Introduction:
Additive Direct Services has brought to market the Pro-3 series; an innovative non-amine/non-aldehyde H₂S scavenger for crude oil applications. A need was identified to reduce fouling created by amine based scavengers in refineries, production streams and crude oil terminals while keeping treating costs in the same level as triazine.

Reaction Overview:

Pro3 + H₂S → R’SO₄²⁻ + H₂O

- Pro-3 will chelate the H₂S molecules and turns them into aqueous non-toxic sulphate salt
- The heavier sulphate salt molecule will drop into produced water stream
- Reaction is fast and irreversible.

Pro-3 will react instantaneously with H₂S once contact is made. It will also react with lower chain mercaptans. Mercaptan reaction time may take up to 24 hours depending on mercaptan types.

- Pro-3 will react with carbon dioxide
- Pro-3 will not react with double bonded mercaptans

Scaling Potential and pH
Pro-3 is an alkaline solution and as such will slightly increase the pH of water. Testing is recommended to determine the increase in pH.

- It should be noted that MEA-triazine will also increase the pH of a produced water stream.

Hydroxide metal ions may form with water with a high mineral contact. Calcium and magnesium hydroxides are insoluble and would lead to a hazy water solution. Precipitation of the metal hydroxides is not likely to occur at ppm levels.
**Pro-3** and Triazine Comparison

**Lab Data:**
A kinetic tower test was designed to effectively test the limits of H₂S scavengers in a high gas-flow situation. The flow rate is electronically controlled, and the gas mixture composition is known (~1% nominally). As gas is bubbled through the scavenger column, it is then fed directly to an H₂S monitor. H₂S breakthrough is noted when the concentration of H₂S passing through the scavenger is 10 ppm, which is the daily 8 hr worker exposure limit. Timed tests are concluded when breakthrough is exceeded. Tower tests for samples are done along with a baseline product, which is repeated to ensure that validity of results obtained. The experimental design allows additional gas composition (CO₂) to test scavengers for different applications. The end result correlates to the maximum weight of H₂S absorbed (in g H₂S/L scavenger) by the scavenger.

It is normally noted that most scavengers, including the baseline product, absorb less H₂S in the presence of CO₂; with one exception being triazine. Amines are normally found in excess to favor the reaction of a triazine, but are also liberated during H₂S scavenging.

<table>
<thead>
<tr>
<th>Scavenger</th>
<th>Sample Size (10 ml)</th>
<th>pH</th>
<th>H₂S flow (sccm)</th>
<th>tbr (min)</th>
<th>gH₂S/L scavenger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Triazine</td>
<td>10</td>
<td>10.7</td>
<td>750</td>
<td>29.0</td>
<td>29.4</td>
</tr>
<tr>
<td><strong>Pro-3</strong></td>
<td>1.0</td>
<td>14.0</td>
<td>750</td>
<td>27.3</td>
<td>276.3</td>
</tr>
<tr>
<td>Troy Triazine</td>
<td>10</td>
<td>10.8</td>
<td>750</td>
<td>1.0</td>
<td>1.1</td>
</tr>
<tr>
<td>Nalco Triazine</td>
<td>10</td>
<td>?</td>
<td>750</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Baker Triazine</td>
<td>10</td>
<td>10.5</td>
<td>750</td>
<td>12</td>
<td>12.1</td>
</tr>
<tr>
<td>Caradan Triazine</td>
<td>10</td>
<td>9.8</td>
<td>750</td>
<td>39</td>
<td>40.7</td>
</tr>
</tbody>
</table>
Notes:
Pro-3 required a modification of our method due to the scavenging capabilities that were found. 10mL of scavenger is mixed with 10mL of water in the scavenger tower; however, in the case of Pro-3, 10mL lead to runtimes that were extremely prolonged. It was decided to dilute 1mL of Pro-3 with 19mL of water for the tower tests. The breakthrough times, and scavenging capabilities in the table reflect the use of 1mL Pro-3. In the absence of CO\(_2\), Pro-3 is able to scavenge 276.3 g H\(_2\)S per litre of scavenger.

Field Data:
Additive Direct Services has found that an injection dosage between 0.18-0.5 ppm of 33% active Pro-3 is needed per 1 ppmv of H\(_2\)S in crude oil in a pipeline. Comparatively a 40% triazine is typically dosed at a 1 ppm 40% active triazine per 1 ppmv of H\(_2\)S in a pipeline. Dosage rates are greatly dependent on contact efficiency and residence times.

A brief analysis is presented below to showcase economics between 40% MEA Triazine and Pro-3:

<table>
<thead>
<tr>
<th>Scavenger Type</th>
<th>Dosage PPM scavenger/PPM H(_2)S</th>
<th>Required Lbs / scavenger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pro-3</td>
<td>0.25</td>
<td>7,348</td>
</tr>
<tr>
<td>Pro-3</td>
<td>0.5</td>
<td>14,696</td>
</tr>
<tr>
<td>MEA Triazine 40%</td>
<td>1</td>
<td>29,392</td>
</tr>
<tr>
<td>MEA Triazine 40%</td>
<td>1.25</td>
<td>36,740</td>
</tr>
</tbody>
</table>

For Information please contact - Sales@AdditiveDirect.com

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