Description

The present invention relates to a method for inhibiting the corrosion of iron or iron-containing metals in contact with aqueous systems by adding certain triazinecarboxylic acids or their water-soluble salts as corrosion inhibitors and also the anticorrosive aqueous systems so obtained.

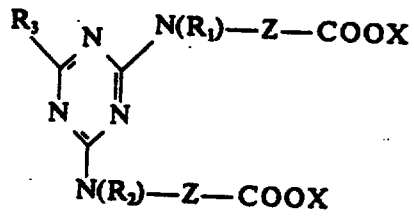
Recently much technical effort has been expended on solving problems which arise in connection with the corrosion of metals in contact with water circulation systems. Various corrosion-inhibiting mixtures have been proposed, for example the mixture of polymaleic acids with zinc salts described in GB-A-1,374,270 or the mixtures of thiocyanates or thioureas with chromates described in US-A-3,133,028. The said known mixtures have certain disadvantages. For example, heavy metals such as chromium or zinc pollute the waste waters because of their toxicity, and because of the more stringent environmental regulations, a search has been made for alternatives. Other corrosion inhibitors, which are free of heavy metals, are, for example, the synergistic mixtures of aminophosphonic acids with nitrites described in GB-A-1,092,044. These have the disadvantage that in the course of use the nitrite is oxidized to nitrate, as a result of which the effect diminishes and algae growth is promoted. In addition, nitrite can react with amines to form toxic N-nitroso compounds.

The methylolmelamine condensation products of US-A-2,485,309 and the unsaturated triazine derivatives of US-A-3,165,515 also do not completely meet the high requirements which are currently imposed on a corrosion preventative.

It has now been found that certain triazinecarboxylic acids and their water-soluble salts are excellent corrosion inhibitors in aqueous systems such as, for example, in water circulation systems, in aqueous

machining fluids, antifreezes, hydraulic liquids or aqueous coating compounds.

The present invention relates to the use of compounds of the formula I



(I),

in which Z is a C_1-C_{11}-alkylene group, X is hydrogen, an alkali metal, mono-, di- or triethanolammonium, R_1 and R_2 are hydrogen or methyl and R_3 is an $-NR_4R_5$ group in which R_4 is -Z-COOX or C_1-C_{12}-alkyl and R_5 is hydrogen or C_1-C_{12}-alkyl, as corrosion inhibitors for aqueous systems which are in contact with iron or iron-containing metals.

If Z is alkylene containing 1-11 C atoms, then it is e.g. methylene, 1,2-ethylene, 1,2-propylene, 1,3-propylene, 1,4-butylene, 1,1-dimethyl-1,2-ethylene, 1,5-pentylene, 1,6-hexylene, 1,8-octylene, 1,10-decylene or 1,11-undecylene. Preferably Z is alkylene containing 1-5 C atoms.

If X is an alkali metal, it may be Na, K or Li.

Preferably R_3 is an $-NR_4R_5$ group wherein R_4 is -Z-COOX or C_1-C_8-alkyl and R_5 is H, CH_3 or C_2H_5.

Examples of specific compounds of formula I are the following:

2,4,6-tris(5'-carboxypentylamino)-1,3,5-triazine
2,4,6-tris(carboxymethylamino)-1,3,5-triazine
2,4,6-tris(3'-carboxypropylamino)-1,3,5-triazine
2,4,6-tris(2'-carboxyethylamino)-1,3,5-triazine
2,4,6-tris(4'-carboxybutylamino)-1,3,5-triazine
2,4,6-tris(11'-carboxyundecylamino)-1,3,5-triazine
2,4,6-tris(5'-carboxypentyl-N-methylamino)-1,3,5-triazine
2,4,6-tris(carboxymethyl-N-methylamino)-1,3,5-triazine
2,4,6-tris(3'-carboxypropyl-N-methylamino)-1,3,5-triazine
2,4-bis(5'-carboxypentylamino)-6-ethylamino-1,3,5-triazine

2,4-bis(5'-carboxypentylamino)-6-n-octylamino-1,3,5-triazine

2,4-bis(5'-carboxypentylamino)-6-diethylamino-1,3,5-triazine

2,4-bis(2'-carboxyethylamino)-6-n-octylamino-1,3,5-triazine

2,4-bis(2'-carboxyethylamino)-6-diethylamino-1,3,5-triazine

2,4-bis(2'-carboxyethylamino)-6-butylamino-1,3,5-triazine

2,4-bis(2'-carboxyethylamino)-6-ethylamino-1,3,5-triazine

2,4-bis(3'-carboxypropylamino)-6-ethylamino-1,3,5-triazine

2,4-bis(3'-carboxypropylamino)-6-n-octylamino-1,3,5-triazine

2,4-bis(3'-carboxypropylamino)-6-n-propylamino-1,3,5-triazine

2,4-bis(carboxymethylamino)-6-n-octylamino-1,3,5-triazine

2,4-bis(carboxymethylamino)-6-dodecylamino-1,3,5-triazine

2,4-bis(5'-carboxypentyl-N-methylamino)-6-ethylamino-1,3,5-triazine

2,4-bis(3'-carboxypropyl-N-methylamino)-6-n-octylamino-1,3,5-triazine

2,4-bis(carboxymethyl-N-methylamino)-6-n-octylamino-1,3,5-triazine

2,4-bis(2'-carboxyethyl-N-methylamino)-6-n-octylamino-1,3,5-triazine

2,4-bis(5'-carboxypentylamino)-6-(2"-carboxyethylamino)-1,3,5-triazine

2,4-bis(5'-carboxypentylamino)-6-(carboxymethylamino)-1,3,5-triazine

2,4-bis(3'-carboxypropylamino)-6-(2"-carboxyethylamino)-1,3,5-triazine

2,4-bis(2'-carboxyethylamino)-6-(5"-carboxypentylamino)-1,3,5-triazine

2,4-bis(3'-carboxypropylamino)-6-(5"-carboxypentylamino)-1,3,5-triazine

The compounds of formula I are not new. Such compounds and their preparation are described, for example, in Zhurnal Analiticheskoi Khimii 15, 419-423

(1960), in German Offenlegungsschrift 1,935,010, in German Offenlegungsschrift 2,819,796, in U.S. Patent Specification 3,697,520 and in J. Prakt. Chemie 23, 173-85 (1963). In none of these literature references, however, is the use of the compounds of formula I as corrosion inhibitors for iron in aqueous systems described or suggested.

The compounds of formula I are preferably used in a quantity of 0.001 to 5% by weight, referred to the aqueous system.

As already mentioned, the aqueous systems may be water circulation systems, for example cooling water circulation systems, they may be aqueous machining fluids as are used, for example, as cooling liquids in drilling, pulverizing, milling, turning, cutting, sawing, grinding, threading, or in rolling or drawing metals, they may be antifreezes or hydraulic liquids on a glycol-water base, and they may be aqueous coating substances such as e.g. emulsion paints or aqueous powder coatings.

The compounds of formula I can be used in the aqueous systems as the only additive or in combination with other additives. Examples of such co-additives in water circulation systems are known corrosion inhibitors such as phosphonates, phosphonocarboxylic acids or phosphinocarboxylic acids, N-acylsarcosines, imidazolines, triethanolamine, fatty amines or polycarboxylic acids. These may be copper passivators such as e.g. water-soluble benzotriazoles, methylene-bis(benzotriazoles) or 2-mercaptobenzothiazoles. These may be dispersing agents and carrier substances such as e.g. poly(meth)acrylic acid and its salts, hydrolysed polyacrylonitrile, polyacrylamide and its copolymers, lignosulfonic acid and its salts, starch and starch derivatives, cellulose, alkylphosphonic acids, 1-aminoalkyl-1,1-diphosphonic acids and their salts, polymaleic acids and other polycarboxylic acids or alkali phosphates.

Further co-additives may be precipitation agents such as e.g. alkali phosphates or alkali carbonates, oxygen scavengers such as e.g. alkali sulfates or hydra-

zine, complexing agents such as e.g. nitrilotriacetic acid or ethylenediaminetetraacetic acid and its salts or antifoaming agents such as e.g. distearylsebacic acid diamide, disterayladipic (sic) acid diamide or ethylene oxide or propylene oxide condensation products of such amides, and also fatty alcohols and their ethylene oxide condensation products.

Aqueous systems which are used as machining fluids may be a cutting or grinding oil which can be diluted with water such as, for example,

a) aqueous concentrates of one or more corrosion inhibitors with or without an antiwear additive which may then be used in a dilution of 1:50 to 1:100 as a grinding fluid,

b) polyglycols which contain biocides, corrosion inhibitors and antiwear agents and which may be used as a cutting fluid in a dilution of 1:20 to 1:40 and as a grinding fluid in a dilution of 1:60 to 1:80,

c) semisynthetic cutting oils with a base similar to b), but additionally containing 10-25% of an oil as well as sufficient emulsifier to keep the liquid transparent on diluting,

d) emulsifiable mineral-oil concentrates which, in addition to the emulsifier, may also contain corrosion inhibitors, antiwear agents, biocides, and antifoaming agents, and which are usually diluted in the ratio of 1:20 to 1:50 with water to form an opaque emulsion,

e) products similar to d), but containing less oil and more emulsifier, which yield translucent emulsions at a dilution of 1:50 to 1:100.

The compounds of formula I can be used either alone or in combination with other additives also for said machining fluids as well as antifreezes or hydraulic fluids. These may contain e.g. other corrosion inhibitors such as

a) organic acids or salts and esters thereof, e.g. benzoic acid, p-tert-butylbenzoic acid, disodium sebacate, triethanolamine laurate, isononanoic acid,

the triethanolamine salt of p-toluenesulfonamidocaproic acid, sodium N-lauroylsarcosinate or nonylphenoxyacetic acid;

b) nitrogen-containing substances such as e.g. fatty-acid alkanolamides, imidazolines, oxazolines, triazoles or inorganic nitrites or nitrates;

c) phosphorus-containing substances, for example amine phosphates, phosphonic acids or inorganic phosphates such as e.g. NaH_2PO_4;

d) sulfur-containing substances such as salts of petroleum sulfonates, or heterocyclic compounds such as sodium mercaptobenzothiazole.

Examples of extreme pressure antiwear additives, which may be contained in functional fluids, are substances containing sulfur, phosphorus or halogen, e.g. sulfonated sperm oil, sulfurated fats, tritolyl phosphate, chlorinated paraffins or ethoxylated phosphate esters.

The following Examples 1 - 15 illustrate the preparation of compounds of formula I, while the Examples 16 - 38 show their use in various aqueous systems. In these parts and percentages refer to parts by weight. The temperatures refer to ° Celsius.

Example 1

Preparation of 2,4,6-tris(5'-carboxypentylamino)-1,3,5-triazine

One third of a solution of 49 parts of sodium 6-aminohexanoate in 70 parts of water is added dropwise within 1 1/2 h to a suspension of 18.5 parts of cyanuric chloride in 150 parts of water at 0°, the temperature being kept below 5°. The remainder of the solution is then added and the reaction mixture is stirred first for 2 h at room temperature, then for 3 h under reflux. During this time, the pH value is kept continuously at 10 to 11 by adding 25% NaOH.

The reaction mixture is cooled to 50° and filtered, the filtrate is diluted with 1,000 parts of water and acidified to a pH of 4-4.5 with concentrated hydrochloric acid, a crystalline precipitate forming. After the reaction mixture has cooled to room temperature, the

precipitate is filtered off, washed with cold water and dried in vacuo. 35 parts of 2,4,6-tris(5'-carboxypentylamino)-1,3,5-triazine, corresponding to a yield of 75%, are obtained. After recrystallization from aqueous acetic acid, the substance melts at 177°C.

Analysis ($C_{21}H_{36}N_6O_6$)

calc.:	C 53.85	H 7.69	N 17.95%;
found:	C 54.07	H 7.68	N 17.26%.

The compounds of Examples 2-7 listed in Table I were prepared in an analogous manner to this.

Example 8

Preparation of 2-n-octylamino-4,6-bis(2'-carboxyethylamino)-1,3,5-triazine

18.5 parts of cyanuric chloride are treated with 200 parts of acetone and the opaque solution stirred into 300 parts of ice-water. 28 parts of n-octylamine are added dropwise at 0 to 5° within one hour to this suspension of freshly precipitated cyanuric chloride and in this process the pH value is held at 5-6 by adding 25% NaOH.

A solution of 42.4 parts of the sodium salt of β-alanine in 60 parts of water is then added and the reaction mixture is brought to room temperature by stirring for 2 hours.

Slow heating to 95°C is then carried out with the acetone being continuously distilled off and in this process the pH value is kept at 10-11 by adding further sodium hydroxide solution. The reaction is finally completed after heating for 6 h at 95 - 100° at pH 10 - 11.

After cooling to 30°, the solution is acidified with concentrated hydrochloric acid to a pH of 4-4.5, a white precipitate depositing. The latter is filtered off, washed with water and dried in vacuo. 26.4 parts of 2-n-octylamino-4,6-bis(2'-carboxyethylamino)-1,3,5-triazine, corresponding to a yield of 69%, are obtained. After recrystallization from water, the substance melts at 138-140°.

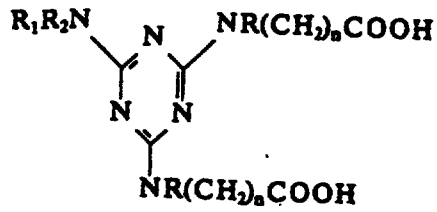
Analysis ($C_{11}H_{50}N_6O_4$)

calc.:	C 53.40	H 7.85	N 21.99%;
found:	C 52.91	H 7.97	N 21.65%.

The compounds of Examples 9-15 listed in Table I were prepared in an analogous manner.

Table I

Prepared compounds of the formula



Example	R	R_1	R_2	n	Yield (%)	m.p. (°C)	Analysis (%)	C	H	N
2	H	$(CH_2)_3COOH$	H	3	67	205,7	$C_{15}H_{24}N_6O_6 \cdot H_2O$			
							calc.	44,77	6,47	20,90
							found	44,60	6,33	20,48
3	H	$(CH_2)_2COOH$	H	2	73	>230	$C_{12}H_{18}N_6O_6$			
							calc.	42,11	5,26	24,56
							found	42,24	5,27	24,24
4	H	CH_2COOH	H	1	92	>230	$C_9H_{12}N_6O_6$			
							calc.	36,00	4,00	28,00
							found	35,13	3,95	27,44
5	CH_3	$(CH_2)_5COOH$	CH_3	5	45	109—11	$C_{24}H_{42}N_6O_6$			
							calc.	56,47	8,24	16,47
							found	56,23	7,84	16,97
6	CH_3	$(CH_2)_3COOH$	CH_3	3	61	146—7	$C_{18}H_{30}N_6O_6$			
							calc.	50,70	7,04	19,72
							found	51,15	7,10	19,68
7	CH_3	CH_2COOH	CH_3	1	65	225—6	$C_{12}H_{18}N_6O_6$			
							calc.	42,11	5,26	24,56
							found	41,80	5,11	24,10
9	H	n-C_8H_{17}	H	3	78	174—6	$C_{19}H_{34}N_6O_4$			
							calc.	55,59	8,35	20,48
							found	55,46	8,51	20,54
10	H	n-C_8H_{17}	H	5	69	119—21	$C_{23}H_{42}N_6O_4$			
							calc.	59,23	9,01	18,03
							found	59,06	8,97	18,05
11	H	C_2H_5	H	2	73	229—31	$C_{11}H_{18}N_6O_4$			
							calc.	44,30	6,04	28,18
							found	43,63	6,01	27,66
12	H	C_2H_5	CH_3	2	73	208—10	$C_{13}H_{22}N_6O_4$			
							calc.	47,85	6,75	25,77
							found	46,85	6,84	24,25
13	H	C_2H_5	H	3	63	192—4	$C_{13}H_{22}N_6O_4$			
							calc.	47,85	6,75	25,77
							found	46,72	7,09	25,39
14	H	C_2H_5	H	5	79	150—2	$C_{17}H_{30}N_6O_4$			
							calc.	53,40	7,85	21,99
							found	52,19	8,08	21,00
15	H	C_2H_5	C_2H_5	5	66	149—51	$C_{19}H_{34}N_6O_4$			
							calc.	55,61	8,29	20,49
							found	54,61	7,70	19,84

Examples 16 - 30

Corrosion-prevention action in aerated water

The corrosion-inhibiting activity of the compounds of the Examples 1 - 15 is demonstrated in a test in flasks containing aerated water, the following types of water being used:

A) water made artificially corrosive of pH 7.5 and a hardness of 30 ppm of $CaCO_3$,

B) acidified water of pH 6.5 and hardness of 200 ppm of $CaCO_3$,

C) water, treated by means of basic ion exchanger, of pH 7.5 and hardness 0.

5 x 2.5 x 0.1 cm sheets of low-carbon steel are scoured with pumice stone, immersed for 1 minute in dilute hydrochloric acid, rinsed with water, dried and weighed.

The individual corrosion inhibitors are dissolved in the different samples of water as sodium salt, a concentration of 100 ppm being established. A steel sheet is placed in each of these solutions, which are filled into flasks, and the flasks are thermostated at 40°C. Air is passed through the test solutions in a quantity of 500 ml/minute. The water evaporating with the current of air is continuously replaced by distilled water so that the volume remains the same.

After 48 h, the steel sheet is removed from the solution, scoured with pumice stone, immersed for 1 minute in dilute hydrochloric acid which contains 1% hexamethylenetetramine, then rinsed with water, dried and the loss in weight of the sheets determined by reweighing. Each test series is accompanied by a blank without corrosion inhibitor. The "degree of corrosion" is the loss in weight in mg per dm^2 of the sample surface per day.

More descriptive is the quotation of the "percentage protection from corrosion" (% KS) which is calculated as follows:

$$\%KS = \frac{\text{Degree of corrosion of blank - degree of corrosion of sample}}{\text{Degree of corrosion of blank}} \times 100$$

Table II

Example	Corrosion inhibitor from Example*)	%KS in the water A	B	C
16	1	95	95	93
17	2	100	96	98
18	3	99	96	97
19	4	(40)	(23)	92
20	5	55	86	96
21	6	86	(28)	97
22	7	76	(30)	74
23	8	63	89	100
24	9	60	(15)	98
25	10	96	100	100
26	11	90	86	96
27	12	—	—	100
28	13	86	96	97
29	14	70	100	100
30	15	97	95	100

*) The compounds were neutralized with NaOH.

The results show that all the compounds have excellent corrosion-prevention action in the various water samples.

(34)

Examples 31 - 33

Corrosion-prevention action in a laboratory heat-exchanger model device

The device is a closed water circulation system consisting of a 20 l container, a 1 l container, a pump, a flow meter, a sample chamber, a heat exchanger and a cooler.

Corrosive service water is gasified in the 20 l container with 5 l/min of compressed air through a sintered plate and pumped from there into the 1 l container. From there, the water flows through the flow meter into the glass sample chamber in which 2.5 x 2.5 cm metal sheets are located on a mounting device of acrylic glass.

The water then flows through the heat exchanger which consists of a steel tube of 1.58 cm inside width. The tube has copper ends and is wound round with a 960 Watt heating coil. After the heat exchanger, the water flows through the cooler back into the 20 l container.

In the steady state, the water circulates through the device at 4.55 l/min. In the circumstances, it has a velocity of 0.46 m/sec in the heat exchanger and a Reynolds number of 8,500. The heating coil gives the heat exchanger an outside temperature of 60°. The water leaves the heat exchanger at 45°. The cooler is operated so that it cools the water to 40° before it starts a new circuit.

The samples consist of sheets of low-carbon steel, cast iron, copper, brass and aluminium. They are cleaned before the test with scouring powder and then immersed in an acid bath and in particular, the steel, iron, copper and brass sheet for 1 minute in concentrated hydrochloric acid diluted 1 : 1 at room temperature, the aluminium sheets for 5 minutes in 5% phosphoric acid containing 2% chromic acid at 75°. The sheets are then washed with water, dried and weighed. They are then mounted on the acrylic glass mounting device, care being taken that they do not touch either each other or metal screws of the mounting device. The tube of the heat

exchanger is pretreated and weighed in the same way as the steel sheet sample.

The device is then assembled and thoroughly cleaned by circulating hydrochloric acid (diluted 1:1). Rinsing is then carried out for about half an hour with fresh tap-water and the device is emptied. The corrosion inhibitor is now filled into one of the containers and the apparatus is filled with 22 l of a standardized corrosion-test water.

The circulation system is brought into operation by switching on the pump and the heating. The inhibitor concentration and the quantity of water in the device is checked daily. After 3 days and after a further 10 days, the heat exchanger tube is dismantled and the sample sheets are removed, cleaned as in the pretreatment and reweighed. In the first 3 days of the test, 100 ppm of corrosion inhibitor are used, in the subsequent 10 day test only 25 ppm.

Table III indicates the degrees of corrosion obtained after 13 days which are derived from the weighed loss in weight.

Table III

Example	Corrosion inhibitor used	Water used	Degree of corrosion in mg/dm/day				
			Steel	Al	Cu	Brass	Exchanger tube
31	-	Manchester water, pH 7.0	140.1	5.8	3.7	4.8	420.6
	KI-1*)	Manchester water, pH 7.0	2.5	2.7	0.9	2.0	39.8
32	-	water purified via basic ion exchanger pH 8.0	139.9	0.0	1.0	1.8	485.3
	KI-1*)	water purified via basic ion exchanger pH 8.0	6.4	4.0	0.9	0.5	11.2
33	-	Macclesfield water, pH 6.5	67.8	8.2	0.6	0.5	215.4
	KI-1*)	Macclesfield water, pH 6.5	19.9	0.0	1.1	0.9	38.5

KI-1 = sodium salt of the compound of Example 1.

Examples 34 - 38

Protection from corrosion in aqueous cutting oils

The corrosion inhibition of aqueous cutting oils according to the present invention is tested by the method described below which is a modification of test method 287 of the Institute of Petroleum.

A 1% solution of the corrosion inhibitor is neutralized with triethanolamine to a pH of 9. This solution is diluted further to the 2-, 4-, 8- and 16-fold volume. The concentration of inhibitor in these part solutions calculated on the basis of the free triazinecarboxylic acid is therefore 0.5%, 0.25%, 0.12% and 0.06%.

These test solutions are poured over cast iron turnings on filter paper and the initial rusting of the paper is assessed visually after 2 hours in accordance with IP test method 287. Here:

O signifies no rust stains

T signifies $\leq$5 no stains (sic)

M signifies $\leq$10% of the area rusty

S signifies >10% of the area rusty.

The tests were made A) with normal (hard) water and B) with deionized water. In addition, the sensitivity to hard water was tested. Here O denotes no turbidity. The results are listed in Table IV.

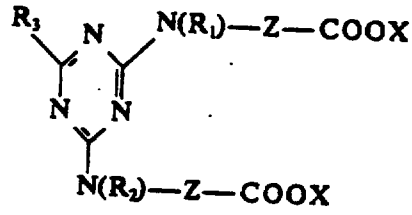
Table IV

Example	Inhibitor used (compound of Example No. and concentration*)	Initial rusting in A	Initial rusting in B	Hardness sensitivity
34	1 — 0,5%	0	0	0
	0,25%	0	0	
	0,12%	0	T—M	
	0,06%	T—M	—	
35	5 — 0,5%	0	0	0
	0,25%	0	0	
	0,12	0	0	
	0,06%	T	—	
36	11 — 0,5%	0	0	0
	0,25%	0	S	
	0,12%	0	—	
	0,06%	S	—	
37	14 — 0,5%	0	0	0
	0,25%	0	0—T	
	0,12%	0	S	
	0,06%	0	—	
38	15 — 0,5%	0	0	0
	0,25%	0	0	
	0,12%	T	M	
	0,06%	T	—	

*) Calculated on the basis of free triazinecarboxylic acid

Patent Claims

1. Use of compounds of the formula I



(I),

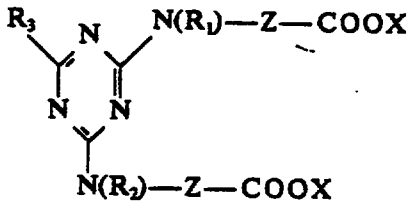
in which Z is a C_1-C_{11}-alkylene group, X is hydrogen, an alkali metal, mono-, di- or triethanolammonium, R_1 and R_2 are hydrogen or methyl and R_3 is an $-NR_4R_5$ group in which R_4 is -Z-COOX or C_1-C_{12}-alkyl and R_5 is hydrogen or C_1-C_{12}-alkyl, as corrosion inhibitors for aqueous systems which are in contact with iron or iron-containing metals.

2. Use according to claim 2, wherein Z is a C_1-C_5-alkylene group, R_4 is -Z-COOX or C_1-C_8-alkyl and R_5 is hydrogen, methyl or ethyl.

3. Aqueous system which, in addition to the corrosion inhibitor of the formula I specified in claim 1, also contains another corrosion inhibitor.

Claims (as printed)

1. Use of compounds of the formula I



(I)

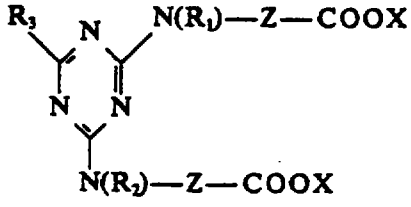
wherein Z is a C_1-C_{11}-alkylene group, X is hydrogen, an alkali metal, mono-, di- or triethanolammonium, R_1 and R_2 are hydrogen or methyl, and R_3 is a group $-NR_4R_5$, in which R_4 is $-Z-CCOOX$ (sic) or C_1-C_{12}-alkyl, and R_5 is hydrogen or C_1-C_{12}-alkyl, as corrosion inhibitors for aquwous systems which are in contact with iron or ferrous metals.

2. Use according to claim 2, wherein Z is a C_1-C_5-alkylene group, R_4 is $-Z-COOX$ or C_1-C_8-alkyl, and R_5 is hydrogen, methyl or ethyl.

3. Aqueous system which contains, besides the corrosion inhibitor of the formula I given in claim 1, a further corrosion inhibitor.

Revendications (as printed)

1. Application de composés répondant à la formule I:



(I)

dans laquelle Z représente un radical alkylène en C_1-C_{11}, X représente l'hydrogène, un métal alcalin ou un radical mono-, di- ou triéthanolammonium, R_1 et R_2 représentent chacun l'hydrogène ou un radical méthyle et R_3 représente un radical $-NR_4R_5$ dans lequel R_4 désigne un radical $-Z-COOX$ ou un alkyle en C_1-C_{12} et R_5 désigne l'hydrogène ou un alkyle en C_1-C_{12}, comme inhibiteurs de corrosion pour des systèmes aqeux qui entrent en contact avec du fer ou des métaux contenant du fer.

2. Application selon la revendication 2 caractérisée en ce que Z représente un radical alkylène en C_1-C_5, R_4 représente un radical $-Z-COOX$ ou un alkyle en C_1-C_8, et R_5 représente l'hydrogène ou un radical méthyle ou éthyle.

3. Système aqueux qui, en plus d'un inhibiteur de corrosion de formule I selon la revensication 1, contient un autre inhibiteur de corrosion.