

The TREND

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Phosphonate Testing with New Dosage Control Ranges

Lab News Update:

The new Field Safety Training is off to a successful start! The positive feedback that we've received proves that the content of this training is a valuable investment in your overall safety in the field. Call to schedule your Field Safety Training session today!

"Very valuable to our company's safety and health program, and it will help our technicians in their understanding of hazards and controls in chemical transportation and handling."
Pete Malone, Brady

"The content touched on all areas that my crew would experience, which was good."
Rick Hopkins, Boland

Watch For:

The new and improved Chemtex Lab Catalog is almost complete—several new items and an improved layout will make ordering a breeze!

Coming up next in *The Trend*

The next issue will highlight our line-up of coil cleaners and how to pick the right one for the job!

Do You Know Where Your Phosphonate Levels Are?

NO?

Here is Your Guide!

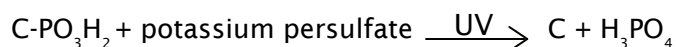
As water treatment providers, one of our challenges is providing a product that is easy to monitor and test for accurately in the field when real-time results can be imperative. For many of you, phosphonate testing is frustrating and choosing the best method is difficult. Palintest



PK-158? LaMotte 7625? Can you use just one for a variety of phosphonates? Or is UV digestion really the best method? The Trend Volume 5 provided you with sound information on the test methods available to you. This issue of the Trend will go beyond the basics, giving you empirical data gathered through careful lab analysis that will help you

make sense of your phosphonate results. Use the tables provided in this Trend as a reference guide to control your phosphonate products at the recommended dosage.

Phosphonate field testing is most commonly performed by UV digestion or a thorium nitrate titration test. The digestion method uses UV light to break the carbon-phosphate (C—P) bond that gives phosphonate its desired stability. The oxidation reaction follows:



Once the C-P bond is broken, the liberated phosphate can be easily tested as orthophosphate. This oxidation reaction can also be achieved with persulfate, sulfuric acid and heat, but the boiling process can be challenging to perform in the field.

Widely-used drop tests, such as PK-158 and LaMotte 7625, are based on a titration of phosphonate with thorium nitrate. Both the phosphonate and the indicator form a complex with thorium nitrate; the phosphonate complex is clear, whereas the indicator complex produces a color change. The phosphonate/thorium nitrate complex is more stable and forms first, but after the titrant chelates all of the phosphonate, the indicator reacts with the thorium nitrate, producing the color change for the end result.

Understanding the chemistry behind these test methods will help you interpret the empirical data collected while lab testing the phosphonate content in our products. Each product was blended in the laboratory and tested using UV digestion, PK-158, and LaMotte 7625 drop tests.

The first issue to address was if a longer UV light exposure time affected the digestion results. For most of the products, the results from 15 minutes of UV light digestion did not significantly differ from the results at 10 minutes of digestion. Ten minutes is the recommended digestion time given in the Hach instructions, but letting the sample digest a few minutes longer will not negatively affect your end results. A slightly longer digestion may actually give you a better result depending on the product and respective phosphonate complexity.

Table 1

	Dosage Control	UV Digestion at Recommended	Ratio of UV Digestion Result Versus
Product	Range	Dose (as PO₄, ppm)	Average Dosage
HS-4030	2.2-3.2	2.6	0.96
HS-4032	2.2-3.2		
HS-4040	2.6-3.6	2.8	0.90
HS-4043	2.6-3.6		
HS-4050	2.2-3.2	2.5	0.93
HS-4210	2.5-3.5	2.5	0.83
HS-4212	2.5-3.5		
HS-4220	1.0-2.0	1.1	0.73
HS-4222	1.0-2.0		
HS-4230	2.2-3.2	2.5	0.93
HS-4232	2.2-3.2		
HS-4240	2.7-3.7	2.6	0.81
HS-4243	2.7-3.7		
HS-4250	2.2-3.2	2.4	0.89
HS-4252	2.2-3.2		
C-490	4.3-5.3	4.0	0.83
C-493	4.3-5.3		
OP-4280	4.3-5.3	4.0	0.83
OP-4283	4.8-5.8	4.8	0.91
OP-4288	3.7-4.7	4.0	0.95
OP-4289	4.5-5.5	4.5	0.90
C-750	3.4-4.4	3.0	0.77
LG-4575	315-385	300	0.86
LG-4576	45-55	48	0.96
		Average	0.88

The UV digestion results show that this method of testing can provide very accurate results for a wide range of phosphonates including, but not limited to, HEDP, PBTC, POCA and HPA. On average, the UV digestion method results fell within the expected dosage control range (see Table 1). Unlike drop tests, this method eliminates the work of running a separate test for a makeup blank and is generally unaffected by variable system conditions. If the UV digestion is performed correctly with clean glassware, you can expect a result that closely matches that of the expected average dose.

Drop test results were higher than the recommended dosage range for most products; this inconsistency is typically seen in the field as well. Instead of actually breaking the phosphonate C-P bond, the drop test reagents form complexes that may be altered by additional constituents of the product or quality of tower water. The end result is positive interference yielding higher results than expected. Lab testing was performed with dilutions made with deionized water, so results in the field with tower water samples may differ more significantly from what is reported in the chart below.

Table 2

	Dosage Control Range	PK-158 at Recommended Dose	Ratio of PK-158 Result Versus Average Dosage	Lamotte at Recommended Dose	Ratio of Lamotte Result Versus Average Dosage
HS-4030	2.2-3.2	4.9	1.8	6	2.2
HS-4032	2.2-3.2				
HS-4040	2.6-3.6	4.9	1.6	5	1.6
HS-4043	2.6-3.6				
HS-4050	2.2-3.2	5.6	2.1	6	2.2
HS-4210	2.5-3.5	2.8	0.9	9	3.0
HS-4212	2.5-3.5				
HS-4220	1.0-2.0	1.4	0.9	6	4.0
HS-4222	1.0-2.0				
HS-4230	2.2-3.2	5.6	2.1	7	2.6
HS-4232	2.2-3.2				
HS-4240	2.7-3.7	4.2	1.3	5	1.6
HS-4243	2.7-3.7				
HS-4250	2.2-3.2	4.2	1.6	7	2.6
HS-4252	2.2-3.2				
C-490	4.3-5.3	4.9	1.0	7	1.5
C-493	4.3-5.3				
OP-4280	4.3-5.3	4.9	1.0	7	1.5
OP-4283	4.8-5.8				
OP-4288	3.7-4.7	5.6	1.3	7	1.7
OP-4289	4.5-5.5				
C-750	3.4-4.4	4.2	1.1	7	1.8
LG-4575	315-385	630	1.9	700	2.0
LG-4576	45-55	112	2.2	120	2.4
		Average	1.5		2.2

Looking at the data in Table 2, the LaMotte 7625 drop test did not perform as well as the Palintest PK-158 drop test, especially in the PBTC-based products HS-4210 and HS-4220. The values at the bottom of the Table 2 show that, on average, the PK-158 read 1.5 times higher than the control range average and LaMotte 7625 read 2.2 times higher. Regardless of the brand of drop test you are using, these results prove that it is necessary to form a correlation between UV digestion and drop test results. Periodically performing UV digestion on your samples will give you the most accurate phosphonate result that you can compare to your drop test result, ensuring that your treatment dosage is accurate.

In addition to the standard UV digestion with an 115V power source, a UV light attached to a smaller 9V battery pack was tested. At first glance, this unit seemed to be quite convenient; small and compact, it would fit nicely in any test kit. Unfortunately the results were erratic and the battery voltage seemed to decrease significantly in just a few tests. The limited power source of the battery pack wasn't enough to overcome the C-P bond of the phosphonate, resulting in much lower results. The larger 115V power source may not be ideal to carry around in the field, but for the present time, it is your best option for accurate UV digestion results.

The narrow dosage ranges in the tables can be helpful as you treat and test your cooling systems. In the past, Chemtex provided a wide control range for each product, or in some cases, didn't provide a phosphonate range at all. Use this new data to maintain your treatment levels within a tighter dosage range using UV phosphonate digestion. This information will also appear in the next edition of the Chemtex Brain Book.

New technologies in phosphonate chemistry continue to enter our market place. Unfortunately, phosphonate testing remains unchanged. The empirical data gathered for this project validates the accuracy of the UV digestion method of testing for a wide range of phosphonates. Drop tests are quick and easy, but relying on them to accurately dose your systems is not recommended. Don't have time to run UV Digestions every time? Develop a correlation between UV Digestion and drop test. Run the drop test on a regular basis, but cross check results with UV digestion periodically to ensure you are dosing your systems accurately.

One last, but important note—**avoid phosphonate testing within 4–6 hours after biocide feed.** Biocides interfere with testing and can break the C-P bond. This will lead to erroneous results.



Meters and Test Kits

Phosphonate

Hach

Colorimeter

Phosphonates (organophosphonates) are primarily used in boilers and cooling towers to control scaling. The Pocket Colorimeter II for Phosphonates is an accurate means of measurement. Includes reagents for 100 tests. Range is 0.02-2.50/1.0-125 ppm as PO₄.

Part Number	Description
58700-07	Hach Phosphonate Pocket Colorimeter II

Parts & Accessories

Part Number	Description
26710-00	Hach UV Lamp, Shortwave, 2.125"
27045-00	Hach Ultraviolet Lamp Kit, includes 115V power supply and UV Lamp, 2.125"
UV-LAMP-HOLDER	Holder, for UV Lamp



Reagents

Part Number	Description
20847-69	Hach Potassium Persulfate Pillows, 100/pk
21060-69	Hach PhosVer 3 Phosphate Reagent, 10 ml, 100/pk
24297-00	Hach Phosphonates Reagent Set, 10 ml, for DR/890 and PCII

Palintest



The Palintest PK-158 Test Kit can be used to determine AMP and HEDP phosphonates. The kit utilizes a convenient tablet form indicator and masking agent with a thorium nitrate titrating solution.

Part Number	Description
AD-1582	Palintest Organophosphonate Tablets for PK-158/250 Tablets
AD-1596	Palintest Organophosphonate #2 for PK-158/50ml
AD-1598	Palintest Organophosphonate #2 for PK-158/500ml
PK-158	Palintest Organophosphonate Test Kit