Friction Reducer PumpEX FRS-108

**Friction Reducer--PumpEX FRS-108** is an anionic polyacrylamide designed to reduce friction in water-based fracturing, acidizing, and brine applications. PumpEX FRS-108 is especially effective in high hardness fluid and in fluids with temperatures of 40°F. As a solid powder, it has a short hydration time and can reach the maximum drag reduction in a short time with salt resistant, especially calcium resistance properties. It also has a good compatibility with minerals.

**Benefits of L.E.A.D. PumpEX FRS-108**

1. Highly effective anionic friction reducer
2. Cost effective due to low dosage concentrations
3. Inverts rapidly at temperatures below 40°F
4. Especially effective in high hardness waters
5. As solid powder, it is convenient to transport and stock
6. Long shelf-life to 12 months
7. No pollution to the environment than emulsion.
8. No need to do gel breaking
9. Easy operation

**Circular Test Analysis**

Take 10 l deionized water or 1% CaCl₂ containing 1% NaCl or join the mixing tank, Δ p water as blank records, Accurate weighing 2.5 ~ 3.0 g powder(Polymer concentration 200ppm); Open the circulation pump, add powder under stirring, Mixed after enough time began to record the change of the pressure gauge of the Δ p measurements, Each test about 20 min.

The formula of drag reduction rate:

\[
FR\% = \left(1 - \frac{AP_{w}}{AP_{A}}\right) \times 100\%
\]

Including Δ p is the pressure difference of water, water Δ p measurements are average pressure difference after adding drag reduction agent;

L.E.A.D. drag reducer PumpEX FRS-108 ring drag reduction experiment results. As shown in figure 2, figure (2.1) L.E.A.D. drag reducer PumpEX FRS-108 in since joining system (time 0) to the 1400 s (about 23 min), the results show that drag reduction agent PumpEX FRS-108 in high calcium environment can maintain higher drag reduction rate (no less than 60%), good viscosity stability; figure (2.2) Drag reduction agent in PumpEX FRS-108 in the first 60 s drag reduction rate curves with time, the results show that the drag reduction agent PumpEX FRS-108 can achieve approximately 40 s biggest drag reduction effect, which can realize fast and efficient sticky drag reduction effect.
To sum up, through a series of the experimental results show that L.E.A.D. drag reducer PumpEX FRS-108 can be implemented in very low concentrations on the stability of the high calcium solution.

**Friction reduction curve**

![Friction reduction curve](image)

**Figure 1** Five different types of PumpEX FRS (200 PPM) in 1% CaCl2 solution of reduction rate changing curve according to time. The figure shows that PumpEX FRS series products have fast viscosity, viscosity stability, and the advantage of high calcium tolerance.

![Friction reduction curve](image)

**Figure 2** (2.1) circuit test reduction rate changing according to time curve (200 ppm, 1% CaCl2)

![Friction reduction curve](image)

**Figure 2** (2.2) PumpEX FRS 108 within 60s reduction curve (200 ppm, 1% CaCl2)
Figure 3 is a commercial friction reducer rate curve in the same test conditions. Compared with PumpEX FRS series, we can know PumpEX FRS series have a good effect to reduction, have a stable viscosity, resistance to high calcium and so on which other friction reducer does not have.

Reduction effect, little using, high salt resistant and other good performance. They can also meet the requirements of outdoor oil production which is water-based fracturing.

Indoor eddy method Evaluation

Measure 200ml water and put it on electromagnetic stirring. When water generates the max. height of eddy, measure this max. height \( H_0 \). At the same time, listen carefully and measure noise decibell(ear-piercing); Determine the mass of 0.05-0.06g powder(Polymer concentration 200ppm); Accurately record and measure the height of eddy \( H_1 \) and noise changing according to time.

Friction reducer FR computational formula

\[
FR\% = \frac{\Delta H}{H_0} \times 100\% = (1 - \frac{H_1}{H_0}) \times 100\%
\]

Experimental results are shown in figure 5, (1) qing aqueous solution under the effect of mixing son of eddy current, (2) for adding drag reduction agent, after solution under the same stirring speed of eddy current, contrast figure (1) and (2), the drag reduction agent has good reduction effect.

Figure 4 for the commercialization of anionic polyacrylamide molecular weight (about 15 million) in the high calcium solution viscosity effects of the test pattern, comparing figure 2 and figure 4 shows that PumpEX FRS series product has good drag reduction performance.
Chart: PumpEX FRS - 108 quality indicators

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MIN.</th>
<th>MAX.</th>
<th>ACTUAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICAL FORM</td>
<td></td>
<td></td>
<td>Dry Powder</td>
</tr>
<tr>
<td>POLYMER CONTENT</td>
<td>28</td>
<td>32</td>
<td>28.8</td>
</tr>
<tr>
<td>DH</td>
<td>25</td>
<td>35</td>
<td>29.3</td>
</tr>
<tr>
<td>MOLECULAR WEIGHT x 10^4</td>
<td>14.5</td>
<td>21.5</td>
<td>15</td>
</tr>
<tr>
<td>VOLUME DENSITY g/ml</td>
<td>0.85</td>
<td>1.15</td>
<td>0.89</td>
</tr>
</tbody>
</table>

PACKAGE:

Packed in Kraft paper bags of 25kg net each with PE inner.

STORAGE:

Sealed and stored in cool, dry conditions.

For more information about how PumpEX FRS-108 can help you meet your environmental goals, please contact L.E.A.D. representative or email info@sloilfield.com