NITRATES BY ION CHROMATOGRAPHY

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REFERENCE: Proceedings of the 1991 Georgia Water Resources Conference, held March 19 and 20, 1991, at The University of Georgia, Kathryn J. Hatcher, Editor, Institute of Natural Resources, The University of Georgia, Athens, Georgia.

INTRODUCTION

A major problem in the field of water pollution is eutrophication, excessive plant growth or algae "blooms" resulting from over-fertilization of rivers, lakes, and estuaries. Results of eutrophication include deterioration in the appearance of previously clear waters, odor problems from decomposing algae and lower dissolved oxygen levels which can adversely affect fish life.

Nitrates are one class of nutrients which fertilize Georgia's receiving streams. Their concentration in a waste-water plant's effluent is strictly regulated by the state. It is in the best interest of the environment for the nitrate concentration to be as low as possible. In this paper I shall present a fast, easy to use, inexpensive method for nitrate detection. The method uses chromatography.

WHAT IS CHROMATOGRAPHY?

Chromatography is a separation science. The word, coined by Mikhail Semyonovich Tswett (1872-1919), means "color" (chromato-) "writing" (graphy). Tswett, a botanist, discovered this technique while trying to separate the components of green leaves. He first crushed the leaves, then did a chloroform extraction. He poured this extract down a glass column filled with calcium carbonate. He observed some colored layers and continued to add chloroform and eluted each band when it reached the bottom of the glass tube. This procedure enabled him to isolate the green and yellow bands of chlorophyll "a" and "b". He named this technique chromatography.

People unwittingly practiced chromato-graphy long before Tswett gave it a scientific name. One of the most popular applications is the removal of fusel oils from raw, freshly-distilled whiskey. The charred inside of the hardwood barrels separates the irritating chemicals from the ethyl alcohol. The pharmaceutical industry is one of the biggest modern users of this separation science which uses it to purify drugs.

While there are many types of chromatograhy (e.g. liquid, gas, thin layer, etc.), they can all be understood as applications of differential migration. I.e. different compounds move through a column at different speeds.

INSTRUMENTATION REQUIRED

Let's look at a typical chromatography system. In basic terms all that is required is: (1) a pump, (2) a solvent reservoir, (3) an injection valve, (4) a column, (5) a detector, and (6) a re-cording device. In our nitrate/nitrite application we add a membrane suppressor to attenuate background noise. The solvent system costs less than five cents/day to operate. It is a very weak solution of baking soda and soda ash ($NaHCO_3$ and Na_2CO_3). And how long does it take to obtain your total nitrogen as nitrate/nitrite? - less than five minutes!

ADVANTAGES OVER THE OLD METHOD

I designate EPA's Method 353.1 the "old" method. This is the colorimetric, automated hydrazine reduction technique which we have used for years. Chromato-graphy offers many advantages - speed, ease of use, and economy. The system also simultaneously tests for fluoride, chloride, sulfate, phosphate, and other anions in drinking water and wastewater. The detection limit (0.01 ppm) for nitrate/nitrite is far lower than our plant permit limits (typically about 5 ppm). This enables the chemist's detector to work in a noise-free attenuation range and produce good, stable baselines.

SITE VARIANCE

This application, EPA's Method 300.0 ("The Determination of Anions in Water by Ion Chromatography") is approved for drinking water and can be used in a wastewater plant for effluent monitoring after obtaining a site variance. According to the EPA this process does not take very long (1 - 3 months after you

mail in the application) because you are simply asking permission to use an EPA method at your plant. It took us about one week of part-time lab work to collect the data for the application. Contact Gene Slaton at the Georgia Dept. of Natural Resources (404-656-7400) for further information on site variance procedures.

SUMMARY

To sum up, nitrate/nitrite testing by ion chromatography gives the analyst greater speed (three times faster), greater economy (less than 1/10th the re-agent cost) and multiple testing capability with only one injection. In this paper's appendix there is a tabular summary which compares the two methods.

LITERATURE CITED

EPA Method 300.0, "The Determination of Inorganic Anions in Water by Ion Chromatography."

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