Flow Loop Friction Reduction Testing

Case Study 1

Flow Loop Friction Reduction Tests Confirm Most Cost-Effective Anionic Emulsion for E&P's Application

Anionic friction reducers (FRs) supplied by multiple vendors and evaluated under the same test conditions permitted an O&G producer to select the friction reducer that was most cost-effective for their specific water chemistry and lateral lengths. Conducting the tests dispelled three common misconceptions:

1. Any FR will provide adequate friction reduction when using fresh water. (Figure 1)
2. When the proper dose is unknown, a higher dose is always more cost effective than less. (Figure 2)
3. The performance of anionic FRs will not degrade much in low-moderate TDS brine. (Figure 3)

Evaluating friction reducer performance in the field water chemisty enables selection of the most appropriate FR and the most cost-effective FR dose for that specific well.

Figures 1-3.

Flow loop friction reduction profiles for several commercial anionic emulsion friction reducers. The performance of all products in each figure were evaluated under equivalent test conditions.

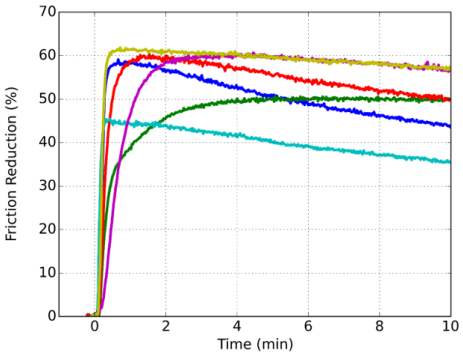

Figure 1
0.2 gpt of each anionic emulsion FR in Tap Water

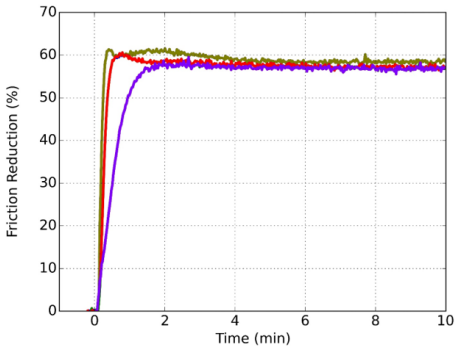

Figure 2
0.5 gpt of gold, red, and blue anionic FRs in Tap Water

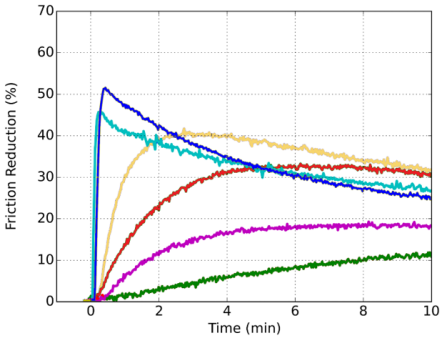

Figure 3
0.2 gpt of each anionic emulsion FR in 138K TDS Brine

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Case Study 2

Comparison of Friction Reducer Performance Facilitated by Flow Loop FR Index

A friction reducer performance index based on the flow loop test parameters: hydration time, maximum friction reduction, and performance decay, facilitates quick and easy comparison of friction reducer performance. The index can be customized for the physical attributes of each well by weighting the significance of each friction reduction parameter. Index results are consistent with field performance.

Figure 2A

Frac Spread Equipment

FR Type	FR ID	Dose (gpt)	*FR Index*
Cationic Emulsion	HH	0.25	**8.52**
Cationic Emulsion	U	0.25	**8.23**
Cationic Emulsion	KK	0.25	**8.12**
Cationic Emulsion	JJ	0.25	**7.76**
Cationic Emulsion	CC	0.25	**7.73**
Cationic Emulsion	T	0.25	**7.45**
Cationic Emulsion	N	0.25	**7.34**
Cationic Emulsion	GG	0.25	**7.13**
Cationic Emulsion	FF	0.25	**6.75**
Cationic Emulsion	F	0.25	**6.73**
Cationic Emulsion	P	0.25	**6.40**
Cationic Emulsion	I	0.25	**5.89**
Cationic Emulsion	Z	0.25	**5.89**
Cationic Emulsion	AA	0.25	**4.95**
Cationic Emulsion	L	0.25	**2.78**
Cationic Emulsion	Y	0.25	**1.96**
Cationic Emulsion	R	0.25	**0.74**

Figure 2B

Friction reduction index for cationic emulsion friction reducers evaluated under equivalent test conditions.