silver, gold, tin, nickel and/or cadmium must be produced in, or added to, the cooling water, preferably in a cation concentration of 10^{-6} to 1 molar, because the water contains no suitable corrosion products originating from the material of the cooling system which can be dissolved in the water as complexes, and their cations then precipitated by a reducing agent without electrical current.

Irrespective of the chosen easily reducible compound of a metal, the cooling water is preferably alkalized to a pH value of 9 to 10, the concentration of both the

complexing agent and the reducing agent being preferably 10^{-6} to 1 molar.

Cooling water having the following properties is suitable for carrying out the invention:

pH value	: 5 - 9
conductivity	: 0.1 - 20 μ mho/cm
O ₂ content	: 0.01 - 0.2 ppm
Cu content (dissolved and undissolved)	: 0.01 - 0.2 ppm

If the physical and chemical properties of the cooling water deviate significantly from these values, it is possible to influence the pH value, conductivity and O₂ and Cu content, using established methods. Part of the water, for example, can be replaced by fully demineralized and deaerated water, while the O₂ concentration, and, hence, the Cu concentration, can be adjusted by controlled admission of air. It has been found particularly beneficial to adjust the total Cu concentration to approximately 0.2 ppm.

In the actual treatment of a leak, morpholine (tetrahydro-1,4-oxazine) is added to the water in an amount of 1 to 2 ppm. This can be done, for example, by means of a dosing pump. Apart from morpholine, other suitable substances are other amines as well as ammonia, amines and mixtures of these or other substances which (1) exhibit an alkaline reaction and (2) at the same time hold cupric oxide or cuprous oxide in solution as complexes.

Complex formation occurs only in alkaline solution, i.e. with pH values greater than 7. The best results are obtained when the pH value lies between 9 and 10. The concentration of the complexing agent should then be between 10^{-6} and 1 molar, preferably approximately 10^{-4} molar.

After this stage of the procedure the reducing agent is added to the cooling water to cause electroless precipitation by chemical reduction of the easily reducible compound in solution. This can also be done with a dosing pump. It is also possible, however, to add the complexing agent and reducing agent simultaneously, by means of a suitable metering device. When hydrazine is used, its concentration should be between 10^{-6} and 1 molar, preferably 10^{-3} molar, which corresponds to approximately 15 - 30 ppm. Reducing agents other than hydrazine may be used, provided they have no harmful side-effects on the cooling fluid or on the object being cooled.

During treatment of the leak, care must be taken that the concentration both of the complexing agent and of the reducing agent is kept approximately constant. If the leakage losses are relatively small, it may be possible to dispense with further addition of the complexing agent as this, in contrast to the reducing agent, is not consumed. If the water escaping from the leak is returned to the cooling circuit, it is generally sufficient to introduce the complexing agent only once. The reducing agent, on the other hand, must be frequently or continuously made up in order to maintain the concentration stated.

In certain cases, a special oxidizing agent is not absolutely essential if the cooling water already contains sufficient corrosion products, e.g. Cu₂O, CuO or oxide of other easily reducible metals, or if these corrosion products are added to the cooling water as a sufficiently fine suspension, or better as a colloidal solution. The important point is that the concentration of soluble

reducible cations lies between 10^{-7} and 10^{-3} , and preferably in the region of 10^{-5} molar.

SPECIFIC EXAMPLE

For example, at an undefinable place in a water-cooled generator rotor there occurred a leak from which the cooling water was escaping. The loss of cooling water increased linearly with time, reaching approximately 40 liters per hour after a few days. The pressure of the cooling water was approximately 80 – 100 bar. As a result of applying the cooling-water treatment described above, the cooling-water loss decreased with time finally stabilizing at about 0.1 liter/hour. At the same time the Cu concentration in the cooling water fell to 0.01 – 0.02 ppm. If the supply of reducing agent, in this case Levexin, is interrupted, the cooling-water loss rises again to approximately the value before treatment.

Other tests have shown that it is possible, though not with the same success as described above, to reduce the cooling-water loss by introducing only hydrazine or Levexin, since these substances act simultaneously as

(weak) alkalizing and reducing agents.

We claim:

1. A method for sealing leaks in a closed cooling system using water as the working medium which comprises, introducing into the water an easily reducible metal oxide selected from the group consisting of copper, silver, gold, tin, nickel, cadmium, lead, cobalt, platinum, rhodium, iridium and palladium, wherein the mole ratio of metal cation is from 10^{-8} to 1 molar, introducing a reducing agent into said water in a concentration of between 10^{-6} and 1 molar, so as to cause electroless precipitation of the metal whereby leaks in the closed cooling system are sealed.

2. The method of claim 1 wherein said easily reducible metal oxide is copper oxide which is produced in situ by corrosive action of the cooling water on the cooling pipes.

3. The method of claim 2 wherein the corrosion products are induced by the addition of air into the water medium.

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