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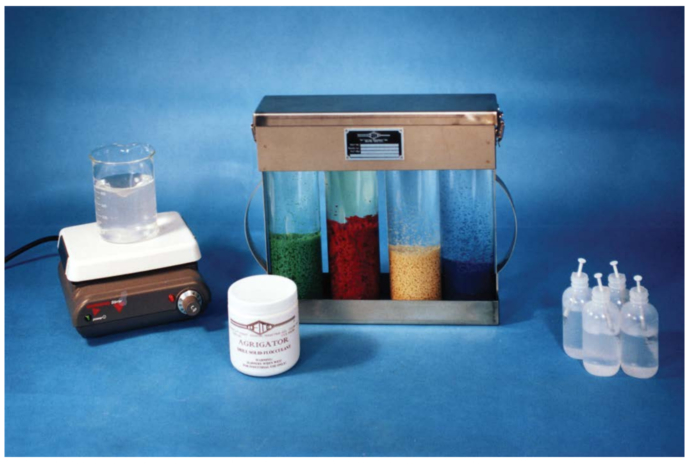

Poly Prep 'N Floc

Part No. 291-00

Instruction Manual

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Ver. 2.0

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Intro

The Poly Prep 'N Floc Test Kit allows field personnel to properly prepare water soluble flocculants/coagulants and observe their effects on the type of fluid or sludge in use. The Poly Prep 'N Floc Test Kit is ideal for quickly selecting the proper polymer and dosage for sludge dewatering and water/wastewater treatment. The test kit includes a balance and low shear stirrer to accurately weigh and dissolve polymers. A stainless steel rack contains four transparent cylinders and stoppers to observe floc characteristics and water clarity after each dose and inversion.

Components

#130-41	Sample Cup
#153-01	Large Wood-Handle Brush
#153-09	Graduated Cylinder, Polypropylene, 250 mL
#153-09-2	Graduated Cylinder, Polypropylene, 1000 mL
#153-53-8	Spinwedge Stirring Bar, 1¾"
#153-53-9	Magnetic Stirrer, 1,500 RPM, 115 Volt
#153-60	Disposable Syringe, 3 × 0.1 mL
#153-60-1	Disposable Syringe, 1 × 0.01 mL
#153-62	Disposable Syringe, 10 × 0.2 mL
#166-03	Pocket Balance, 0 to 320 gram
#291-01	Rack for 4 Acrylic Cylinders, Stainless Steel
#291-06	Cylinder, Clear Acrylic, 1 liter
#291-07	No. 13.5 Stopper for Acrylic Cylinders, Neoprene
#297-08	Natural Boston Round Poly Bottle, 4 oz
#297-10	Natural Boston Round Poly Bottle, 8 oz

Optional:

#155-25	Digital Stopwatch

Dilution Steps

After receiving a number of various grades, types, and forms of polymer samples from the preferred supplier, it is recommended to dilute the original (or **neat**) polymers before each comparative test. To simulate full-scale polymer use, dilution is recommended to be performed in three stages.

Stage 1

During the **First Stage of Dilution**, a small amount of neat polymer is mixed into a prescribed volume of distilled water. This step is referred to as the primary make-up, and the mixture that results is known as a stock solution. Most stock solutions range from 0.5% (5 g/L) to as high as 1.0% (10 g/L). Stock solutions should be stored away from direct sunlight and disposed of within 7 days for anionic polyacrylamides (negative charged flocculants) and three days for cationic polyacrylamides (positive charged flocculants).

Stage 2

The **Second Dilution Stage** is termed secondary make-up or working solution. To perform this dilution, a small amount of stock solution is mixed into a prescribed volume of water used at the treatment plant. A recommended strength is 0.05 (0.5 g/L) for low solids sludge to 0.2% (2 g/L) for high solids sludge. Dilute solutions are recommended to be disposed of 24 hours from the time of preparation.

Stage 3

The **Third Dilution Stage** is actually the working solution being applied to the sludge itself (or suspension being conditioned). This stage simulates the in-line feeding of a polymer solution into a sludge stream. To achieve this third dilution on a bench scale, a small portion of the working solution is added (or dosed) to the appropriate volume of sludge for analysis in a cylinder, jar, or other tests. The final polymer concentration in the jar is the same as that concentration which would be used for full-scale polymer treatment.

In summary, the order of decreasing concentration of these solutions is:

neat product —*primary dilution*→ stock solution —*secondary solution*→ working solution

working solution + sludge ——→ plant scale/jar test concentration

Polymer Preparation

5.0 g/L (0.5%) Stock Solutions in 8 oz (237 mL) bottles

Liquid Solution Polymers, Emulsion Polymers, and Polymers in Powder Form (Mannich, Polyamines, Polydadmacs, Polyacrylamides, etc.)

1. Make sure cap is secure and shake polymer sample bottle vigorously for 1 minute in an up and down motion.

2. Calculate the volume of liquid product needed to prepare a 0.5% (5 g/L) active polymer stock solution using the equation below.

$$\frac{A \times 100 \times L}{p \times P} = \text{Volume of Polymer (mL)}$$

   Where:

   A = grams per liter of polymer solution desired.
   L = Total volume of solution being prepared in Liters.
   p = Polymer "neat" specific gravity supplied by the supplier or measured in g/mL.
   P = Percent Activity of the polymer supplied by the supplier or measured.

3. A Digital Microdispenser with disposable tips is recommended for withdrawing the fractional portion of "neat" Liquid Solution Polymers and Polymers in Emulsion Form from sample bottles.

   Take extra care to make sure that the "neat" Liquid Polymer evacuates the syringe. Purge the syringe 2 to 3 times with the working solution while it is being mixed.

4. Syringes are most often disposed of after each use when withdrawing "neat" Liquid Polymer in Emulsion Form. But they can be reused as long as they are evacuated well with running water and allowed to dry.

5. Apply a small adhesive-backed label to each bottle containing stock solution of each grade of polymer prepared. Use a pen to mark the name of the product, solution strength, and preparation date. The label is to be peeled off when stock solution that is currently inside has expired.

   The bottles can be reused as long as they are washed thoroughly and allowed to dry.

Example 1

Stock Solution Preparation of Liquid Solution Polymer

Determine the volume of the Liquid Solution Polymer named Mannich 21 needed to prepare a 250 mL stock solution containing 5.0 g/L (0.5%) of polymer by weight. Mannich 21 has a specific gravity of 1.022 g/mL and 7.25% activity.

$$\frac{5.0 \times 100 \times 0.250}{1.022 \times 7.25} = 16.87 \text{ mL of Mannich 21}$$

Result: Add 233.13 mL of Water and 16.87 of Mannich 21 into a beaker and allow to stir for approximately 5 minutes on a magnetic stirrer with stir bar.

Example 2

Stock Solution Preparation of Liquid Polymer in Emulsion Form

Determine the volume of the Liquid Solution Polymer named AGRIGATOR 23 EM needed to prepare a 250 mL stock solution containing 5.0 g/L (0.5%) of polymer by weight. AGRIGATOR 23 EM has a specific gravity of 1.068 g/mL and 38.0% activity.

$$\frac{5.0 \times 100 \times 0.250}{1.068 \times 38.0} = 3.08 \text{ mL of AGRIGATOR 23 EM}$$

Result: Add 246.02 mL of water into a plastic beaker and insert a magnetic stir bar. Turn on the magnetic stirrer and adjust the rpm to develop a large/strong vortex. Add 3.08 mL of AGRIGATOR 23 EM along the sides of the vortex and allow to mix approximately 10 minutes using the magnetic stirrer.

Example 3

Stock Solution Preparation of Polymer in Powder Form

Determine the volume of the polymer in Powder Form named AGRIGATOR 5 D needed to prepare a 250 mL stock solution containing 5.0 g/L (0.5%) of polymer by weight. AGRIGATOR 5 D has a 95.0% activity.

$$\frac{5.0 \times 100 \times 0.250}{95.0} = 1.31 \text{ grams of AGRIGATOR 5 D}$$

Result: Add 250.0 mL of water into a plastic beaker and insert a magnetic stir bar. Turn on the magnetic stirrer and adjust the rpm to develop a large/strong vortex. Use a weigh boat and balance to weigh out 1.31 grams of AGRIGATOR 5 D. Immediately add AGRIGATOR 5 D along the sides of the vortex and allow to mix approximately 60 to 90 minutes using the magnetic stirrer.

Polymer Preparation

2.0 g/L (0.2%) Working Solutions in 4 oz (118 mL) bottles

Liquid Solution Polymers, Emulsion Polymers, and Polymers in Powder Form (Mannich, Polyamines, Polydadmacs, Polyacrylamides, etc.)

1. Make sure cap is secure and shake stock solution polymer sample bottle vigorously for 1 minute in an up and down motion.

2. Place a beaker on top of magnetic stirrer and insert stir bar.

3. Add 72.0 mL of water used at the plant into the beaker. Turn on magnetic stirrer and adjust rpm to generate a large/strong vortex.

4. Using a clean syringe withdraw 48.0 mL of stock solution from the appropriate bottle and apply along the sides of the vortex. Purge the syringe 3 to 4 times with the now called working solution while mixing.

5. Allow the working solution to mix for approximately 5 minutes to make sure it is homogenous.

6. Apply a small adhesive-backed label to each bottle containing stock solution of each grade of polymer prepared. Use a pen to mark the name of the product, and solution strength. The working solution is recommended to be discarded 24 hours from the time it was made.

Note

Multiply the percent of the solution × 10,000 to convert to mg/L.

Use the following formula to determine the making down a working solution from a stock solution.

$$C_2 = \frac{C_1 \times V_1}{V_2}$$

Where:

C_1 = Concentration of the initial polymer solution, (mg/L)
V_1 = Volume of the initial polymer solution being diluted, (mL)
V_2 = Total volume of the new solution, (mL)
C_2 = Final concentration of the new polymer solution, (mg/L)

Example

$$2{,}000 \text{ mg/L} = 5{,}000 \text{ mg/L} \times \frac{48 \text{ mL}}{120 \text{ mL}}$$

Coagulation and Flocculation

Coagulation is the process by which colloidal particles are destabilized, and is achieved mainly by neutralizing their electrical charge. Without coagulation, 1 micron (colloidal) sized particles could take up to 20 years to settle through 3 feet of water by gravitational forces alone.

Coagulation is usually achieved by the addition of organic and organic/inorganic liquid polymers that are high in cationic charge with molecular weights less then 600,000, which allows rapid absorption on a particle surface to form, thus allowing coagulation to occur. These types of coagulants do not require supplemental pH adjustment as required by aluminum and iron salt coagulants.

All suspensions, which contain a high proportion of colloidal organic substances, cannot be directly flocculated. Most often they require a coagulant to be applied first to destabilize the particles then followed by a flocculant to aggregate the particles.

Flocculation is used to describe the action of polymeric materials which form bridges between individual particles. Bridging occurs when segments of a polymer chain absorb on different particles and help these particles aggregate.

The most commonly used flocculants are polyacrylamides, which is a nonionic polymer. Polyacrylamide polymers can be given an anionic (negative) by co-polymerizing acrylamide with acrylic acid. Cationic Polyacrylamide polymers are prepared by co-polymerizing acrylamide with a cationic monomer.

For each suspension, a certain degree of anionic, cationic or non-ionic character is beneficial. Usually, the intrinsic flocculating power increases with the molecular weight.

Use of Sludge or Wastewater Samples

The polymer selection and bidding process is typically an annual event. This means that sludge conditioning and wastewater tests should, ideally, select the polymer that will function well under all conditions encountered (climate, logistics, mixing and dosing equipment, type of solids separation equipment, etc.). If there is more than one sludge, or wastewater stream to be conditioned, separate tests should be performed for each such case. If sludges, or wastewater streams are combined from different sources prior to conditioning, the sample obtained should be at the usual mixing ratio, or if this varies substantially, separate samples should be obtained and mixed for additional tests at the extreme ratios.

In order to insure uniformity of sludge or wastewater samples, obtain approximately a four-gallon sample contained in a five gallon bucket. Sampling time, location, water temperature, pH, and Total Solids should be recorded. Do not seal the bucket too tightly while in transport, particularly if a sludge is anaerobically digested.

Prior to drawing the amount of sample required to conduct a jar test, remove the lid and stir well with a paint stirring stick or some other type of stirring device to provide homogeneity. Stirring of sample should be done each time a container draws a sample. Draw a sample and pour into a container prior to evaluating polymers. This sample is to be used as a reference to compare results obtained with polymer additions.

Jar Test Procedure

The following OFITE Jar Test Procedure is designed to permit the rapid comparison of floc size, floc setting rates, thickening, and water clarity as would normally be done using a jar test with paddles (e.g. Phipps & Bird). The main advantage is that the OFITE Jar Test device removes the human element from the inversion process and ensures strict uniformity.

1. Obtain the polymer solutions that were prepared according to the "Preparation of Polymer Procedures."

2. Designate a number, or letter, to each bottle containing a working polymer solution.

   Example: ABC 12 VC, 0.25% solution = Polymer Sample #1

3. Write down all of the polymer solutions with their designated polymer sample #s on a piece of paper (refer to OFITE POLYMER PREPARATION LOG).

4. Insert one clean syringe per Polymer Sample bottle. Purge the syringe 2 to 3 times with polymer solution. Withdraw (pre-load) into syringe the amount of polymer solution to be used for the initial dose.

5. Stir the sample of sludge, or wastewater to be tested.

6. Use a beaker to fill a graduated cylinder with the amount of sludge, or wastewater, to be tested. The amount of sludge, or wastewater, most often used is 500 mL.

7. Pour the sludge, or wastewater, from the graduated cylinder into the one-liter acrylic cylinders. Be accurate in filling each of the four cylinders with equal amounts of sludge, or wastewater.

8. Add the amount of Polymer Solution pre-loaded from each syringe into the appropriate one-liter acrylic cylinder.

9. Place the rubber stopper firmly inside the one-liter acrylic cylinders. Place the one-liter acrylic cylinders with stoppers inside the stainless steel rack. Attach and latch the stainless steel rack cover.

10. Grab the sides of the stainless steel rack with hands and invert the rack 3 to 5 times. The inversion process is achieved by bringing the stainless steel rack towards the chest and then extending the arms downward towards the floor.

    Observe and note which cylinder containing the sludge, or wastewater changes character during inversion.

11. Place the stainless steel rack onto a level surface and rate the appearance of solids flocculation within the cylinders as defined below:

0	=	No Floc
2	=	Floc Scarcely Visible, Pin Floc
4	=	Small Floc
6	=	Medium Size Floc
8	=	Good Floc
10	=	Very Bulky Floc

    Observe settling and floc characteristics for 10 minutes. Record the information on a data sheet (refer to OFITE JAR TEST - DATA SHEET).

12. If the desired floc characteristics were not achieved, continue with Steps 4, 8, 9, 10, and 11. After dosing the sludge, or wastewater sample with more than 300 mg/L of polymer solution, it is recommended to abort this series of polymer sample testing.

    After aborting the first series of polymer samples, it is recommended to prepare and test a second series of polymer solutions of different ionic character and charge density, and repeat steps 4 through 11.

    In most cases, it can take up to 4 series of tests (20 grades of polymers) to find the polymer that provides optimum floc characteristics and water clarity.

    If floc characteristics and water clarity are not achieved after trying anionic, non-ionic, and cationic polymers, it is recommended to prepare solutions of different types of coagulants and perform steps 4 through 11.

    It is recommended to test the preferred coagulant with the polymers that ranked the best in the previous tests using polymers.

13. Use Table 1 to help determine the polymer dosage being applied to 500 mL of sludge, or wastewater, in one-liter acrylic cylinders.

Appendix

Table 1

Volume of Working Polymer Solution Added to 500 mL of Sludge

Concentration of Working Polymer Solution Used, g/L (%)	Polymer Dosage (mg of Polymer / Liter of Sludge)					
	50	**75**	**100**	**150**	**200**	**300**
	mL of Polymer Working Solution to Add to 500 mL of Sludge Sample (mL)					
0.5 g/L (0.05%)	50	75	100	750	200	300
1.0 g/L (0.1%)	25	37.5	50	75	100	150
2.5 g/L (0.25%)	10	15	20	30	40	50
5.0 g/L (0.5%)	5	7.5	10	15	20	30
10.0 g/L (1.0%)	2.5	3.75	5	7.5	10	15

OFITE Jar Test Data Sheet

Date:______________________________ Analyst:______________________
Location:____
Type of Sludge or Wastewater:__________________________________
Flowrate (gpm):____
Amount of Sample per Cylinder (mL):____________________________
Total Solids of the Sludge Sample (mg/L): ________________________
Concentration of Polymer Solution (mg/L): ________________________
Total Suspended Solids of Sludge (mg/L): _________________________

CYLINDER 1 Polymer No.___				CYLINDER 2 Polymer No.___				CYLINDER 3 Polymer No.___				CYLINDER 4 Polymer No.___			
mL of Polymer				mL of Polymer				mL of Polymer				mL of Polymer			
F	FW	C	SR	F	FW	C	SR	F	FW	C	SR	F	FW	C	SR
mL of Polymer				mL of Polymer				mL of Polymer				mL of Polymer			
F	FW	C	SR	F	FW	C	SR	F	FW	C	SR	F	FW	C	SR
mL of Polymer				mL of Polymer				mL of Polymer				mL of Polymer			
F	FW	C	SR	F	FW	C	SR	F	FW	C	SR	F	FW	C	SR
mL of Polymer				mL of Polymer				mL of Polymer				mL of Polymer			
F	FW	C	SR	F	FW	C	SR	F	FW	C	SR	F	FW	C	SR
mL of Polymer				mL of Polymer				mL of Polymer				mL of Polymer			
F	FW	C	SR	F	FW	C	SR	F	FW	C	SR	F	FW	C	SR
Total mL Polymer				Total mL Polymer				Total mL Polymer				Total mL Polymer			
mL of Polymer				mL of Polymer				mL of Polymer				mL of Polymer			
Rank (1-4)				**Rank (1-4)**				**Rank (1-4)**				**Rank (1-4)**			

F (Floc size)
0 = No Floc
2 = Floc Scarcely Visible,
Pin Floc
4 = Small Floc
6 = Medium-size Floc
8 = Good-Strong Floc
10 = Very Large-Bulky Floc

FW (Free Water)
1 = Yes, 2 = No

C (Free Water Clarity)
1 = Clear
2 = Hazy
3 = Drk. Cloudy

SR (Settling Rate)
Visual:
VS = Very Slow
S = Slow
F = Fast
VF = Very Fast
or Timed:
min/sec to settle out

Rank (1-4)
1 = Worst Result
2 = Fair Result
3 = Good Result
4 = Best Result

Notes

OFITE Polymer Preparation Log

Cationic Polymers	% Solution	Charge Density	Data Sheet Polymer No.
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Cationic Polymers	% Solution	Charge Density	Data Sheet Polymer No.
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Non-Ionic Polymers	% Solution	Charge Density	Data Sheet Polymer No.
1.			
2.			

Coagulants	% Solution	Charge Density	Data Sheet Polymer No.
1.			
2.			
3.			
4.			