Method Abstract

Scope

This method is used to determine orthophosphate in estuarine and coastal waters (seawater) according to USEPA Method 365.5 and Standard Methods 4500– P F. This method can also be used to analyze low-turbidity limnological and fresh water samples. Additionally, this method enables orthophosphate analysis according to ISO Method 15681-2.

Summary

Orthophosphate reacts with molybdenum(VI) and antimony(III) in an acidic solution to form an antimony-phosphomolybdate complex. Ascorbic acid subsequently reduces this complex to form a blue color, and the absorbance is measured at 880 nm.

Interferences

Filter turbid samples prior to analysis. The presence of more than 40 mg/L of iron(III), more than 10 mg/L of copper, or more than 10 mg/L of silica may interfere. Samples with background absorbance at the analytical wavelength may interfere. Residual phosphate in the flow system components and from continuous analysis may interfere. Wash the system with dilute HCl to avoid interferences.

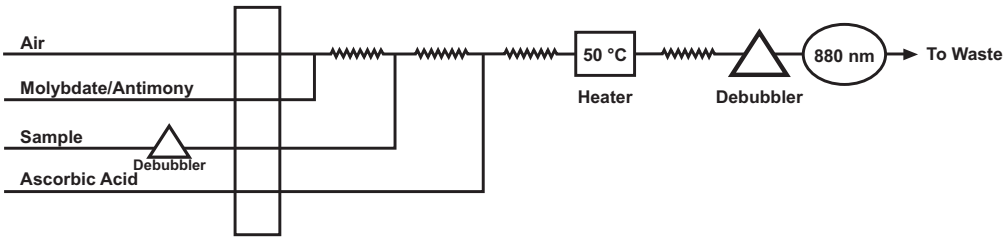
Performance Specifications

Range	1.0–400 μg/L (0.03–13 μmoles/L)
Throughput	30 samples/hour
Precision at:	
4 μg/L	<2% RSD
40 μg/L	<1% RSD
Method Detection Limit (MDL)	0.25-μg/L (0.008 μmoles/L)

Chemicals

Ammonium Molybdate Tetrahydrate, $(NH_4)_6Mo_7O_{24}•4H_2O$	Magnesium Sulfate Heptahydrate, $MgSO_4•7H_2O$
Sodium Hydroxide, NaOH	Potassium Phosphate Monobasic, KH_2PO_4
Ascorbic Acid, $C_6H_8O_6$	Sodium Bicarbonate, $NaHCO_3$
Deionized Water (ASTM Type I or II)	Sodium Chloride, NaCl
DOWFAX® 2A1 (PN A000080)	Antimony Potassium Tartrate Hemihydrate, $K(SbO)C_4H_4O_6•Q/wH_2O$
Hydrochloric Acid, concentrated, HCl	Sulfuric Acid, concentrated, H_2SO_4

Basic Flow Diagram



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Selected References

Determination of Orthophosphate in Estuarine and Coastal Waters by Automated Colorimetric Analysis. *Methods for Chemical Analysis of Water and Wastewater;* EPA/600/4-79-020; U.S. Environmental Protection Agency, Office of Research and Development, Environmental Monitoring and Support Laboratory Cincinnati, OH, 1997; Method 365.5.

Sample Preservation. *Methods for Chemical Analysis of Water and Wastes*; EPA/600/4-79-020; U.S. Environmental Protection Agency, Office of Research and Development, Environmental Monitoring and Support Laboratory: Cincinnati, OH, 1984; xvii.

Water Quality–Determination of Orthophosphate and Total Phosphorus Contents by Flow Analysis (FIA and CFA)–Part 1: Method by Continuous Flow Analysis (CFA). International Standard; ISO 15621–2:2003 (E); 1st. ed: Geneva, Switzerland, 2003.

Figures

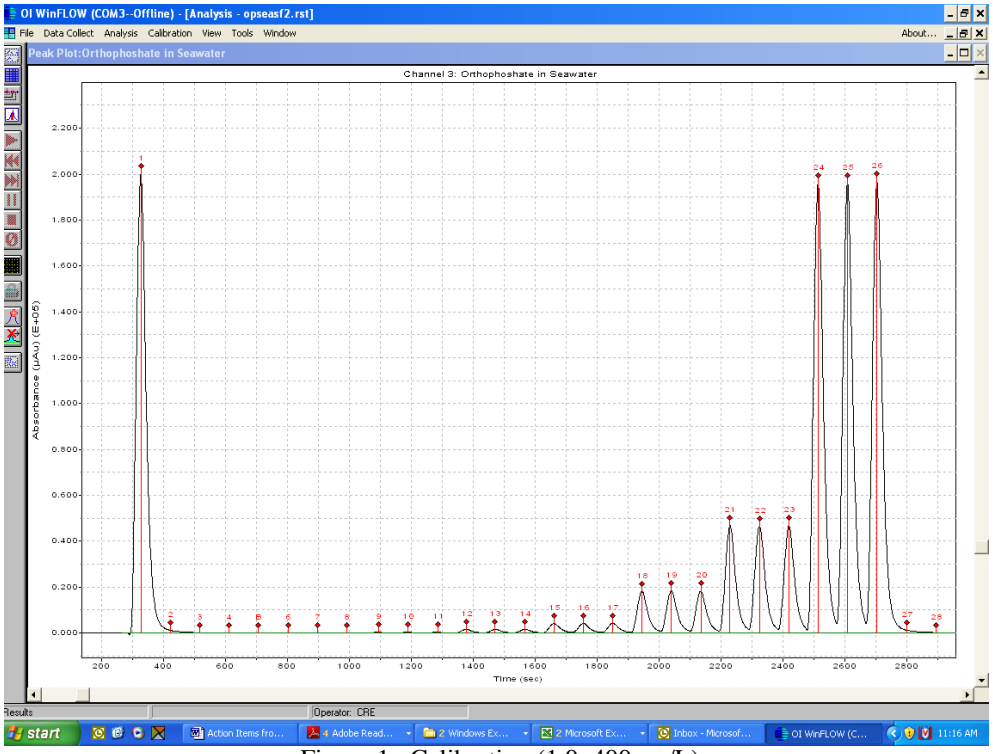

Figure 1. Calibration (1.0–400 µg/L)

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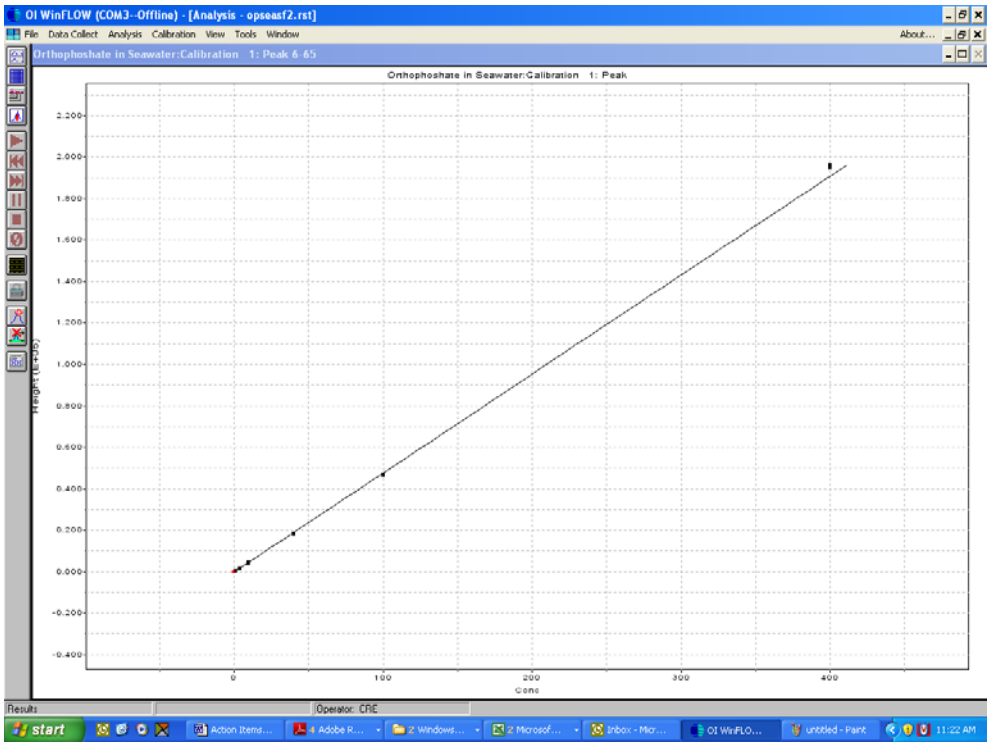

Figure 2. Calibration Curve (1.0–400 μg/L)

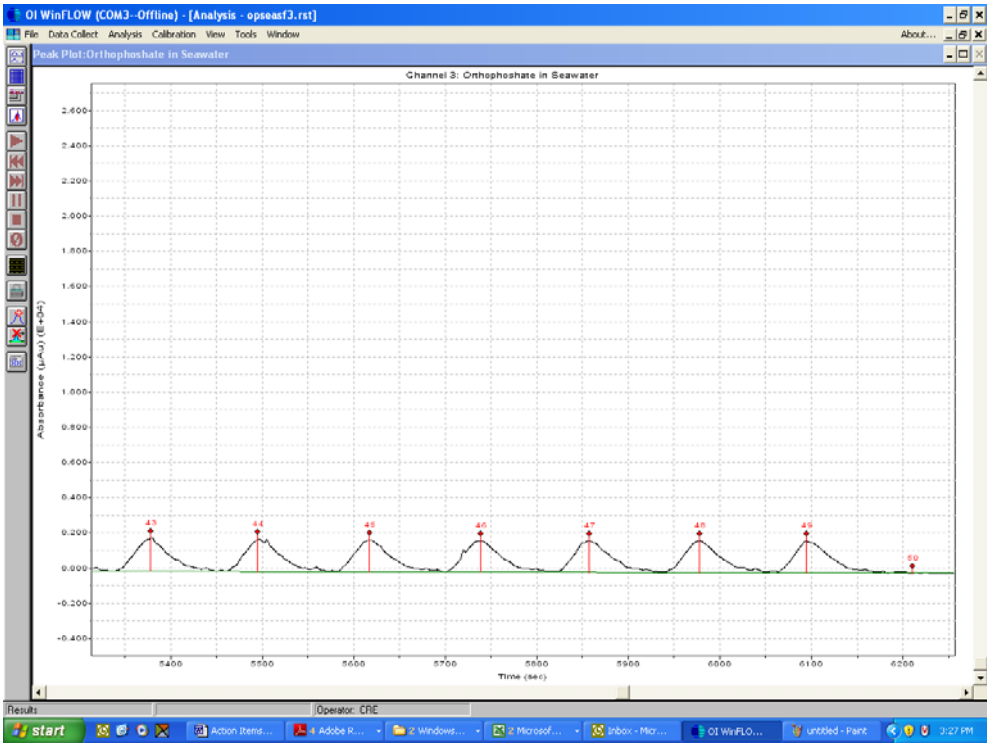

Figure 3. Method Detection Limit (at 4.0 ppb)

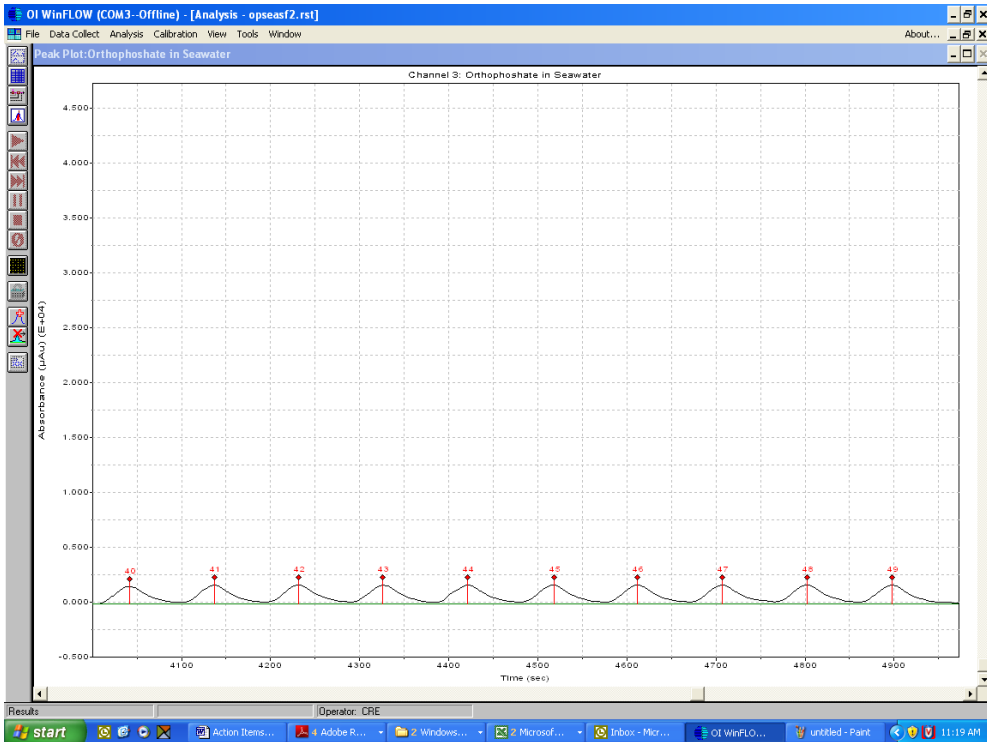

Figure 4. Precision at 4.0 µg/L (<2% RSD)

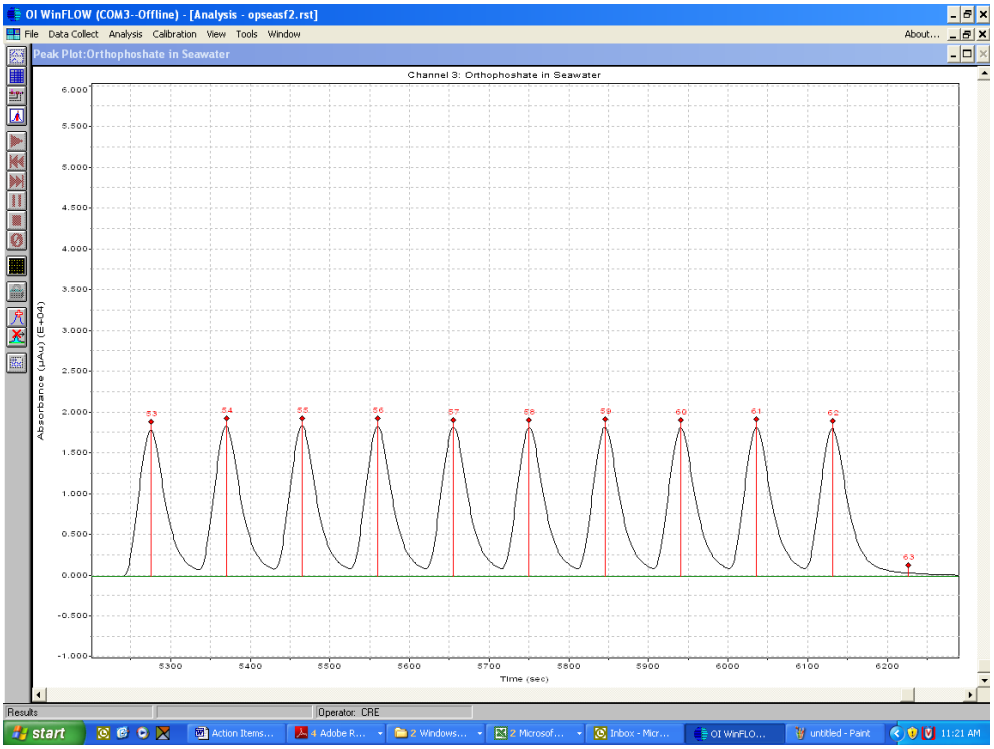

Figure 5. Precision at 40 µg/L (<1% RSD)

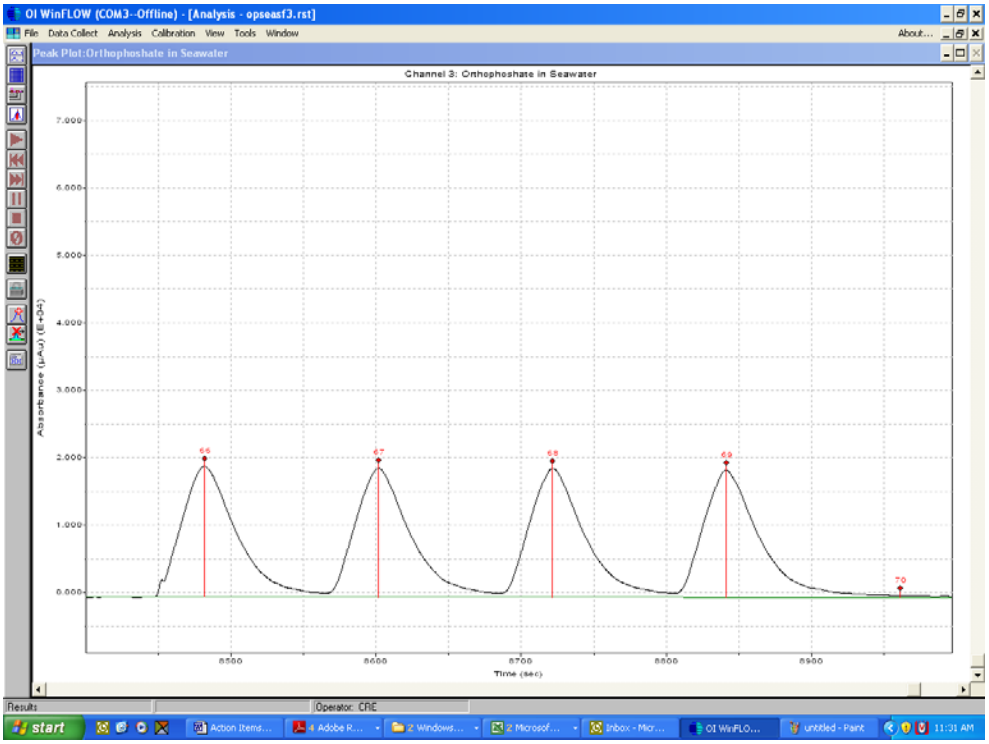

Figure 6. ERA QC (40 ppb)

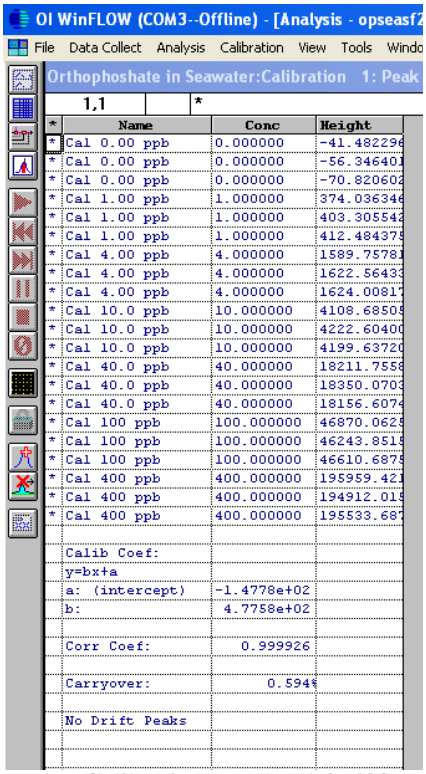

Figure 7. Calibration Results (1.0–400 µg/L)

Table 1. Orthophosphate in Seawater Validation Results Table

Parameter	Calibrant 4.0 µg/L	Calibrant 4.0 µg/L	Calibrant 40 µg/L	ERA QC Standard 40 µg/L
Rep 1	4.1750	3.6898	38.0171	43.3424
Rep 2	4.0383	3.9047	38.6523	42.4701
Rep 3	3.9623	3.9027	38.7161	42.4450
Rep 4	3.9457	3.8743	38.5921	41.9483
Rep 5	3.9902	3.9280	38.3155	—
Rep 6	4.0411	3.9104	38.2750	—
Rep 7	3.9953	3.9304	38.3525	—
Rep 8	—	3.9050	38.2286	—
Rep 9	—	3.8935	38.4257	—
Rep 10	—	3.9085	38.0134	—
Average	4.0211296	3.8847261	38.358836	42.551442
Standard Deviation	0.0765285	0.0703237	0.2437438	0.5794373
% RSD	1.9031585	1.8102603	0.6354307	1.3617337
MDL	0.2402994	—	—	—
% Accuracy	—	—	—	105.83

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