

Chemical Phosphorus Jar Testing Protocol

1. Supplies Needed

- a. Beaker (preferably 1-liter but 2-liter will also work)
- b. Magnetic stirrer
- c. Magnetic stir bar
- d. Micropipette
- e. 0.45-micron filter (if testing samples with significant particulate)
- f. pH meter
- g. Spectrophotometer or colorimeter for phosphorus test (Hach TNT or Powder Pillow method are easiest)

2. Sample Collection and Preparation

- a. Collect sample from desired dosing locations.
 - i. Note that samples should be taken during normal flows and not wet weather.
- b. Split sample into either 1-liter or 2-liter beakers
 - i. If using 2-liter beakers, make sure to multiply dosage x2.

3. Dosage Calculation (Neat)

- a. A volume of 1 mL of water has a weight of 1 gram. When chemicals are added, it can be assumed that the solution weight is the same as the weight of the water.
- b. When using a 1-liter beaker and micropipette, the target dosage rate is $X / \text{specific gravity}$, in microliters. For example, if the chemical has a specific gravity of 1.37 and you want to dose 10 mg/L, you would add $(10 / 1.37)$ 7.30 microliters to a 1-liter beaker of sample.
 - i. If using a 2-liter beaker, multiply the above calculation x2.
- c. Start with 10 mg/L and work up in increments of 10. i.e., 10,20,30, etc.

4. Testing Procedure

- a. Run initial phosphorus and pH test on each sample before introducing the chemical. If sample contains heavy particulate, it is a good practice to filter the sample through a 0.45-micron filter before performing the phosphorus test. (Take sample from the same place in each beaker with a steady hand to not disrupt floc.) Typically, orthophosphate testing is done for convenience purposes.

Total phosphorus test measures all forms of phosphorus in a sample by digesting the sample to convert other forms to orthophosphate. However, the digestion process is time consuming. For convenience, phosphorus can be measured as orthophosphate using HACH test kits and converted to PO₄ as P using a conversion factor. The conversion factor for orthophosphate to PO₄-P is $X / 3.06$. For example, if the ortho value is 3.42 $(3.42 / 3.06)$ the estimated PO₄-P concentration will be 1.14 mg/L. Although this method is not the most accurate way of quantifying TP in wastewater, it can still be



employed to save time since the most dominant species of phosphorus in wastewater is orthophosphate.

- b. Dose chemical "neat."
- c. Mixing and settling times are as follows:
 - i. Rapid mixing: 300-400 rpm for 30 seconds to 1 minute.
 - ii. Slow mixing: 35-40 rpm for 5 to 10 minutes.
 - iii. Sedimentation: 15 to 30 minutes
- d. Run phosphorus and pH test to determine chemical performance.
 - i. The conversion factor for orthophosphate to total phosphate can again be used for convenience purposes.
 - ii. The final sample should be taken from the same place as the initial sample in the beaker.

5. Plotting and Results Interpretation

- a. Record results on a jar testing evaluation form.
 - i. Include volumes, pH, phosphorus concentrations, etc.
- b. Note any observations made during the test.
 - i. This can include floc appearance and any changes observed after adding the chemical.
- c. Plot results on a graph to create a dosage curve.
 - i. Microsoft Excel works well for recording bench testing results.
 - ii. Results should be calculated into percentage removal to assess performance: $\text{initial concentration (mg/L)} - \text{final concentration (mg/L)} / \text{initial concentration} \times 100$
 - iii. Results can then be automatically transformed into a graph. Figures 1 and 2 demonstrate examples of a dosing table and curve. (Please note that the results below are just generic and not real-world results.)

	A	B	C	D	E
1	Dose mg/L	Ferrous Chloride (% Rem)	Alum (% Rem)	Ferric Chloride (% Rem)	Rare Earth (% Rem)
2	0				
3	10	25	40	30	40
4	20	28	45	35	50
5	30	35	56	37	60
6	40	42	54	40	70
7	50	50	60	46	80
8	60	60	64	50	90
9	70	65	68	52	100
10	80	70	72	60	100
11	90	71	75	65	100
12	100	72	80	75	100
13	110	73	85	88	100
14					

Figure 1: Dosing Table



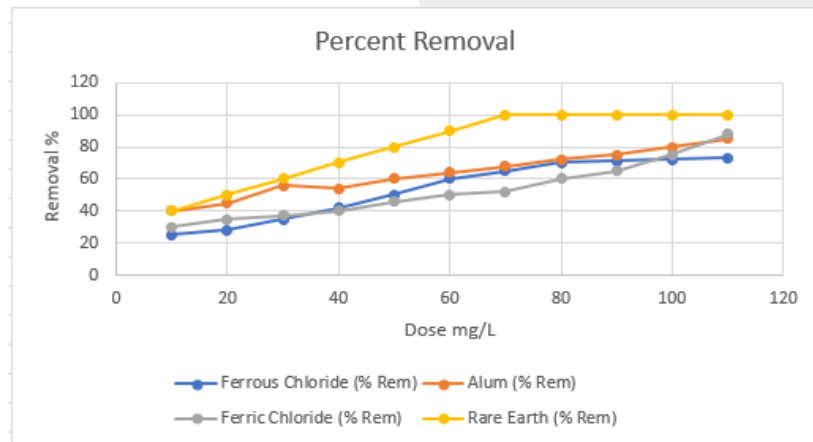


Figure 2: Dosage Curve

