P-TTCL

CEMENTING SERVICE BULLETIN

1-10-22

P-TTCL (PETROCHEM - THIXOTROPIC CEMENT LIQUID)

TECHNICAL DATA

P-TTCL is a liquid additive of which the distinguishing feature is thixotropy. This property enables the cement slurry to be fluid when in motion (such as being pumped) and of forming a gel when allowed to stand. This gel structure is strong enough to support the weight of the slurry column, preventing fall back. If sufficient force is applied to move the slurry the gel structure is disturbed and the slurry returns to a fluid/pump-able state. However, these systems develop considerable gel strength and becomes difficult to move after remaining stationary for a period of time.

Cement slurries prepared with P-TTCL are almost indistinguishable from those prepared with Gypsum and as such remain dimensionally stable. However, the major advantages of P-TTCL over Gypsum slurries are, it creates higher early and ultimate compressive strength development, in many cases, slurries prepared with P-TTCL reach full strength within 24 hrs. whereas comparable slurries prepared with Gypsum require seven days to attain. Figure 1. shows a typical comparison of the strength development of the Gypsum cement with the P-TTCL system.

A limitation of gypsum is that it cannot be used with cements having Tri-Calcium Silicate content (C3A) less than 5% while the P-TTCL can be used with any Portland cement, since the C3A content is not a limiting factor. Also, P-TTCL can be used with either fresh or seawater.

The fact that the use of **P-TTCL** does not depend on the C3A content is a major advantage, especially when local cement producers may exhibit poor quality control or low C3A content in their cement, also laboratory tests will show that P-TTCL provides uniform gel strength and superior thixotropic properties when used with a wide variety of cement brands.

COMPATIBILITY

Like Gypsum, only a limited number of additives can be used with P-TTCL. These include Cellophane flakes, P-ACC/L (Petrochem - Calcium Chloride powder or liquid), Kolite, P-AFA2 (Anti-Foam powder), P-DFL (Petrochem De-foamer liquid) P-TCR/L (Petrochem-Thixotropic cement retarder powder or liquid). P-TF/L, (Petrochem- Thixotropic fluid-loss powder/liquid). Note: **Dispersants will destroy** the thixotropic properties of the slurry.

FORMULATION

Essentially all Portland cements and API class J cement can be used to prepare P-TTCL slurries. When used at low temperatures where an accelerator is required Calcium chloride may be added to the mix water, but when retarding the slurry is required, only P-TCRL or P-SR/L (Petrochem-Thixotropic cement retarder liquid or powder) should be used.

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P-TFL or P-F400 (Petrochem-Thixotropic Fluid-Loss powder or Liquid) are the only known compatible Fluid-loss additives recommended for use with P-TTCL. As a fluid-loss example, the use of 0.6 GPS P-TTCL, 0.2 GPS P-TFL (or P-F400) 0.02 GPS P-TCRL – P-SR/L mixed with class G cement at 14.1 PPG. (Mix water 7.76 Gal/Sk, Slurry yield 1.51 cult/Sk. @ 125F.), will provide a fluid-loss of approximately 98ml/30 mins.

TYPICAL DATA

Tables I and II show P-TTCL data representative of typical formulations. These systems are formulated using P-TTCL with class G cement and correspond generally to slurries containing 10 % to 12 % of Gypsum. The slurries are designed at three temperatures: 80F, 100F, 165F, BHCT. To show the effects of seawater, slurries 1 and 2, for 80F. and 100F are repeated using seawater in instead of fresh water.

Table I shows the slurry properties for these five slurries systems. Note that the liquid additives plus the water make up the percent liquid and total fluid per sack. Table II shows the thickening times and compressive strengths at the indicated time for these same five systems. These data are presented to show general trends. However, laboratory tests should be performed for a specific well application.

MIXING

P-TTCL must be thoroughly dispersed in the mix water before being added to the neat cement. This material is very easily mixed with water and diffuses rapidly. P-TCRL, P-AFAL and P-TFL should also be added to the mix water, and not to the cement slurry in the mix tub.

PRODUCT	FORM	SP.GR.	PACKAGING
P-TTCL	Light Green Liquid	1.3	55 Gal. Drums

SAFETY

Read the SDS before use.

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TABLE I (SLURRY PROPERTIES)

SYSTEM	ONE	TWO	THREE	FOUR	FIVE
GAL/SK P-TTCL	0.80	0.80	0.68	0.80	0.80
GAL/SK P-TCRL	0.00	0.04	0.08	0.00	0.04
GAL/SK P-CCL	0.57	0.00	0.00	0.57	0.00
% LIQUID	60.00	70.00	70.00	64.00*	70.00*
WEIGHT PPG	14.80	14.10	14.10	14.80	14.30
YIELD CUFT/SK	1.38	1.88	1.88	1.45	1.54
WATER GAL/SK	5.40	7.06	7.02	5.85	7.06
TOTAL FLUIDS	6.77	7.90	7.78	7.22	7.90

* Seawater

TABLE II (PERFORMANCE)

SYSTEM	ONE	TWO	THREE	FOUR	FIVE
BHCT DEG. F.	80	100	165	80	100
BHST DEG. F.	80	140	210	80	140
TT. (HR: MIN) @ BHCT	4:15	4:10	3:10	3:20	3:10

COMPRESSIVE STRENGTH (PSI) BHST						
8	HRS.	490	470	700	590	550
24	HRS.	1000	1300	1400	840	1600
72	HRS.	1900	2000	1800	1700	1900
168	HRS.	2400	2400	2000	2800	2500

These systems are made with class G cement.

CLASS G CEMENT + TTCL	
DENSITY	14.2 PPG
YIELD	1.46 FT^3/SK

THICKENING TIMES UNDER API CONDITIONS			
ADDITIVE P-TTCL GPS	**P-TCRL GPS**	**DEPTH (FT)**	**SETTING TIME**
0.80	0.02	2700	3:00
0.80	0.13	4600	4:00
0.80	0.14	6100	3: 25
0.80	0.15	7200	4:30

COMPRESSIVE STRENGTH				
ADDITIVE P-TTCL GPS	**P-TCRL GPS**	**DEPTH (FT)**	**12 HRS**	**24 HRS**
0.80	0.02	2700	650	1000
0.80	0.13	4600	750	1250
0.80	0.14	6100	750	1275

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METHOD FOR EVALUATION OF THIXOTROPIC

SLURRIES IN TERMS OF GEL STRENGTH

INTRODUCTION

Due to the special rheological behavior of thixotropic slurries, a standardized procedure to evaluate the gel strength has been developed.

RHEOLOGICAL EVALUATION OF THIXOTROPIC SLURRIES

(A) Prepare two identical slurries according to the method specified by the API. Pour one slurry into the Fann V-G Meter slurry cup for immediate rheological evaluation. Place the other slurry in a consistometer for 20 minutes for later evaluation.

(B) Gradually lift the slurry cup to measurement position with the motor running at 600 RPM. Continue stirring at 600 RPM for one minute or until viscosity reading stabilizes. Stop the motor and allow slurry to remain undisturbed for the indicated rest period. Restart the motor at 3 RPM. Note the maximum reading the meter reaches before the gel breaks. Also note the minimum value to which the meter falls to after the gel breaks. Change the speed back to 600 RPM and allow slurry to become thoroughly dispersed. Note the change in viscosity value indicated by the meter. Some agitation with a stirring rod may be necessary to accomplish this. Continue the 600 RPM speed for one minute and then stop for the next rest period. Continue with this procedure until all rest periods have been covered. Recommended rest periods are: 1, 3, 5, 10, 20, and 30 minutes.

(C) Evaluate the rheology of the slurry that has been stirred for 20 minutes. The procedure described in Step 2 is to be follow with this slurry also. The data collected from this slurry is very important because it better approximates a field application and will relate to the durability of the thixotropic nature of the cement slurry.

INTERPRETATION OF DATA

(1) GEL STRENGTH

It has been determined that a gel strength between 100 to 200 Lbs. /100 ft^2 is sufficient for the slurry to be self-supporting. A value within this range should be attained after the 5-minute rest period. The maximum gel strength, above which pumping problems would occur has yet to be determined. It is known that gel strengths running into the thousands of pounds per hundred square feet are problematic because pumps at the well sites cannot exert sufficient force to break such a gel. A tentative estimate of the maximum permissible gel strength for a thixotropic slurry is about 500 Lbs. /100 ft^2.

(2) DEGREE OF THIXOTROPIC

After the gel breaks it is important that the viscosity fall back to a level that would permit easy pumping. In general, the meter reading should fall to a level below 50 Lbs. /100 ft^2 after the gel is broken. Thus, an ideal- case would be for the slurry to maintain a gel strength of about 150 to 200 Lbs. /100 ft^2 and then fall back to 40 or so. The difference between the high and low values relates to the degree of thixotropy the system is exhibiting. The greater the difference is, the better the performance as a thixotropic slurry.

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(3) 600 RPM READING

This value is important because it indicates the viscosity that the pumps would have to contend with during placement of the slurry. In general, the 600 RPM value should not exceed 300 Lbs./100 ft^2 (spring 1, bob: 1). Most thixotropic slurries will give reading between 200 and 270 Lbs./100 ft^2 at this speed.

CONCLUSION

The method of evaluation and interpretation described here should be of value. It is important that it be realized that the criteria specified here are not absolute. These measurements are heavily dependent upon the composition of the slurry, the peculiarities of the Fann instrument, and many other factors. The trend of the measured data is what is important here.

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