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# Nitrogen, Nitrate

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For water and wastewater

Cadmium Reduction Method

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## Introduction

Nitrate represents the most completely oxidized state of nitrogen, and is commonly found in water. Nitrate-forming bacteria convert nitrites into nitrates under aerobic conditions; lightning converts large amounts of atmospheric nitrogen ( $N_2$ ) directly to nitrates. Many granular commercial fertilizers contain nitrogen in the form of nitrates.

High levels of nitrate in water may indicate biological wastes in the final stages of stabilization, or run-off from heavily fertilized fields. Nitrate-rich effluents discharged into receiving waters can degrade water quality by encouraging excessive growth of algae. Drinking waters containing excessive amounts of nitrates can cause infant methemoglobinemia (blue babies). For this reason, a maximum concentration level in drinking water has been established by the USEPA in accordance with the Safe Drinking Water Act.

Two methods of analysis are used in the high range tests. The NitraVer™5 high range method is a modification of the Cadmium Reduction Method, using gentisic acid in place of 1-naphthylamine. All the necessary reagents have been combined into a single stable powder.

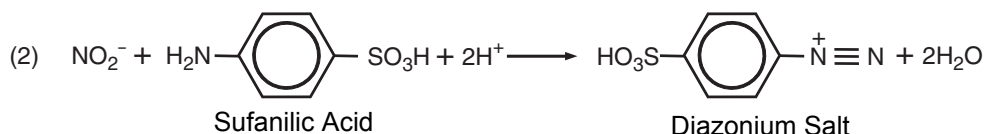
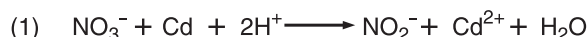
The Chromotropic Acid high range nitrate method involves the reaction of nitrate in a strong acid medium with chromotropic acid. The final reaction mixture is contained in the screw-capped Test 'N Tube™ vial.

The low range nitrate test is also a modification of the Cadmium Reduction Method, and uses a very sensitive chromotropic acid indicator. Both methods register nitrate and nitrite nitrogen.

## Chemical reactions

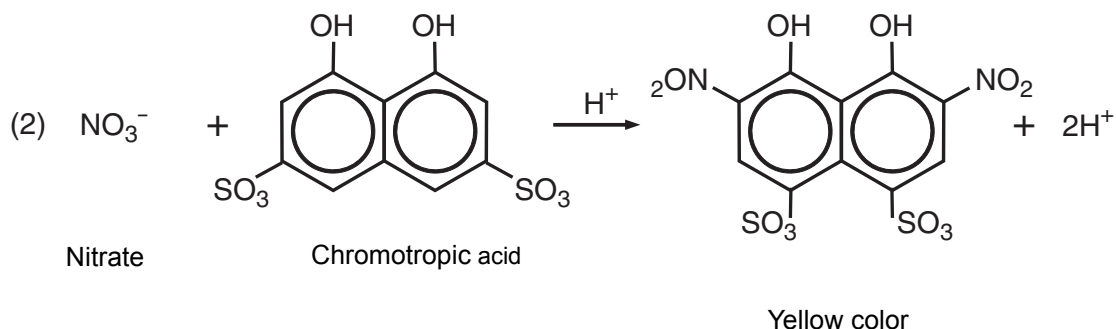
### High range—NitraVer 5

In the NitraVer 5 high range test, cadmium metal is used to reduce nitrates ( $NO_3^-$ ) to nitrites ( $NO_2^-$ ) (reaction 1). Next, the nitrite ions react in an acidic medium with sulfanilic acid to form an intermediate diazonium salt (reaction 2) which, when coupled with gentisic acid (reaction 3), forms an amber-colored compound. Color intensity of the compound is directly proportional to the nitrate concentration of the water sample.



**High range—Chromotropic acid method**

In the Chromotropic Acid test, sample is added to a Test 'N Tube™ vial containing sulfuric acid. This sample/sulfuric acid mixture is used to zero the spectrophotometer. Chromotropic acid is then added as NitraVer X Reagent B. Two moles of nitrate react with one mole of chromotropic acid to form a yellow reaction product, which exhibits maximum absorbance at 410 nm.



**Low range**

In the low range nitrate test, cadmium metal is used to reduce the nitrates to nitrites. The cadmium is provided in NitraVer 6 Reagent Powder Pillows. Nitrite ions react with sulfanilic acid to produce an intermediate diazonium salt, as in the high range test. The diazonium salt then forms a red-orange complex with chromotropic acid. The color intensity is in direct proportion to the nitrate concentration in the sample (reaction 4). In the low range test the sulfanilic acid and chromotropic acid are contained in NitriVer 3 Reagent Powder Pillows.

