OGMCOAL - Fwd: Polymer Testing Report

From: Kevin Lundmark
To: OGMCOAL; Steve Christensen
Date: 1/18/2011 11:45 AM
Subject: Fwd: Polymer Testing Report
Attachments: Residual Polymer Testing Report- Rev 011311.pdf; UPDES Spreadsheet 2010.xls

>>> "Marrelli, Dana" <dmarrelli@coalsource.com> 1/17/2011 8:51 AM >>>
Hello Kevin,
Here is the final Polymer Testing Report from WaterSolve. I have also attached the spreadsheet showing the Aluminum values at both pre-002 and 002 outfalls for 2010. I will begin to sample for aluminum along with the polymer testing for comparison. Please let me know if you need anything else.
Thank you,

Dana Marrelli
Utah American Energy Inc.
PO Box 910
East Carbon, Utah 84520
Work: 435-888-4026
Cell: 435-650-9799

RESIDUAL POLYMER TESTING REPORT
CRANDALL CANYON MINE
UTAHAMERICAN ENERGY, INC.

For:
Dana Marrelli
Genwal Resources, Inc.

By:
WaterSolve, LLC
4964 Starr St., SE
Grand Rapids, MI 49546
www.gowatersolve.com
616-575-8693

November 30, 2010
Revised December 20, 2010
Revised January 13, 2011

1. Scope of Work

WaterSolve, LLC was tasked to perform tests that would determine the residual polymer present in the treated effluent at the Crandall Canyon Mine. The objectives were to complete the qualitative and quantitative tests according the procedure (Appendix A) and to determine the effect of presence of the coagulant on the results from this test compared to samples without the coagulant.

2. Materials & Methods

Two five gallon samples (one prior to treatment and one after chemical treatment) were received at WaterSolve's Laboratory (Grand Rapids, MI). The pre-treatment sample (without settled solids) was used for the preparation of the known concentration samples and for the polymer make-down or dilution. Samples of the current products (coagulant and flocculent) used at the facility were also received.

The products were "made-down" or diluted at a 0.5% concentration for this dewatering trial. Products were added to a sample with a 1-mL plastic syringe and homogenized. The settlement times were then measured according to the procedure.

3. Results

The results of the quantitative testing are included in Appendix B. When various doses of coagulant were added to the test samples, the settling doses were higher than when the flocculent was analyzed alone. The potential presence of residual coagulant does have an effect on the test. Based on the typical coagulant feed rates and analytical data, it is estimated that the residual coagulant concentration would be approximately 1-ppm or less.

4. Recommendations

It may be possible to more accurately estimate the residual coagulant concentrations by analyzing the relative Aluminum concentrations in the influent and effluent. Unless the residual coagulant can be estimated with analytical testing, the conservative approach of assuming that some coagulant is present is prudent for residual flocculent testing.

DETERMINATION OF THE PRESENCE OF POLYMER USING THE FLOCCULATION METHOD

1. PURPOSE

The purpose of this method is to provide a means of qualitatively determining the presence of a flocculent or coagulant within a solution, water sample, etc. Additionally, in cases where the polymer present within a sample is known, this method can be tentatively used as a quantitative measure.

2. PRINCIPLE

Slurry of kaolin clay is very easily flocculated or coagulated when either a flocculent or a coagulant is present. Therefore, for qualitative purposes, the sample being tested is mixed with kaolin clay slurry, and the effects are visually assessed by comparison to a blank. If polymer is present, significant coagulation or flocculation will be seen from the sample being tested as compared to that seen in the blank.

These principles can also be applied to the quantification of the concentration of polymer present within a sample. However, the exact product present within the sample must be known, and the water used to prepare all solutions must be similar in pH, hardness, etc. to the water present in the sample being tested. Standard solutions containing the known product are prepared at different concentrations. Each solution is then mixed with a kaolin clay slurry, and the settlement time of each is measured. A curve and the equation of the curve are then generated from the obtained results, the settlement time of the unknown sample is measured, and the concentration of the specific product in the unknown sample is calculated by substitution into the obtained equation.

3. PROCEDURE DESCRIPTION

3.1 Hazards and Safety Precautions

The information provided below is not a substitute for the MSDS but is supplementary to it. All users must have read and be familiar with the appropriate manufacturer's MSDS before using the chemicals listed below.

All unknown water samples and polymer solutions should be considered irritants to the skin and eyes.

Contact with calcium chloride powder may cause irritation to the skin, eyes, or respiratory tract.

General laboratory safety procedures should be followed.

3.2 Apparatus and Reagents

Apparatus	Reagents
General Apparatus: 1) 100 mL Glass Mixing Cylinders with Stoppers 2) Syringes (as appropriate) 3) Three Place Top Loading Balance 4) Bottles with Caps (as appropriate) **Additional Apparatus Required for Quantification Procedure**: 1) Stopwatch 2) Graduated Cylinders [200 mL and 50 mL] 3) 400 mL Glass Beakers (2)	1) ACS Grade Calcium Chloride 2) Laboratory Grade Kaolin Clay

3.3 Procedures

Preparation of the Clay Slurry

1. Preparation of a 1% Calcium Chloride Solution

   a. Determine how much 1% calcium chloride will be needed to perform the required testing. Please note that approximately 1.7 mL of a 1% calcium chloride solution is required for each test.
   b. Calculate the required weight of calcium chloride needed to obtain the desired weight of 1% calcium chloride solution using the equation below.

$$W_1 = \frac{W_2 \ x \ C_2}{C_1}$$

   Where:
   W_1 = Weight of Calcium Chloride Required to Prepare the Solution (g)
   C_1 = Concentration of the Calcium Chloride Being Used (%)
   W_2 = Desired Weight of 1% Calcium Chloride Solution (g)
   C_2 = Concentration of Calcium Chloride Solution Required (1%)

   c. Tare an appropriately sized bottle on a three place top loading balance.
   d. Accurately weigh out the calculated weight of calcium chloride required into the tared bottle. The accuracy of this weight should be ±0.002 g. Add deionized water to the bottle to achieve the desired final solution weight. For example, if 100 g of 1% calcium chloride solution is desired, add 1.000 g of pure calcium chloride to a tared bottle, and add deionized water to achieve a final weight of 100.000 g.

2. Preparation of the Clay Slurry

a. Determine how much clay slurry will be needed to perform the required testing. Please note that 5 mL of slurry is needed for each test.
b. Tare an appropriately sized bottle on a three place top loading balance.
c. Into the tared bottle, weigh out 1 part laboratory grade Kaolin clay and 2 parts 1% calcium chloride solution.
d. Cap the bottle, and shake vigorously until the contents are homogeneous.

Qualitative Determination of the Presence of Polymer in a Sample

1. Perform a blank as follows. To a 50 mL glass mixing cylinder, add 5 mL of the previously prepared clay slurry and 45 mL of water. Please note that the water used for this blank should be similar in quality to the water present in the sample which is to be tested with regard to hardness, pH, etc.

2. To a second 50 mL glass mixing cylinder, add 5 mL of the previously prepared clay slurry and 45 mL of the sample being tested.

3. Invert both cylinders three times, and visually assess whether flocculation or coagulation has occurred in the sample being tested by comparing the settlement rate and floc size of the clay in the sample cylinder to the settlement rate and floc size of the clay in the blank sample. Record observations.

Quantitative Determination of the Presence of a Specific Product in a Sample

1. A quantitative determination of the presence of polymer in a sample can only be performed with any accuracy in cases where the exact product present within a sample is known and when the quality of the water being used to prepare all solutions does not vary significantly from the quality of the water sample being tested.

2. Obtain a sample of the product which is known to be present within the sample to be tested.

3. For Liquid Dispersion or Emulsion Grade Products – Prepare a 0.5% standard stock solution using a sample of the product known to be present and water which is similar in quality to the water present in the sample to be tested.

   a. Measure 200 mL of sample water in a graduated cylinder.
   b. With a 1 mL syringe measure 1 mL of the product know to be present.
   c. Cap the cylinder and mix vigorously for two minutes.

4. Prepare a series of standard solutions with various ppm from the stock solution.

5. Measure the settlement time of each solution.

a. To a 50 mL glass graduated cylinder with topper, add 5 mL of the previously prepared clay slurry and 45 mL of the sample with a predetermined ppm.
b. Invert the cylinder three times, and using a stopwatch, measure the time taken for the mudline formed by the flocculated clay to travel from the 50 mL mark on the cylinder to the 40 mL mark on the cylinder. The stopwatch is to be started after the third inversion and stopped when the mudline reaches the 40 mL. This constitutes the settlement time, in seconds, given by the know ppm standard.
c. Repeat Steps a and b for the various known ppm standard, and for the water sample being tested.

6. Determine the quantity of the specific product in the sample being tested.

   a. Using the obtained settlement times for the standards, plot a graph of settlement time vs. concentration.
   b. Fit this data with the best fit curve, and obtain the equation of the generated curve from the software.
   c. Substitute the obtained settlement time from the unknown sample for Y in the obtained equation. Solve this equation for X. The resulting value obtained for X is the concentration of the specific product, in mg/L, within the sample.

Addendum to Presence of Polymer Procedure- Crandall Canyon Mine- January, 2011

Preparation of 1-ppm PAC Solution

1. Measure 200-mL of site water in a graduated cylinder. Add 1-mL of the PAC to the water and mix well. (0.5% PAC solution)
3. Measure 500-mL of site water in a graduated cylinder. Add 0.1-mL of 0.5% PAC solution and mix well. (1-ppm PAC solution)

Preparation (make-down) of Flocculent

1. Measure 200-mL of site water, add 1-mL of the neat flocculent to the solution and mix thoroughly with a hand mixer. (0.5% made-down flocculent solution)

Preparation of various ppm Flocculent solutions

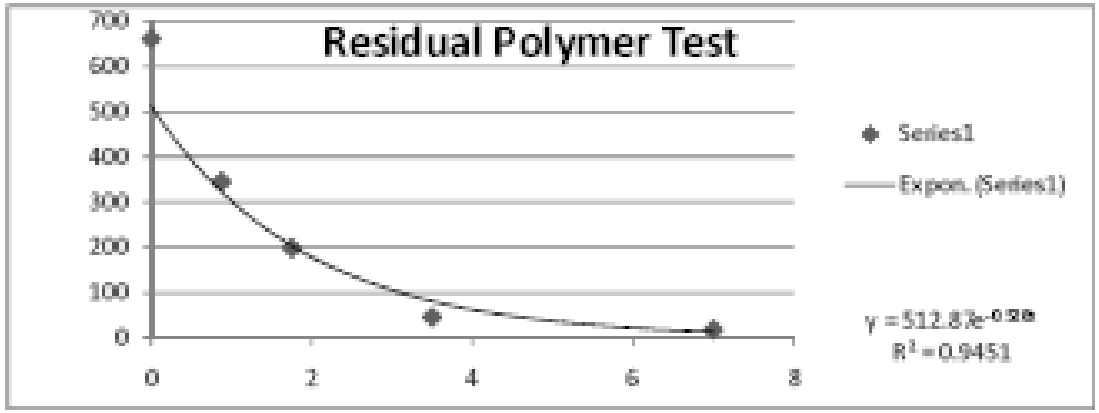
1. Measure 100-mL of the 1-ppm PAC solution in a graduated jar with cap. Add 0.14-mL of the 0.5% flocculent solution to the 1-ppm PAC solution. Cap and shake vigorously. (7-ppm flocculent & 1-ppm PAC solution)
2. Measure 50-mL of the 7-ppm flocculent 1-ppm PAC solution in a graduated jar with cap. Add 50-mL of the 1-ppm PAC solution. Cap and shake vigorously. (3.5-ppm flocculent & 1-ppm PAC solution)
3. Measure 50-mL of the 3.5-ppm flocculent 1-ppm PAC solution in a graduated jar with cap. Add 50-mL of the 1-ppm PAC solution. Cap and shake vigorously. (1.75-ppm flocculent & 1-ppm PAC solution)
4. Measure 50-mL of the 1.75-ppm flocculent 1-ppm PAC solution in a graduated jar with cap. Add 50-mL of the 1-ppm PAC solution. Cap and shake vigorously. (0.875-ppm flocculent & 1-ppm PAC solution)

Residual Polymer Test

Customer: **Utah America**

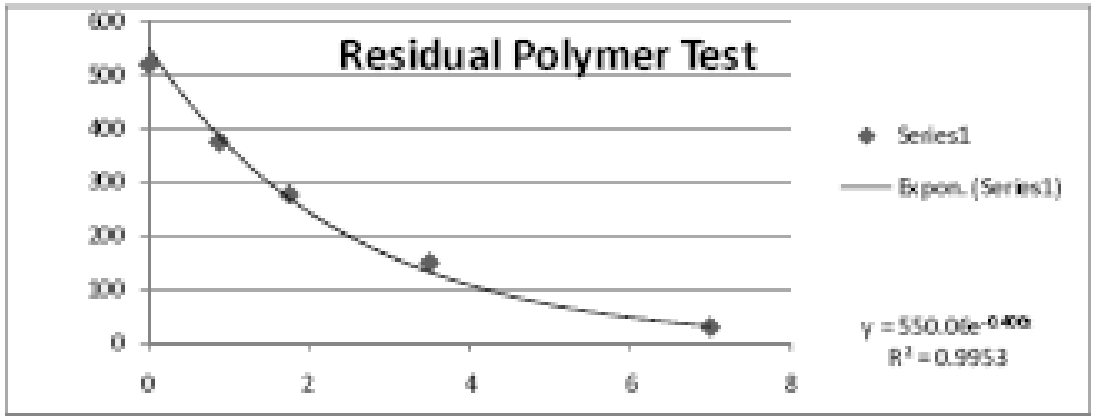
Flocculent only

P.P.M.	Settling Time (sec)
0	662
0.875	345
1.75	198
3.5	45
7	17



Coagulant(1-ppm) and Flocculent

P.P.M.	Settling Time (sec)
0	520
0.875	375
1.75	277
3.5	150
7	30



Sample (based on 1-ppm Coagulant)

Date Collected	Settling Time (sec)	Residual Polymer (ppm)
10/29/2010 Received	510	0.2
12/13/2010 (3:00)	575	0
12/21/2010 (11:00)	533	0.1
		#NUM!
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Crandall Canyon Mine

Pre-Treatment Mine Water 2010

Parameter	Units	January	February	March	April	May	June
		1/28/2010	2/23/2010	3/26/2010	4/21/2010	5/18/2010	6/23/2010
Field							
pH	std. units	6.98	7.76	7.27	6.91	6.93	7.26
Temperature	deg. C	8.1	10.1	10.9	10.2	11	13.5
Conductivity	µmhos/cm2	1010	1030	1030	1000	1000	981
Dissolved Oxygen	mg/L	4.89	5.31	6.31	6.53	5.23	4.3
Lab							
Iron	total, mg/L	3.000	3.300	3.709	4.268	3.119	5.312
Iron	dissolved, mg/L	0.9	1.3	1.531	1.11	0.965	0.689
Iron	ferrous, mg/L	<0.10	0.77	1.2	1.23		0.848
Aluminum	total, mg/L	<0.10	<0.10	0.13	<0.02	0.04	0.06
Aluminum	dissolved, mg/L	<0.10	<0.10	0.11	<0.02	<0.02	<0.02
Manganese	total, mg/L	0.14	0.13	0.13	0.114	0.126	0.134
Manganese	dissolved, mg/L	0.14	0.13	0.13	0.124	0.126	0.114
Alkalinity	Bicarbonate, mg/L	381	379	374	380	382	380
Alkalinity	Carbonate, mg/L	<10	<10	<10	<10	<10	<10
Alkalinity	Total	381	379	374	380	382	380
Sulfate	mg/L	159	170	174	182.2	183.6	170
TDS	mg/L	648	631	625	624	630	646
Suspended Solids	mg/L	7	6	6	8	6	8
Chloride	mg/L						
Calcium	Dissolved, mg/L						
Potassium	Dissolved, mg/L						
Sodium	Dissolved, mg/L						
Magnesium	Dissolved, mg/L						
Silica	Dissolved, mg/L						
Hot Acidity	mg/L						

Crandall Canyon Mine

Pre-Treatment Mine Water 2010

Parameter	Units	July	August	September	October	November	December
		7/21/2010	8/27/2010	9/29/2010	10/29/2010	11/22/2010	12/17/2010
Field		SGS					
pH	std. units	7.27	7.1	7.05	6.97	7.21	7.5
Temperature	deg. C	16	11	12	11	11	10
Conductivity	µmhos/cm2	956	554	950	937	939	895
Dissolved Oxygen	mg/L	4.48	4.53	4.58	4.35	6.73	5.63
Lab							
Iron	total, mg/L	3.970	3.230	3.470	2.810	3.190	3.290
Iron	dissolved, mg/L	0.73	0.83	0.69	0.61	<0.03	0.07
Iron	ferrous, mg/L	1.04	1.187	1.004	0.912	1.29	1.018
Aluminum	total, mg/L	<0.03	<0.03	<0.03	0.06	<0.03	<0.03
Aluminum	dissolved, mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Manganese	total, mg/L	0.113	0.113	0.112	0.11	0.104	0.108
Manganese	dissolved, mg/L	0.113	0.113	0.112	0.11	0.104	0.108
Alkalinity	Bicarbonate, mg/L	370	374	375	380	378	386
Alkalinity	Carbonate, mg/L	<5	<5	<5	<5	<5	<5
Alkalinity	Total	370	374	375	380	378	386
Sulfate	mg/L	158	157	168	167	160	156
TDS	mg/L	606	618	598	600	609	593
Suspended Solids	mg/L	8	10	7	<5	6	10
Chloride	mg/L		10	11	11	11	11
Calcium	Dissolved, mg/L		100.41	100.85	100.2	97.67	98.65
Potassium	Dissolved, mg/L		8.24	8.27	8.27	8	7.96
Sodium	Dissolved, mg/L		35.06	34.59	35.88	34.37	35.79
Magnesium	Dissolved, mg/L		55.69	55.31	55.17	54.35	54.3
Silica	Dissolved, mg/L		7.4	9.2	8.66	8.84	8.6
Hot Acidity	mg/L		-372	-370	-368	-368	-376