



# P-FSC

## **CEMENTING SERVICE BULLETIN**

04/1/15

### **P-FSC (PETROCHEM – FREE WATER & SETTLING CONTROL)**

#### **TECHNICAL DATA**

##### **Introductory Summary**

Complete information on health hazards, protective equipment, handling precautions, environmental hazards and disposal is listed in the current Material Safety Data Sheet (MSDS) for this product.

P-FSC is a powder additive developed to reduce free water, sedimentation, and density gradation collectively called slurry instability in cement slurries. It provides this stability improvement with varying increases in rheological values depending on the slurry design. P-FSC should have minimal effects on thickening time, fluid-loss control and compressive strength development.

P-FSC can be used at temperatures ranging from 80 to 300°F (27 to 149°C). Above 300°F (149°C), it undergoes a rapid degradation that cannot be overcome by increasing its concentration.

There is no defined slurry range for P-FSC applications, although the recommended lower density limit is 12.5 PPG (1.5 S.G.) for Class G and H cements containing extenders other than P-SL50.

P-FSC can be used in cement systems containing 0 to 37% BWOW Sodium Chloride; however, concentrations of Sodium Chloride greater than 5% BWOW must be dry blended or added to the mix water after adding the P-FSC. P-FSC can be used with seawater, although the required concentrations may be slightly higher and the results will not be as good as with freshwater or Sodium Chloride systems. P-FSC is not effective in slurries containing Calcium Chloride.



P-FSC is suitable for use with powder additive system equipment. P-FSC cannot be diluted with water before use, and cannot be pre-blended with other powder additives. It must be directly added to the mix water at the desired concentration in its original form.

The normal P-FSC concentration range for correcting slurry instability is 0.1 to 1.5% BWOC which will stabilize slurries from 12 to 22 PPG. Beyond this concentration range, the slurry rheological values are affected to varying degrees.

### **SLURRY DESIGN**

Unlike conventional cement additives, P-FSC is a remedial cement additive. It is designed to reduce slurry stability problems when the other slurry properties are close to optimum after the initial slurry design. It is used at very low concentrations (0.005 to 0.025 gal/sk.) and normally has very little influence on the other slurry properties. Large differences in the properties of a slurry with and without P-FSC could be due to errors in the performance measurement of the unstable slurry.

### **SLURRY STABILITY**

Cement slurries are designed to provide certain performance properties under well bore conditions. These properties, Permeability, Compressive strength and Zonal isolation are dependent on the slurry maintaining a stable solids-to-powder ratio throughout the well bore.

Tests to measure the stability of a cement slurry have been constantly increasing in number and complexity. These tests basically look for one piece of information; how uniform is the suspension of cement particles throughout the slurry under placement and curing conditions. P-FSC is designed to improve the slurry suspension properties, even for over dispersed cement slurries.

### **FREE WATER**

In the laboratory, free water is the clear fluid that develops at the top of a static column of cement contained in a graduated cylinder. Under well bore conditions; it can take the form of channels along one side of a deviated well bore or pockets of water within a vertical column of set cement.

In some slurries, a density profile develops from the top (less than design density) to the bottom (greater than design density) of the cement column and it steadily increases as the column compresses. The quantity of this density increase with depth is referred to as the density gradation of the slurry. It is usually considered acceptable when the density difference between the top and bottom is less than or equal to 10% of the design density.



Free water is present in slurries with and without cement additives. With easily dispersed cements, the free water can increase when dispersants and fluid-loss additives are incorporated.

P-FSC only counteracts free water induced by cement additives, which exhibit dispersing properties. It is not effective in curing free water that naturally occurs in a cement slurry. Therefore, it may sometimes be necessary to add a dispersant to the cement system to increase the P-FSC effectiveness in controlling the free water.

### **SEDIMENTATION**

Sedimentation, which is unrelated to free water, results from over dispersed slurries following Stokes Law on suspended particles.

The density profile of a severely over dispersed cement slurry shows a bed of packed cement particles at the bottom of the column having a density approaching that of bulk cement. This solids bed is referred to as slurry sedimentation. The remaining slurry in the column has a density varying from much lower than the design density just above this bed to a density very close to water at some point further up the column.

Sedimentation can and frequently does occur without the presence of clear free water. As mentioned earlier, sedimentation and free water are not related phenomena.

### **FLUID-LOSS CONTROL**

P-FSC is compatible with all Petrochem fluid-loss additives, including P-1000 when it is applied as a fluid-loss additive. At the proper concentration, P-FSC should not have any substantial effect on the fluid-loss control, except when good fluid-loss control is achieved by slurry sedimentation in the fluid-loss cell. In this case, the fluid-loss value of the unstable slurry is artificially low and improved slurry stability then results in higher fluid-loss values.

### **CAUTION:**

If high P-FSC concentrations are use, then the fluid-loss control of some slurries may be completely eliminated. This effect is caused by the creation of a strong microstructure, which prevents the filter cake formation necessary for fluid-loss control.

P-FSC is particularly well suited for curing sedimentation problems with systems containing Fluid-loss Additives P-FLAL.



### **LIGHTWEIGHT P-1000 (GAS CONTROL) APPLICATIONS**

Besides reducing slurry instability, P-FSC can be used as the slurry stabilizer in lightweight P-1000 systems. Lightweight P-1000 systems containing Extender P-SL50 requires the use of P-FSC. P-SL50 concentrations should follow the lightweight P-1000 design guidelines. Typical P-FSC concentrations from this application range from approximately 0.01 to 0.2 % BWOC.

### **CAUTION:**

When using P-FSC, the fluid-loss control of P-1000 slurries must be verified. As mentioned earlier, sufficiently high P-FSC concentrations can eliminate the fluid-loss control, even in P-1000 slurries.

### **TEMPERATURE LIMITATIONS**

P-FSC does not function at temperatures greater than 300°F (149°C). As it approaches this temperature, P-FSC performance undergoes a rapid degradation that cannot be overcome by increasing its concentration.

### **RETARDERS**

P-FSC is compatible with all Petrochem retarders. At temperatures less than 125°F (52°C), it may have a retardation effect on the slurry.

### **ACCELERATORS**

P-FSC performance is satisfactory with Sodium Chloride systems. P-FSC is not effective in systems containing Calcium chloride.

### **DISPERSANTS**

P-FSC is designed to counteract the detrimental effects that dispersants have on cement slurry stability. As previously mentioned, P-FSC performance is not optimum without the presence of a dispersant, dispersing retarder or dispersing fluid-loss additive. Therefore, the addition of 0.05 gal/sk. P-D88L (Dispersant) may sometimes be necessary to improve the P-FSC performance in controlling free water and sedimentation.

Increases in slurry rheological values are observed with increasing P-FSC concentrations. The increase in plastic viscosity can be two to three times the original values, while the yield point can increase from 2 to 7 lbf/100 ft<sup>2</sup>. This phenomenon is increased with decreasing mixing energy (see Mixing Energy Effects).



### **SALT TOLERANCE**

P-FSC can be used in cement systems containing 0 to 37% BWOW Sodium Chloride; however, sodium chloride concentrations greater than 5% BWOW must be dry blended or added to the mix after hydrating the P-FSC (see Salt Cement Systems).

Sodium chloride slurries exhibiting stability problems require higher P-FSC concentrations than unstable freshwater systems to achieve good stability and free water values. Even with higher concentrations, it will frequently be difficult to achieve zero free water in unstable salt slurries.

P-FSC can be used with seawater, although the required concentrations may be slightly higher and the results will not be as good as with freshwater or sodium chloride systems.

Because its performance is impaired by the seawater, P-FSC does not always improve the stability of these systems in the presence of free water and it rarely reduces the free water value to zero.

### **SLURRY DENSITY RANGES**

P-FSC can be used in slurries with densities ranging from 12.5 to 22.0 PPG, provided proper extenders or weighting agents are correctly used. These density limits are more a function of proper slurry design than a limit of P-FSC performance.

### **EXTENDERS**

P-FSC is compatible with all Petrochem cement extenders and is an excellent slurry stabilizer for cement systems containing P-SL50.

P-FSC is not an extender; therefore, it should only be used with extenders to improve stability. P-FSC is a particle-suspending agent, but it does nothing to occupy large volumes of water or to reduce the cement bulk weight role of conventional extenders. If P-FSC is used to artificially extend a cement slurry beyond its normal density, then the potential exists for the development of large pockets or channels of excess water within the set cement and high permeability's within the cement matrix, perhaps sufficiently high to allow interzonal communication.



### **WEIGHTING AGENTS**

P-FSC is compatible with all Petrochem weighting agents. The only design limitation with high-density slurries using P-FSC is the mix ability of the cement slurry.

As discussed earlier, P-FSC helps reduce the density difference in a vertical cement column. This attribute becomes more noticeable as the concentration of the weighting agent is increased. P-FSC helps improve the suspension of the weighting agent throughout the cement slurry to ensure that the slurry properties remain as per design.

### **SHELF LIFE**

The reported shelf life of P-FSC in a sealed (unopened) container is greater than two years.

### **FIELD MIXING PROCEDURES**

Several special field considerations must be applied when using P-FSC. These considerations involve continuous-mix operations, salt cement systems and the effect of variations in mixing energy on the slurry properties.

### **CONTINUOUS-MIX OPERATIONS**

If the mix water is prepared prior to the job, then the P-FSC must be added to the water at a high-shear area in the tank and allowed to hydrate for 5 to 10 minutes.

Because P-FSC affects the slurry rheology, the material must be added to the cement slurry at the design concentration. Variations in concentration can alter the flow properties of the cement slurry, possibly decreasing its placement efficiency.

### **SALT CEMENT SYSTEMS**

P-FSC does not properly hydrate in mix waters containing greater than 5% BWOW sodium chloride. If sodium chloride is to be added to the mix water at concentrations exceeding 5% BWOW, then the P-FSC must be hydrated in the mix water before adding the sodium chloride. P-FSC completely hydrates in several minutes.

An alternative mixing procedure for high sodium chloride concentrations is to dry blend the sodium chloride with the cement and continuously add the P-FSC to the mix water.

For sodium chloride concentrations up to 5% BWOW in the mix water, P-FSC can be added either before or after the sodium chloride addition to the mix water. These low sodium chloride concentrations do not significantly affect the P-FSC hydration process.



### MIXING ENERGY EFFECTS

Contrary to most cement formulations, P-FSC slurries exhibit higher rheologies when lower mixing energies are applied to the slurry. Preliminary tests show that the rheology of normal-density slurries mixed at high-shear closely correlate to the rheology of API-mixed slurries.

When the field-mixing energy is known to vary substantially from the API energy, special laboratory procedures should be used to simulate the field-mixing energy. Good correlations between lower Warring blender speeds and lower field-mixing energy conditions have been observed.

### PROPERTIES

<u>PRODUCT</u>	<u>FORM</u>	<u>SP.GR.</u>	<u>ABV</u>	<u>PACKAGING</u>
P-FSC	Grey/White Powder	1.298	0.0924	50 Lb. /sack.