THE MEASUREMENT OF DANGEROUS ORGANIC MATERIALS IN WATER BY GAS CHROMATOGRAPHIC METHODS.

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ABSTRACT: Four dangerous organohalogen materials, which are expected to be in water have been studied chromatographically after finding the most suitable conditions for the analysis. These four compounds are: chloroform, bromoform, trichloroethane and methylene chloride, which are classifiedi as carcinogenic. Drinking and river water samples have been analyzed daily. An interpretation was suggested for the results comprehensively to cover all the results obtained.

INTRODUCTION:

Water supply and sanitation are an integral part of the infrastructure of any country, such systems have been symbols of progress and prosperity of any country throughout history.

There are some water born diseases like cholera, typhoid, hepatitis and poliomyclitis. The organisms that cause these diseases can be controlled by chlorine:

$$Cl_2 + H_2O \rightleftharpoons HOCl + HCl$$

$$HOCl \rightleftharpoons H^+ + OCl^-$$

both HOCl and OCl^- are capable of disinfection and the concentrations of the two species are equal at PH = 7.5. The efficiency of HOCl is much higher than OCl^- and that is why it is preferable to have a PH less than (PH = 7.5) in order to shift the equilibrium to the left. Drinking waters could be contaminated by chloroform and chloroform-like substances, these are called trihalomethanes (THM,S) which impose a serious problem. These materials suspected to be carcinogenic and they enter water when it is disinfected by chlorination in the presence of some organic materials. Since these compounds are reported as carcinogenic, control levels as low as 5 µg/l are being specified by various countries.

EXPERIMENTAL PART:

Reagents: Source and purity:

Choroform stabilized with ethanol (puriss) of Fluka, trichloroethane (puriss) of Merck, methylene chloride of Uvasol (99.5%) and bromoform (Puriss) of Fluka were used to prepare standards in distilled water.

Instruments

Pye Unicam GCV chromatograph equipped with electron capture detector, 1% PEG - 20M column and pure argon as a carrier gas (40 ml/ min) was used for the analysis.

Procedure:

•Stock solutions for the materials under investigation in methanol were prepared (20 g/l). ••A Primary aqueous standard for all solutions were prepared from the stock solutions. 0.3 µl of all samples were injected using Hamilton syringes of 1µL size and equipped with an adjustable device. A concentration of as low as 0.001 ppm was reached for bromoform, 0.00002 ppm for both chloroform and trichloroethane. For methylene chloride the detection limit was only 0.01 ppm. The standard deviation was estimated and an error of less than 1% was found for all measurements.

•stock methanol solutions are stable for six months at 4°c.

••Primary aqueous solutions are stable for one month at 4°c.

RESULTS AND DISCUSSION:

Table I. Example results

NO.	Sample	Concentration(ppm) $CHBr_3$	$CHCl_3$	CH_3ccl_3
1	Drinking Water	0.0081	0.0002	less than 0.00002
2	=	0.0031	less than 0.00002	0.0018
3	=	0.0038	0.0007	0.0001
4	=	0.0192	0.00004	0.0001
5	=	0.0150	less thon 0.00002	0.002
6	River water	—	0.00004	0.0002
7	=	—	0.0002	0.0010

It seems from literature that there is no international agreement on a definite value for the maximum allowance of trihalomethanes, it varies from 0.025 - 0.350 ppm depending on the legistillation applied in each country. All the concentrations of chloroform and trichloroethane found in river waters are much lower than the maximum allowed value (they vary from 0.0001 to 0.0003 ppm). Also all the values obtained for drinking water over different periods are much less than the maximum allowed value. This indicates that the disinfection by chlorine according to the procedure applied by the water supply station does not impose any problem. According to literature the concentration of many dangerous organic Compounds can be reduced to a great extent by applying chemical reduction using a catalyzed metal powder as a reductant. Some experiments have been done by using the reductants: iron, zinc and aluminum. According to our results zinc was found to be the most efficient one, although iron is cheaper and more available. As 100 ppm of bromoform is reduced to 22.20 ppm by using iron and to 2.70 ppm by using zinc applying exactly the same procedure in both cases.

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