Pen-88M™ Surfactant

Pen-88M™ surfactant is a highly effective nonionic penetrating surfactant for use in aqueous treatment fluids. The reduced surface tension imparted by Pen-88M surfactant will allow fluids to penetrate into the formation more easily, allowing less pumping pressure to inject a fluid into a formation compared to the same fluid without this surfactant.

**Applications**

**Penetrating Aid for Treatment Fluids:** When added to a treatment fluid, Pen-88M surfactant can lower the pressure required to inject the fluid into the formation.

**Breakdown Fluid Ahead of a Fracturing Treatment:** Pen-88M surfactant can be used in most breakdown acid stages ahead of a fracture-acidizing or propped-fracturing treatment. Normally, lower breakdown pressures will be observed when using Pen-88M surfactant in the breakdown fluid. This reduction in pressure is achieved by increased matrix penetration of the acid containing the Pen-88M surfactant, which allows for transmission of energy from the wellbore to the formation rock.

**Matrix Acidizing for Removal of Near-Wellbore Damage:** Pen-88M surfactant can be used in many different applications where the near-wellbore permeability has been damaged by scale or other solids. The penetrating properties of Pen-88M surfactant help the treatment fluid contact the solid material that is to be dissolved or otherwise removed.

**For Removal of Water Blocks:** Water blocks can be removed by using a solution of water containing the appropriate clay-control additive (6% NaCl or 7% KCl when water-swelling clay minerals are present), methanol or mutual solvent (Musol® solvent, Musol A mutual solvent, or Musol E mutual solvent), nonemulsifier if liquid hydrocarbons are present, and Pen-88M surfactant. The Pen-88M surfactant concentration should be 0.5% in such an application. For maximum benefit, the treatment fluid should be commingled with CO₂.

**Features**

Pen-88M surfactant is a nonionic microemulsion blend of solvents and surfactants. A microemulsion is the stable dispersion of one immiscible liquid in another in the form of spherical droplets that have diameters of less than 0.14 microns. Dispersed droplets of this size allow light to pass through, forming a translucent solution (appearing clear). One essential property of a microemulsion is that it spontaneously disperses and will not separate into mutually insoluble phases.

Properly formulated microemulsion additives, such as Pen-88M surfactant, have the ability to penetrate into a tight or damaged formation. Once a fluid containing Pen-88M surfactant enters the formation, its unique properties enable the aqueous treatment fluid to penetrate the formation, displace oil, and increase the relative permeability to aqueous stimulation fluids.

**Compatibility**

The nonionic character of Pen-88M surfactant allows it to be used with most other stimulation chemicals. Pen-88M surfactant leaves both sandstone and carbonate formations in a water-wet condition. Pen-88M surfactant has an upper temperature limit of 225°F (107°C). Above this temperature Pen-88 HT™ surfactant should be used.

Pen-88M surfactant use in foamed or emulsified fluids can destabilize those fluids. Its use in such systems should be avoided unless testing has shown no compatibility issues exist.

**Benefits**

Pen-88M surfactant can provide the following benefits:

- Acts as a penetrating aid for all types of acid allowing reduced pressure for injection of the fluid into the formation.
- Its use in acid stages before fracturing treatments allows more effective breakdown of formations.
- Water wets both sandstone and carbonate formations. Its water-wetting properties also enable fluids that contain Pen-88M surfactant to be more effective in removing scale deposits and other types of near-wellbore damage that must be contacted by an aqueous treatment fluid to be dissolved.
## Pen-88M Surfactant-Product Specifications

<table>
<thead>
<tr>
<th>SAP No.</th>
<th>Specific Gravity</th>
<th>Bulk Density</th>
<th>pH</th>
<th>Flash Point</th>
</tr>
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<tbody>
<tr>
<td>101325319 Bulk</td>
<td>0.94</td>
<td>7.90 lb/gal</td>
<td>5 to 7</td>
<td>156˚F (68˚C)</td>
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<tr>
<td>101325318 Tote Tank</td>
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<td>100003718 55-gallon drum</td>
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<tr>
<td>100009537 5-gallon bucket</td>
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<tr>
<td><strong>Form</strong></td>
<td><strong>Colorless liquid</strong></td>
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