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(54) **Corrosion inhibiting admixture of an orthophosphate compound and a polyether, together with a process of inhibiting corrosion.**

(57) The instant invention is directed to a corrosion inhibiting admixture comprising: (A) 10 to 90%, by weight, of a water-soluble orthophosphate compound, and (B) 10-90%, by weight, of a polyether.

The instant invention is also directed to the use of the admixture in inhibiting corrosion of steel.

- 1 -

C-1387

TITLE OF THE INVENTION

CORROSION INHIBITING ADMIXTURE OF AN ORTHOPHOSPHATE COMPOUND
AND A POLYETHER, TOGETHER WITH A PROCESS OF INHIBITING CORROSION.

5 BACKGROUND OF THE INVENTION

A variety of compositions have been employed
in the art for the purpose of inhibiting corrosion of
metal surfaces in water-carrying systems. The most
common inhibitors include polyphosphates,
10 phosphonates and zinc.

DESCRIPTION OF THE INVENTION

The instant invention is directed to a
corrosion inhibiting admixture, comprising: (A)
15 10-90%, by weight, of a water-soluble orthophosphate
compound, and (B) 10 to 90%, by weight, of a
polyether.

The instant invention is also directed to a method of inhibiting corrosion of steel in an aqueous system, comprising the step of treating the system with at least 0.1 ppm of an admixture comprising: (A) 10 to 90%, by weight, of a water-soluble orthophosphate compound and (B) 10 to 90%, by weight, of a polyether.

The water-soluble orthophosphate compounds which are operable for the present purposes generally include phosphoric acid, sodium orthophosphates, the potassium orthophosphates, the lithium orthophosphates and ammonium orthophosphates. The following specific compounds may be mentioned as exemplary: H_3PO_4 phosphoric acid, LiH_2PO_4 lithium diacid phosphate, Na_3PO_4 trisodium orthophosphate, Na_2HPO_4 disodium orthophosphate, NaH_2PO_4 monosodium orthophosphate, $\text{NaH}_5(\text{PO}_4)_2$ hemisodium orthophosphate, K_3PO_4 tripotassium orthophosphate, K_2HPO_4 dipotassium orthophosphate, KH_2PO_4 monopotassium orthophosphate, $(\text{NH}_4)_3\text{PO}_4$ triammonium orthophosphate, $(\text{NH}_4)_2\text{HPO}_4$ diammonium orthophosphate, and $(\text{NH}_4)\text{H}_2\text{PO}_4$ monoammonium orthophosphate.

In addition to the inorganic orthophosphates set forth above may be mentioned the organic phosphates which are set forth in U.S. Patent 3,510,436, which is hereby incorporated by reference.

These compounds are excellent sources of orthophosphate. The admixture should contain 10 to 90%, preferably 40 to 60%, by weight, of a water-soluble orthophosphate compound and 10 to 90%, preferably 40 to 60%, by weight, of a polyether.

Any polyether may be used. Examples include polyalkylene oxide compounds, polyalkylene glycol, polyalkylene glycol acrylate, polyalkylene glycol methacrylate, and mono- and di-polyalkylene glycol maleate, fumate and itacomate. Also mixtures of polyethers formed from polyethylene oxide with other polyalkylene oxides, such as propylene or butylene oxide may be used. The polyether chain may be capped, with an alkyl, aralkyl, sulfonate or phosphonate group, or uncapped.

The polyether preferably should have a weight average molecular weight of 1,000 to 50,000 as determined by light scattering. The polyether may also be copolymerized with acrylic acid or methacrylic acid.

Zinc may also optionally be added to the admixture. The ratio of zinc to the above-described admixture should be 10:1 to 10:1.

The admixtures are used in a minimum dosage of 0.1 ppm in inhibiting corrosion, preferably in a dosage of 1 to 500 ppm, and most preferably 1 to 200 ppm.

EXAMPLES

The corrosion rate (mils per year) was determined for the corrosion inhibitors listed in Table 1 by the following method:

The electrochemical cell used in these experiments consists of the coupon holder (working electrode); reference electrode (S.C.E.), counter-electrode (graphite rods) and aerator. Test coupons were presanded to 120 grit and rinsed with acetone

before insertion into coupon holders. After the addition of inhibitor to test solutions, pH was adjusted to that of the particular medium under observation. There was no pretreatment of coupons at elevated dosages of inhibitor in any of these tests. Following twenty-four hours aeration at 50°C, the cell was analyzed electrochemically via potentiodynamic control. Corrosion data are obtained from composite information from two types of tests: polarization resistance and Tafel plot. In the polarization resistance procedure, the potential is scanned from -20 to +20 mv of E_{corr} (the equilibrium potential, at which anodic current density equals cathodic current density, i.e. no net current flow exists). The result is a current density versus potential plot, the slope of which is R_p , or polarization resistance. A Tafel plot is then constructed, scanning the cell potential from ($E_{\text{corr}} - 200$ mv) to ($E_{\text{corr}} + 200$ mv). The result is a potential versus log current density curve with both anodic and cathodic linear portions. The Tafel constants, b_a and b_c , are the slopes of the respective linear portions. The three experimental parameters (R_p , b_a , b_c) are then substituted into the following equation for corrosion current:

$$i_{\text{corr}} = \frac{b_a \cdot b_c}{2.3 (b_a + b_c)} \cdot \frac{1}{R_p}$$

Corrosion current is then converted to a corrosion rate by the formula:

$$5 \quad \text{Corrosion Rate} = i_{\text{corr}} \cdot \frac{1 \text{ mole metal}}{n \text{ equivalents}} \cdot \text{MW} \cdot \frac{1}{\rho} \cdot 128,680$$

TABLE 1

10	<u>Example</u>	<u>Additive</u>	<u>Amount (ppm)</u>	<u>Corrosion Rate</u>
	1*	blank		54.0
15	2*	orthophosphate	13.4	9.0
	3*	polyethylene glycol mwt 7500	10.0	35.0
20	4	orthophosphate/ polyethylene glycol	13.4/10.00	4.6
	5*	polyethylene glycol- acrylic acid copolymer	10.0	39.0
25	6	orthophosphate/ 40% polyethylene glycol 60% acrylic acid copolymer	13.4/10.0	6.8

30 *comparison examples

WHAT IS CLAIMED IS:

1. A corrosion inhibiting admixture comprising: (A) 10 to 90%, by weight, of a water-soluble orthophosphate compound, and (B) 10-90%, by weight, of a polyether.
2. The corrosion inhibiting admixture of Claim 1, wherein 40 to 60%, by weight, of said water-soluble orthophosphate compound, and 40 to 60%, by weight, of said polyether are used.
3. The corrosion inhibiting admixture of Claim 1, wherein said polyether is a copolymer with acrylic acid and/or methacrylic acid.
4. A method of inhibiting corrosion of steel in an aqueous system, comprising the step of treating the system with at least 0.1 ppm of an admixture comprising: (A) 10 to 90%, by weight, of a water-soluble orthophosphate compound, and (B) 10 to 90%, by weight, of a polyether.
5. The method of Claim 4, wherein 40 to 60%, by weight, have said orthophosphate compound, and 40 to 60%, by weight of said polyether are used.
6. The method of Claim 4, wherein 0.1 to 200 ppm of said admixture is used.
7. The method of Claim 4, wherein said polyether is a copolymer with acrylic acid and/or methacrylic acid.