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SUMMARY AND CONCLUSIONS

Synthetic waste solutions from both the ferrous ammonium sulfate and oxalate flowsheets were prepared and portions of each solution were adjusted to pH 7, pH 8, and pH 9. Two sets of specimens of SAE 1020 carbon steel were exposed in both the vapor phase and the liquid phase of each of these solutions for periods of one month and three months, respectively. The general corrosion, the maximum pitting, and the average pitting rates determined for each specimen were approximately 2×10^{-5} , 1.5×10^{-4} , and 1×10^{-4} IPM, respectively. The corrosion rates of the specimens exposed in the vapor and those exposed in liquid were the same order of magnitude.

From these data, it is concluded that there is no significant difference in the corrosive effect on SAE-1020 carbon steel exposed to TBP waste at either pH 7, pH 8, or pH 9. Further, the data show that no significant difference exists between the corrosivity of waste produced with the ferrous ammonium sulfate flowsheet and the waste resulting from the oxalate flowsheet. It must be pointed out, however, that these tests were of very limited duration for this type of study. Without sufficient exposure time to enable a determination of the change of corrosion rate with respect to long periods of time, extrapolation of these data must necessarily be done with extreme caution. *end*

DETAILS

One stock solution used in this study was made synthetically to meet flowsheet specifications for RAW as indicated in HW-19140. The other stock solution had the same composition except 0.05M oxalic acid was substituted for 0.03M ferrous ammonium sulfate in the RAS, and 0.25M sodium oxalate was substituted for 0.37M sodium sulfate in the ROS. The chemical compositions of these two solutions are tabulated in Table I. Portions of each solution were neutralized with sodium hydroxide to pH 7, pH 8, pH 9, respectively. Each of the six solutions was then concentrated to a specific gravity of 1.38 g/cc.

The specimens of SAE-1020 carbon steel were prepared by polishing on #80 grit wet emery belt followed by polishing on #240 grit wet emery belt. They were then dried in methanol and weighed.

Twelve 500 ml Erlenmeyer flasks containing 250 ml of solution with a specimen exposed in the vapor and a specimen exposed in the liquid were maintained at 30 C by using infra-red heat lamps as a heat source and aluminum foil as a means of distributing the heat uniformly. The specimens in six of the flasks were removed after one month, while those in the other six flasks were exposed for three months.

After exposure the specimens were washed in water, dried in methanol and weighed. The general corrosion rate was calculated using the following formula:

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$$\text{ipm} = \frac{43.9 \times W}{D \times A \times T}$$

where ipm = Corrosion rate - inches penetration per month

W = Weight loss - grams

D = Density - grams per cubic centimeter

A = Area - square inches

T = Time - hours

The average pitting rate was determined by scanning the specimen under a magnification of 250X and selecting at random the six deepest pits. The depth of these pits were then measured by means of a short focal length optical microscope, averaged, and the rate calculated as follows:

$$\text{P. R.} = \frac{P}{25,400 T}$$

where P.R. = Pitting rate - inches penetration per month

P = Pit depth - micro inches

T = Time - months

The maximum pitting rate was calculated by the same method using the deepest pit found. These data are tabulated in Table II.



Corrosion and Welding
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TABLE I

CHEMICAL COMPOSITION OF SYNTHETIC
 TBP WASTE STREAM (RAW + ROW)

(Ferrous Ammonium Sulfate Flowsheet)

<u>Component</u>	<u>Concentration (moles/liter)</u>
UNH	0.0117
SO ₄ ²⁻	0.584
PO ₄ ³⁻	0.179
NO ₃ ⁻	4.45
Cl ⁻	0.016
(H ₂ NSO ₃) ⁻	0.034
H ⁺	2.60
Na ⁺	3.54
Fe ²⁺	0.017
NH ₄ ⁺	0.034

CHEMICAL COMPOSITION OF SYNTHETIC
 TBP WASTE STREAM (RAW + ROW)

(Oxalate Flowsheet)

<u>Component</u>	<u>Concentration (moles/liter)</u>
UNH	0.011
SO ₄ ²⁻	0.26
PO ₄ ³⁻	0.26
NO ₃ ⁻	7.71
Cl ⁻	0.023
C ₂ O ₄ ²⁻	0.25
H ₂ O	4.32
H ⁺	5.21

TABLE II

CORROSION RATES IN TSP WASTE SOLUTIONS

Flowsheet	pH	Location	Specimen	One Month Exposure			Three Month Exposure			
				General Corro- sion Rate- μm	Pitting Rate IPM		General Corro- sion Rate- μm	Pitting Rate IPM		
					Max.	Ave.	Specimen		Max.	Ave.
Ferrous Ammonium Sulfate	7	Liquid	4F - 43	1.0×10^{-5}	67×10^{-5}	51×10^{-5}	4F - 45	0.7×10^{-5}	76×10^{-5}	46×10^{-5}
		Vapor	4F - 44	4.8×10^{-5}	94×10^{-5}	80×10^{-5}	4F - 46	0.5×10^{-5}	111×10^{-5}	76×10^{-5}
	8	Liquid	4F - 47	1.4×10^{-5}	102×10^{-5}	73×10^{-5}	4F - 49	0.5×10^{-5}	43×10^{-5}	38×10^{-5}
		Vapor	4F - 48	1.6×10^{-5}	59×10^{-5}	41×10^{-5}	4F - 50	2.0×10^{-5}	84×10^{-5}	54×10^{-5}
	9	Liquid	4F - 51	1.5×10^{-5}	82×10^{-5}	61×10^{-5}	4F - 53	0.6×10^{-5}	104×10^{-5}	87×10^{-5}
		Vapor	4F - 52	2.0×10^{-5}	102×10^{-5}	74×10^{-5}	4F - 54	3.0×10^{-5}	92×10^{-5}	77×10^{-5}
Oxalate	7	Liquid	4F - 55	2.4×10^{-5}	149×10^{-5}	102×10^{-5}	4F - 57	—	55×10^{-5}	46×10^{-5}
		Vapor	4F - 56	—	106×10^{-5}	87×10^{-5}	4F - 58	0.5×10^{-5}	66×10^{-5}	47×10^{-5}
	8	Liquid	4F - 59	1.6×10^{-5}	288×10^{-5}	128×10^{-5}	4F - 61	1.2×10^{-5}	91×10^{-5}	79×10^{-5}
		Vapor	4F - 60	1.2×10^{-5}	117×10^{-5}	98×10^{-5}	4F - 62	1.6×10^{-5}	79×10^{-5}	74×10^{-5}
	9	Liquid	4F - 63	1.8×10^{-5}	118×10^{-5}	95×10^{-5}	4F - 65	1.0×10^{-5}	59×10^{-5}	45×10^{-5}
		Vapor	4F - 64	1.6×10^{-5}	71×10^{-5}	60×10^{-5}	4F - 66	0.5×10^{-5}	38×10^{-5}	37×10^{-5}

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