

FERROSPONGE

SUPERB HYDROGEN SULFIDE SCAVENGER

Report of the kinetics of the reaction of sulfide with Ironite Sponge and FERRO-SPONGE scavengers at normal pressure and at room temperature.

SUMMARY

Ironite Sponge and FERRO-SPONGE H₂S scavengers were compared under the conditions described in a publication regarding their effect (pH 8-10, room temperature, normal pressure). FERRO-SPONGE proved to be superior over Ironite Sponge in reaction speed as well as completeness of catharsis. The residual sulfide contents, measured after a realistic processing time of 20 minutes, were (depending on pH value) 10 to 20% lower than with Ironite Sponge.

INTRODUCTION

R. P. Wendt (publication by ASME 78-Pet) evaluated the kinetics of the reaction of Ironite Sponge (Fe₃O₄) scavengers with hydrogen sulfide in aqueous solution in the pH range of 8-10. Additional results are published in Ironite company literature. Sodium sulfide is used as model substance for hydrogen sulfide in experiments by Ironite Company and also by Wendt (Loyola University, New Orleans). The authors specify the following kinetic reaction law:

$$\frac{d(S)}{Dt} = -3000 \times (S)^2 \times (H^+)^{1.06} \times (Fe_3O_4)$$

According to the authors, this formula is valid only for the pH range 8-10, determined experimentally. According to Wendt, the specified kinetic equation loses its validity at pH values of lower than 7. In the acidic range, higher reaction velocities were experimentally determined than those calculated with the above equation.

In spite of the fact that no general metering recommendation of iron oxide scavenger can be made with the above kinetic equation, it is sufficient to follow the temporal course of the decrease of the sulfide concentration for preliminary comparisons of the effectiveness of various iron oxides.



SCOPE

The systematic evaluation of the effect of Fe_3O_4 (Ironite Sponge) under laboratory conditions at pH values of 8, 9, and 10 was described by Wendt. In this evaluation, Ironite Sponge in aqueous dispersion is reacted at 23-C with 3720 ppm sulfide (as sodium sulfide) under turbulent agitation. The curves of decay of the sulfide concentration are based on the determination of the sulfide concentration depending on time and pH value.

The purpose of this test was to:

- a. Duplicate the trials according to Wendt under identical reaction conditions with Ironite Sponge;
- b. After the successful duplication, run the trials analogous under the same reaction conditions with FERRO-SPONGE scavenger, and
- c. Compare the sulfide curves of decay of Iron Sponge with FERRO-SPONGE scavenger.

TRIAL

1. Trial products: Ironite Sponge (Ironite Co.)
Ferro-Sponge scavenger (Messina Inc.)
2. Scavenger amount:
 - a. 28.4 g iron oxide (Fe_3O_4) in 500 ml purified water
3. Sulfide amount: 14 g $\text{Na}_2\text{S} \times 9 \text{H}_2\text{O}$ corresponds with 3720 ppm sulfide
4. Reaction conditions:
 - a. Trial time: 2 hours
 - b. Trial temperature: about 25-C
 - c. pH-range - 8, 9, 10

5. Experiment:

The reaction was performed in a Braun mixing apparatus with special agitator and external cooling shell. Because of the considerable influence of the agitation speed on the reaction speed, testing was done in the range of maximum (turbulent agitation flow) of the heterogenic system (Braun Mix, Stage 1). At low agitation speed far below the highest possible mixing, a greatly reduced reaction speed of iron oxide with sulfide was observed. The reaction was performed with protective gas (n_2) to reduce the influence of oxygen during the trial time. The reaction temperature was maintained at 25-C by the cooling shell. Without cooling, temperature of about 60-C were rapidly reached.



All reaction mixtures were produced by adding 14 g $\text{Na}_2\text{S} \times 9\text{H}_2\text{O}$ to 580 ml demineralized water. Sufficient amounts of NaHCO_3 were added to adjust pH values of 8, 9, and 10. Then 28.4 g Fe_3O_4 was added and agitated (start of reaction). The first sample was taken after 10 minutes of agitation. Additional samples were drawn at 20-minute intervals.

The samples were reacted with sale and centrifuged for 5 minutes to separate finely dispersed iron oxide. From the remaining clean solution specific amounts were taken to determine the respective sulfide concentration via the gas-train aperture. All samples were directly processed, because the influence of oxygen and the presence of Fe (III) - ions causes the oxidization of dissolved sulfide ions, and lower sulfide values or higher scavenger effect are stimulated.

DISCUSSION

The decay curves of the sulfide concentration in the presence of Ironite Sponge scavenger were somewhat supplication for pH values of 8, 9, and 120. The sulfide concentrations according to Wendt lie after 100 minutes at 120 ppm (ph - 8), 120 (pH - 9), and 1400 ppm (pH = 10). The sulfide concentrations, which were determined with Ironite Sponge in the laboratory after 100 minutes, were at 300 ppm (pH - 8), 700 (pH = 9), and 1200 ppm (pH - 10). The difference between Ironite measurement and the measurements stem from the certain different geometry of the agitator blades. According to orientation trials, this has a dominating influence on the velocity of the decrease of sulfide concentration. The Wendt publication contains no information about the agitator blade geometry. The differences regarding the decrease of sulfide concentration are insignificant, because for comparability of the scavenger effect, only the decay curves under exact identical conditions (same agitator geometry) may be compared.

When the decay curves of the sulfide concentration with the time of FERRO-SPONGE and Ironite Sponge scavenger under exact identical reaction conditions and identical agitator are compared, the following values result for different pH values:

The sulfide concentrations after the first 20 minutes and at the end of the reaction, after 120 minutes, are shown for comparison of the scavenger effect:

1. pH = 8

FERRO-

SPONGE scavenger reacts with sulfide more rapidly than Ironite Sponge. The sulfide value is lower by about 300 ppm after 20 minutes.

For Ironite Sponge we found 1000 ppm sulfide, for FERRO-SPNGE, 700 ppm sulfide.

After 120 minutes reaction time, the remaining sulfide value with FERRO-SPONGE had dropped to less than 20 ppm, while Ironite Sponge still had 260 ppm.

2. pH = 9

At pH = 9, the difference of effect of Ironite Sponge and FERRO-SPONGE scavenger becomes even more clear.

After 20 minutes the remaining sulfide content of FERRO-SPONGE was about 1000 ppm, while Ironite Sponge still had 1400 ppm sulfide. During the course of further reaction time, the difference grew to 500 ppm after 120 minutes. We found a remaining sulfide content of 65 ppm for FERRO-SPONGE; for Ironite Sponge, however, we still found 600 ppm sulfide remaining.

3. pH = 10

The scavenger effect of FERRO-SPONGE was higher than that of Ironite Sponge also at pH = 10. After 20 minutes, the sulfide values for the FERRO-SPONGE product were about 200 ppm lower. After 120 minutes a sulfide value of 900 ppm was found for FERRO-SPONGE; for Ironite Sponge still about 1000 ppm.

RESULTS

In all three pH-ranges, FERRO-SPONGE had a distinctly higher scavenger effect toward sulfide than Ironite Sponge in the trials. The difference is particularly obvious at pH = 9.

The following Table shows the remaining sulfide content with Ironite Sponge and FERRO-SPONGE after 120 minutes at different pH values.

	Remaining Sulfide (ppm)	
	<u>Ironite Sponge</u>	<u>FERRO-SPONGE</u>
pH = 8	259	20
pH = 9	583	65
pH = 10	1058	885

SULFIDE CONCENTRATION IN RELATION TO TIME AND pH-VALUE (25-C)

Reaction Time (Min.)	Ironite Sponge Scavenger (Literature Value acc. Wendt)			Ironite Sponge Scavenger (Laboratory Value)		
	Sulfide Concentration (ppm)			Sulfide Concentration (ppm)		
	pH = 8	pH = 9	pH = 10	pH = 8	pH = 9	pH = 10
10	1039	1351	1935	1296	1922	2203
20	614	843	1846	1015	1368	1900
40	338	500	1741	712	1252	1728
60	225	361	1578	475	1058	1360
90	152	250	1445	302	799	1274
100	136	225	1395	---	---	---
120	---	---	1304	259	583	1058

Co (Sulfide) = 3720 ppm
Scavenger Amount = 28.4 g Ironite Sponge

SULFIDE CONCENTRATION IN RELATION TO TIME AND pH-VALUE (25-C)

Reaction Time (Min)	Ferro-Sponge Scavenger			Ironite Sponge Scavenger		
	Sulfide Concentration (ppm)			Sulfide Concentration (ppm)		
	pH = 8	pH = 9	pH = 10	pH = 8	pH = 9	pH = 10
10	1166	1533	1879	1296	1922	2203
20	691	1015	1728	1015	1368	1900
40	475	777	1468	712	1252	1760
60	280	475	1252	475	1058	1360
90	108	237	1058	302	799	1274
120	20	65	885	259	583	1058

Co (Sulfide) = 3720 ppm (= 14 g No₂S x 9H₂O in 500 ml purif water)
Scavenger Amount = 28.4 FE304

FERRO-SPONGE is a Messina trademark

