FTD-HT-23-631-68

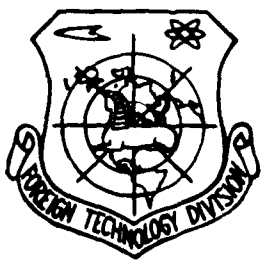
AD 683540

FOREIGN TECHNOLOGY DIVISION

APPLICATION OF CERTAIN SHALE PRODUCTS AS CORROSION INHIBITORS

by

R. E. Metsik



1

FTD-HT-23-0[illegible]1-68

EDITED TRANSLATION

APPLICATION OF CERTAIN SHALE PRODUCTS AS CORROSION INHIBITORS

By: R. E. Metsik

Translated under: Contract F33657-68-D-0865/P002

PREPARED BY:

TRANSLATION DIVISION
FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

DATA HANDLING PAGE

01-ACCESSION NO.	98-DOCUMENT LOC	99-TOPIC TAGS
TP8001853		acetate, desalination, phenol, corrosion inhibitor, solution acidity, steel corrosion, sulfuric acid.

09-TITLE
APPLICATION OF CERTAIN SHALE PRODUCTS AS CORROSION INHIBITORS

47-SUBJECT AREA
11

45-AUTHOR/CO-AUTHORS	10-DATE OF INFO
METSIK, R. E.	-----66
43-SOURCE	68-DOCUMENT NO.
TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA, KIYEV (RUSSIAN)	FTD-HT-23-631-68
	69-PROJECT NO. 72301-78

63-SECURITY AND DOWNGRADING INFORMATION	64-CONTROL MARKINGS	97-HEADER CLASN
UNCL, 0	NONE	UNCL

76-REEL/FRAME NO.	77-SUPERSEDES	78-CHANGES	40-GEOGRAPHICAL AREA	NO. OF PAGES
1887 0296			UR	4
CONTRACT NO.	X REP ACC. NO.	PUBLISHING DATE	TYPE PRODUCT	REVISION FREQ
F33657-68-D-0865	65-BC8000600	94-00	Translation	NONE

STEP NO.	ACCESSION NO.
02-UR/0000/66/000/005/0095/0097	

ABSTRACT

→ The effect of H_2O-sol. shale phenols on the corrosion of C steel in aq. solns. of AcOH, NH_4Cl, K_2SO_4, HCl, KCl, and H_2SO_4 was studied. The corrosion rate decreased by a factor of 5-25. A shale de-emulsifier used in the desalination of oils had an analogous action. The presence of a shale de-emulsifier in an amt. of 5 g./l. in a 0.5N H_2SO_4 soln. decreased the corrosion of C steel from 23 to 1.5 g./m.^{2} hr. From Ref. Zh., Khim. 1967, Pt. II, Abstr. No. 5P80.

UDC 620.197.3

APPLICATION OF CERTAIN SHALE PRODUCTS AS CORROSION INHIBITORS

R.E. Metsik, *Candidate of Technical Sciences*

At present, the shale industry is producing water-soluble phenols that are obtained by extraction with butyl acetate from tar water and used as a raw material for the production of synthetic tanning agents and adhesives of type DFK. These water-soluble phenols consist chiefly of dimethylresorcinols. The content of monophenols (phenol, cresol and other water-soluble monophenols) in the mixture is only 10-15%, and the remaining components are bifunctional water-soluble phenols.

TABLE 1

Decrease in Rate of Corrosion of Carbon Steel in Hydrochloric Acid on Addition of 6 g/liter of Phenols

1 Характеристика среды	2 Скорость при 20°С, *мм/год*	3 Эффект ингибитора, %
4 0,1 н. раствор соляной кислоты	0,13	95
1,0 н. » » »	0,04	96
0,01 н. » » »		
5 насыщенной сероводородом	0,22	98

1) Description of medium
2) Rate at 20°C, mm/year
3) Effect of inhibitor, %
4) 0.1n hydrochloric acid
5) Saturated with hydrogen sulfide

It was noted in the corrosion laboratory of the Shale Institute that the corrosion of steel is reduced to a fraction in the presence of small quantities of the above phenols in acidic aqueous solutions and in butyl acetate. This indicates a possibility of using phenols as corrosion inhibitors.

Gravimetric studies showed that the corrosion rate of carbon steel in acidic aqueous solutions is reduced by factors of 5-25 under the influence of shale phenols, with the inhibitor effect reaching 98% in certain cases (Tables 1 and 2).

FTD-HT-23-631-68

TABLE 2

Decrease in Corrosion Rate of Carbon Steel in Acidic Salt Solutions Under the Influence of Phenols at 20°C

A Состав раствора, *мэкв/л*					pH	B Количество добавленных фенолов, *г/л*	C Скорость коррозии в растворе, *мм/год*	
CH_3COOH	NH_4Cl	K_2SO_4	HCl	KCl			не содержащем фенолы D	содержащем фенолы E
11	25	35	100	—	1,0	7,0	2,54	0,12
—	60	—	100	30	1,3	4,3	2,68	0,12
11	25	20	—	—	3,4	1,0	0,50	0,10
5	25	20	—	—	4,7	2,0	0,58	0,07
11	25	—	—	25	3,4	0,1	0,50	0,30

A) Solution composition, mg-eq/liter
B) Amount of phenols added, g/liter
C) Corrosion rate in solution, mm/year
D) Not containing phenols
E) Containing phenols

TABLE 3

Rectification Data of Phenols and Characterization of Fractions Obtained

1 Пределы кипения, °C		4 Выход фракций, %	5 Содержание группы OH, %	6 Молекулярный вес
2 при 15 *мм рт. ст.*	3 в пересчете на атмосферное давление			
75—145	170—260	15,6	13,1	118
145—161	260—280	9,2	19,5	130
161—165	280—285	7,1	23,8	134
165—169	285—290	26,5	24,6	138
169—173	290—295	16,8	24,4	141

1) Boiling range, °C
2) At 15 mm Hg
3) Converted to atmospheric pressure
4) Yield of fraction, %
5) OH-group content, %
6) Molecular weight

It is seen from polarization curves that corrosion is reduced in hydrochloric acid under the influence of the phenols chiefly as a result of cathode-process inhibition.

The phenols were rectified (Table 3) to determine the inhibitor properties of the individual fractions. Bifunctional phenols were obtained by separating the total phenols on silica gel by distributive solvent (benzene and methanol) chromatography.

Gravimetric studies indicated (Table 4) that all phenol fractions have almost identical inhibiting properties, with the inhibitor effect above 90% in all cases. Increasing the amount of

TABLE 4

Protective Effect of Phenols in Corrosion of Carbon Steel in 0.1n Hydrochloric Acid

A Наименование присадки	B Количество присадки, г/л			
	1	5	1	5
	C Скорость коррозии, мм/год		D Эффект ингибитора	
E Суммарные фенолы . . .	0,14	0,17	94	93
F Двухатомные фенолы . .	0,18	0,09	93	96
G Фракция фенолов 170—260° С	0,20	0,08	91	97
Фракция фенолов 260—280° С	0,15	0,05	94	98
Фракция фенолов 280—285° С	0,16	0,06	93	97
Фракция фенолов 285—290° С	0,37	0,07	85	97
Фракция фенолов 290—295° С	0,13	0,06	95	97

A) Additive
B) Amount of additive, g/liter
C) Corrosion rate, mm/year
D) Inhibitor effect
E) All phenols
F) Bifunctional phenols
G) ...°C phenol fraction

TABLE 5

Inhibitor Effect in Pickling of Steel in the Presence of Phenols, %

A Количество фенолов, г/л	B Серная кислота, 10%		B Серная кислота, 20%		D Соляная кислота, 10%	
	C при 20°С	C при 60°С	C при 20°С	C при 60°С	C при 20°С	C при 60°С
10	72	79	60	65	60	67
30	95	81	96	93	86	80
40	98	97	98	97	91	85

A) Amount of phenols, g/liter
B) Sulfuric acid
C) At
D) Hydrochloric acid

additive from 1 to 5 g/liter lowers the corrosion of carbon steel in all cases in 0.1n hydrochloric acid.

It is seen from Table 5 that water-soluble shale phenols can be used as corrosion inhibitors for pickling of carbon steel in sulfuric acid.

Shale deemulsifiers may become one of the methods of protect-

ing metals from corrosion.

A shale deemulsifier is a 45% solution of the sodium or ammonium salts of shale-tar sulfo acids. At the present time, this material is being produced by the shale refinery at Syzrany and is used in the petroleum industry as a deemulsifier for desalting of petroleum.

Study of this material in the corrosion laboratory of the ESSR Shale Institute showed that the deemulsifier has inhibitor properties.

The presence of 5 g/liter of shale deemulsifier in 0.5n sulfuric acid solution lowers the corrosion of carbon steel from 23 to 1.5 $g/m^2 \cdot h$. In solutions of chlorides and sulfates (pH 2), the corrosion rate of carbon steel is lowered from 0.38 to 0.03 $g/m^2 \cdot h$ with an inhibitor effect higher than 90% under the influence of 1 g/liter of shale deemulsifier.