P-MS3L

CEMENTING SERVICE BULLETIN

09/25/12

P-MS3 (PETROCHEM – HIGH STRENGTH LOW WEIGHT LIQUID)

TECHNICAL DATA

P-MS3L is a liquid suspension of P-MS3 in water at an active matter concentration of approximately 50% by weight. For field conversions, 1.0 gal/sk P-MS3L is equal to 6.2% BWOC P-MS3.

P-MS3L is primarily a cement extender which can be used to formulate lightweight slurries ranging in density from 10 to 13 PPG. Usually it is used in the concentration range of 0.8 to 3.2 gal/sk added to the mix water. At higher concentrations, P-MS3L will improve both free water and compressive strength, but mixing will be more difficult due to higher viscosities. With proper slurry design, good compressive strength at low temperatures, together with acceptable free water and thickening time can be achieved.

P-MS3L slurries exhibit rheological properties with good laminar-flow characteristics. With concentrations greater than 1.6 gal/sk, P-MS3L imparts some fluid-loss control to the slurry.

The use of P-MS3L as an extender is only recommended up to 185°F (85°C). Above this temperature and up to about 300°F (149°C), only P-SRL or P-TTCL will retard P-MS3L extended slurries.

SLURRY DESIGN

As with most cement additives, P-MS3L performance depends greatly on cement class, brand and even batch. Therefore, the data presented in this section should be considered as a guideline only and the slurry properties must be checked and fine-tuned in the laboratory prior to each job.

PETROCHEM USA, INC.
4111-D N.W. 132ND ST, OPA LOCKA, FL. 33054 U.S.A.
TEL: (305) 685-8282, FAX: (305) 685-9339, E-MAIL: info@petrochem.us

P-MS3L COMPOSITION & BEHAVIOR

P-MS3L is a suspension of amorphous silica spheres with an average particle between 0.1 and 1.0 micron and a purity of around 95%. It is a manufacturing process by-product of silicon metals and ferrosilicon alloys. The addition of P-MS3L to cement slurries is beneficial for the following reasons:

- It acts as an additional cementitious material, reacting with calcium ions in solution in the cement slurry to form calcium silicate hydrate (C-S-H) gel. It is this gel which allows the use of large quantities of mix water without excessive free-water separation. The formation of C-S-H gel also accelerates the reaction of tricalcium silicate with the mix water by lowering the concentration of divalent calcium in solution, thus reducing the thickening time and improving early compressive strength development.

- Since P-MS3L is composed of small particles, it acts as an excellent plugging agent. It decreases the permeability by filling the void space around the cement particles which are normally up to fifty times larger than the particles in P-MS3L.

SLURRY DENSITY

Liquid Extender P-MS3L and cement are used to formulate lightweight slurries normally ranging in density from 11 to 13 lbm/gal. Slurry densities as low as 10.5 lbm/gal can be achieved by incorporating LITEPOZ Extender D35. With P-SL50 or P-SL60 Extender and cement, a slurry density of 10 lbm/gal can be obtained.

P-MS3L CONCENTRATION

At a fixed slurry density, increasing the P-MS3L concentration improves the early compressive strength development and reduces the free water, while slightly increasing the slurry viscosity. High slurry viscosities can be reduced by using dispersants, but concentrations will be limited by the acceptable amount of free water.

With decreasing slurry densities, the increased mix-water content allows higher P-MS3L concentrations to be used while maintaining acceptable slurry viscosities. However, it results in lower compressive strengths. The P-MS3L concentration must be selected initially based on the desired slurry density and acceptable free water. Through laboratory testing, its final concentration along with the concentration of other required additives would be determined, as the acceptable slurry and set-cement properties are achieved.

PETROCHEM USA, INC.
4111-D N.W. 132ND ST, OPA LOCKA, FL. 33054 U.S.A.
TEL: (305) 685-8282, FAX: (305) 685-9339, E-MAIL: info@petrochem.us

FLUID-LOSS CONTROL

At concentrations greater than 1.6 gal/sk, P-MS3L imparts some fluid-loss control to the slurry which is normally sufficient for most lightweight cement applications. If additional fluid-loss control is required, any Petrochem fluid-loss additive can be used. However, many fluid-loss additives promote slurry viscosification which may make their use unacceptable.

DISPERSANTS

Due to the high surface area of the solids contained in P-MS3L, some mixing difficulties may be encountered even at densities ordinarily not associated with high viscosity. Addition of P-D88, P-D88L or P-D90L dispersants to the mix water will improve the mixability of the slurry and, in normal concentrations, should not cause free water problems. At low temperatures, where thickening times with these dispersants are too long, P-LTDL has been successfully used with P-MS3L.

Occasionally, gelation experienced with P-MS3L has been successfully reduced with P-D88/L; however, this is a sensitive solution and should be thoroughly evaluated at the Laboratory for precise slurry designs before field use.

RETARDATION

Up to 185°F (85°C) BHCT, any Petrochem retarders can be used to extend the thickening time of slurries containing P-MS3L. Due to the high reactivity of P-MS3L in the slurry, effective retardation of slurries with P-MS3L becomes a problem above this temperature.

From 185°F (85°C) to about 300°F (149°C), only P-SRL/P-TTCL will retard P-MS3L-extended slurries. Since P-MS3L is always reactive, the effectiveness of P-SRL/P-TTCL as a retarder is limited as well. For this reason, P-MS3 does not have an unlimited temperature range.

STRENGTH RETROGRESSION

P-MS3L reacts with calcium hydroxide in the cement slurry to form additional calcium silicate hydrates.
P-MS3L will also alter the overall cement-to-silicate ratio of the cement slurry when used in high concentrations. However, because the suspended particles in P-MS3L are much smaller than P-SF or P-SF,

PETROCHEM USA, INC.
4111-D N.W. 132ND ST, OPA LOCKA, FL. 33054 U.S.A.
TEL: (305) 685-8282, FAX: (305) 685-9339, E-MAIL: info@petrochem.us

P-MS3L is more reactive at lower temperatures and the crystalline compounds formed at higher temperatures are not as predictable. P-MS3L is not a liquid substitute for P-SF (Silica Flour) in preventing strength retrogression.

Studies indicate that while P-MS3L does improve long-term compressive strength and permeability, silica and P-MS3L combinations showed long-term compressive strengths that were less than silica alone at the equivalent concentration.

In cement designs that expose P-MS3L to temperatures greater than 230°F (110°C), a combination of P-MS3L and P-SF or P-SS (Silica Sand) should be used. The minimum quantity of P-SF/P-SS to use is 10% BWOC, with at least 4.0 gal/sk. P-MS3L: this is equivalent to a total silica content of 35% BWOC.

ANTIFOAM AGENTS

Foaming problems encountered with P-MS3L due to air entrainment can be avoided by adding P-AFAL or P-DFL to the mix water first. Dry-blended P-AFA2 may also be used when no other antifoam agent is available.

EXTENDER P-SL50 & P-SL60

Cement designs with P-SL50/P-SL60 often develop density segregation of solids: the reverse problem of free water. Due to the extreme density differential between the cement and P-SL50/P-SL60 spheres which are lighter than water, the spheres tend to rise to the top of the slurry and the cement settles to the bottom. This can result in extreme decreases in compressive strength at the top of the cement column.

The addition of P-MS3L to P-SL50/P-SL60 slurries stabilizes the density gradient of the slurry by eliminating the sphere separation. The addition of P-MS3L also can enhance the compressive strength to values suitable for completion, with slurry densities as low as 10 lbm/gal.

The P-SL50/P-SL60 cement-and-micro silica combination has been used with great success.

FLY-ASH EXTENDER

The combination of FLYASH and micro silica has been used for some time to achieve lightweight slurries at 10.5 lbm/gal more economically than P-SL50/P-SL60 and operationally easier than foamed cement. See EXTENDER P-MS3 for additional information.

PETROCHEM USA, INC.
4111-D N.W. 132ND ST, OPA LOCKA, FL. 33054 U.S.A.
TEL: (305) 685-8282, FAX: (305) 685-9339, E-MAIL: info@petrochem.us

FIELD MIXING PROCEDURES

Since P-MS3L is a liquid additive, it does not have the bulk handling problems associated with P-MS3. Higher mixing rates are also possible than with P-MS3 slurries. Foaming should be anticipated. P-AFAL or P-DFL should be blended in the mix water first to avoid operational problems.

JOB DESIGN DATA

At concentrations from 0.8 to 2.4 gal/sk, P-MS3L and cement-slurry formulations at 11 to 13 lbm/gal have performance properties similar to those expected when using P-EXT. For example, Class G cement with 2.4 gal/sk P-MS3L mixed at 12.5 lbm/gal will have a 48-hr compressive strength of around 500 psi at 80°F (27°C) with 1% or less free water. These numbers are very similar to the performance of 2% P-EXT with the same Class G cement.

By increasing the P-MS3L concentration to 4.0 gal/sk, the P-MS3L system will have 500-psi compressive strength in 24 hr. with zero free water. At 6.4 gal/sk P-MS3L concentration, 24-hr compressive strength will exceed 1000 psi. However, the slurry viscosity must be observed carefully when increasing the P-MS3L concentration to ensure slurry mixability in the field.

PETROCHEM USA, INC.
4111-D N.W. 132ND ST, OPA LOCKA, FL. 33054 U.S.A.
TEL: (305) 685-8282, FAX: (305) 685-9339, E-MAIL: info@petrochem.us