

Application News

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Spectrophotometric Analysis

Analysis of Orthophosphate, Nitrate Nitrogen, and Hexavalent Chromium in Water Samples Using the Shimadzu UV-1280 Spectrophotometer

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■ Introduction

The analysis of tap water is of interest to many people and industries. Users expect that the water that they come into contact with has been tested for impurities and has been adjusted such that those impurities are present in concentrations lower than that allowed by current regulatory standards. Spectrophotometers have the ability to measure many contaminants based on colorimetric reactions, and can be effective tools for measuring the concentration of analytes in water samples. The use of an affordable and reliable spectrophotometer to measure contaminants, or lack thereof, is of paramount concern, as the need for mobile laboratories and standardized testing facilities increases.

The current accepted methods for water analysis found in the Standard Methods compendium has published several standard methods for the determination of analytes in water, and have published minimum requirements for UV-Vis spectrophotometers. Several spectrophotometers have been released that claim the capability to analyze water, but few have the photometric accuracy to determine minute analyte concentration

differences, as well as provide the photometric range to obtain readings at very low concentrations. These limitations may reduce the apparent validity of results.

In this document, we report the use of Shimadzu's benchtop UV-1280 UV-Vis spectrophotometer (p/n 220-93630-04) for the analysis of three water contaminants – phosphate, nitrate, and hexavalent chromium. Where indicated, the Shimadzu UV-1280 was equipped with a long path length cuvette holder.

■ Results

Reactive Phosphate in the form of orthophosphate was analyzed by the Standard Method 4500-P E (Ascorbic Acid Method) using a 50 mm path length cuvette to detect low concentrations of orthophosphate. Standards ranging from 0.1 ppm to 2.5 ppm were analyzed at 880nm following the development of the reaction. The use of the long path length cuvette allowed for precise analysis of samples at low concentrations. The phosphate curve shown in Figure 1 demonstrates good linearity of results using a broad range of phosphate concentrations.

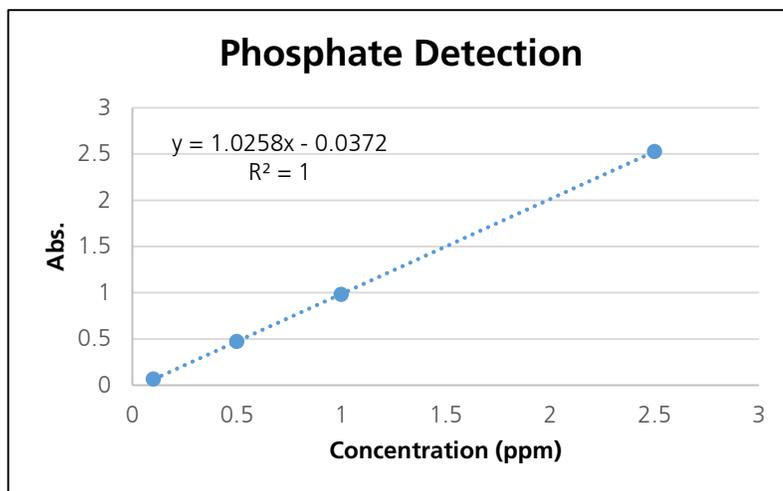


Figure 1: Calibration curve standards of orthophosphate from 0.1 to 2.5 mg/L

Hexavalent Chromium was analyzed based on the Standard Methods method 3500-Cr B (Colorimetric Method) with a 10mm cuvette and holder (p/n 220-93630-01). Solutions of chromium were prepared from standards ranging in concentration from 0.01 ppm to 1.0 ppm and absorbance values were measured with the Shimadzu UV-1280 spectrophotometer at 540nm. The curve in Figure 2 shows the sensitivity of the instrument to effectively quantitate chromium accurately even at low concentrations. Further, good linearity is achieved throughout the range of analysis.

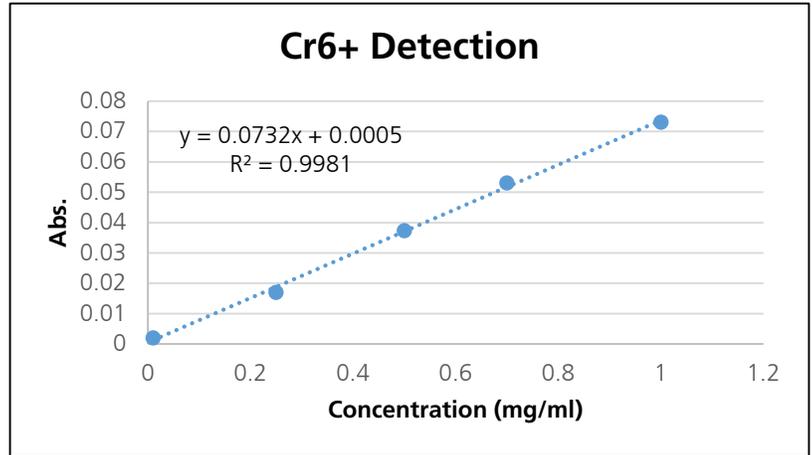


Figure 2: Calibration curve of hexavalent chromium from 0.01 mg/mL to 1 mg/mL

Nitrate was analyzed using the NECi Superior Enzymes Low Range Nitrate Test Kit (SKU: NTK-TTLR-100, Superior Enzymes, Lake Linden, MI) that is modified from Validated Method (ATP Case No. N07 -003) based on the reduction of nitrate to nitrite with NADH. The UV-1280 spectrophotometer was equipped with a 10mm path length semi-micro cuvette and holder and 1.4 mL of sample was used. The absorbance of various concentrations of nitrate ranging from 0.05ppm to 1.0ppm were recorded. After the development of color, absorbance readings were taken at 540nm. The curve shown in Figure 3 shows the ability of the instrument to detect all the concentration ranges tested with potential to measure higher concentrations easily.

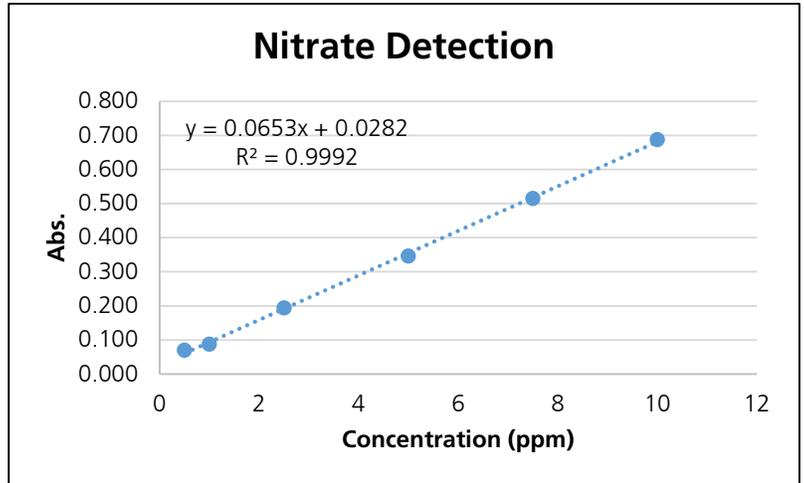


Figure 3: Calibration curve of Nitrate standards from 0.1 ppm to 1.0 ppm

■ Conclusion

Shimadzu's UV-1280 offers users the ability to analyze nitrate, phosphate, and chromium in water samples, even at low concentrations. These analytes can be easily and effectively quantitated in drinking water, waste water and ground water using this technology.

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