Phosphonates

For water **Ultraviolet Photochemical Oxidation Method**

Introduction

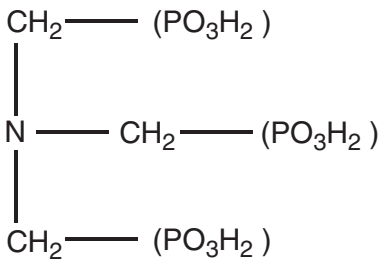
Phosphonates are employed as chemical additives to function as threshold antiscalants, corrosion inhibitors, chelants, sludge conditioners, deflocculants, dispersants and crystal growth modifiers in various industrial water treatment processes. They are used predominantly as scale and corrosion preventatives for boiler and cooling tower waters. Phosphonates exist in various formulations as acids or salts and are marketed in the form of concentrated solutions.

Until recently, analytical methods for phosphonates have been difficult, time consuming and subject to many interferences. The Ultraviolet (UV) Photochemical Oxidation Method involves a photochemical oxidation of phosphonate followed by conventional colorimetric determination of the liberated orthophosphate by the Ascorbic Acid Method. The UV Photochemical Oxidation Method is rapid, easy to use, relatively free from interferences, and applicable to both field and laboratory situations.

Chemical reactions

Phosphonic acids are organic compounds of the form R-PO_3H_2. Structures of two commonly used treatment chemicals are shown below; the phosphonic acid group is shown in parentheses. Phosphonates are the corresponding anions formed by ionization of one or more of the acidic hydrogens.

Aminotri
(methylene phosphonic acid)



Hydroxyethylene diphosphonic
acid

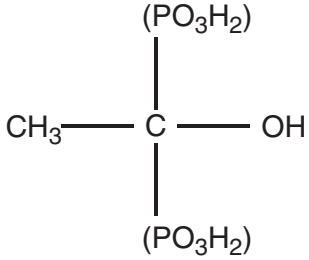
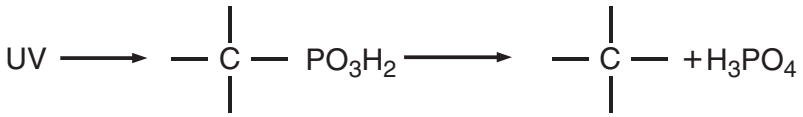


Figure 1 Chemical structures of two common phosphonic acids

Decomposition of these compounds by oxidation will liberate the organically bound phosphate as orthophosphate. The combined action of the UV radiation and oxygen will liberate orthophosphate rapidly without the necessity of heat or corrosive agents. When the photo-oxidation is carried out in the absence of acid, no significant degree of depolymerization or hydrolysis of condensed (pyro, meta or other poly) phosphates occurs, making the method a true test for organic phosphate. Presence of excess oxygen is ensured by the addition of a small amount of potassium persulfate. In this oxygen-rich environment UV light will rapidly catalyze the oxidation of the phosphonate C-P bond.



The orthophosphate formed can then be determined colorimetrically using the Ascorbic Acid method. Reagents for the Ascorbic Acid Method for orthophosphate have been combined into a single reagent powder, PhosVer™3. Determination of orthophosphate using PhosVer 3 is described in the Phosphorus methods.