NEUTRON ACTIVATION AND MASS SPECTROMETRIC MEASUREMENT OF $^{129}$I

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An integrated procedure has been developed for measurement of $^{129}$I by neutron activation analysis and mass spectrometry. An iodine isolation procedure previously used for neutron activation has been modified to provide separated iodine suitable for mass spectrometric measurement as well. Agreement between both methods has been achieved within error limits. The measurement limit by each method is about $10^7$ atoms /2 fg/ of $^{129}$I.

INTRODUCTION

Iodine-129 is one of the longest-lived fission products of major interest to the nuclear industry$^1$. Measurements of environmental $^{129}$I have been made for many years by neutron activation analysis /NAA/.$^2-^5$. The neutron

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activation method requires a nuclear reactor for neutron irradiation and radiochemistry facilities for post-irradiation processing of samples. The desirability of eliminating the need for such facilities led to early efforts by McHugh and Sheffield to develop a mass spectrometric method for iodine isotopic analysis. In their work, interfering contaminants limited measurement sensitivity for $^{129}$I to about 1 ppm of the natural $^{127}$I. This sensitivity is not adequate for the measurement of $^{129}$I in many environmental materials.

More recently, Delmore used negative surface ionization mass spectrometry (MS) to measure fission product iodine in which $^{129}$I was the major isotope. He also measured the background level in the mass spectrum of natural $^{127}$I which indicated the feasibility of extending measurement sensitivity beyond 1 ppm. Stoffel subsequently demonstrated the ability of negative surface ionization mass spectrometry to measure trace levels of $^{129}$I /Ref. 8/. His measurements were limited to pure iodine compounds prepared in the laboratory.

Further work at the Pacific Northwest Laboratory to develop procedures for extracting iodine from environmental and other materials in a form and purity suitable for both NAA and MS has now been completed. The work reported here provides an integrated procedure for the measurement of $^{129}$I by both methods. Measurements of $^{129}$I at levels down to the measurement limit of the methods are also reported.

MATERIALS AND METHODS

Steps in the integrated procedure for $^{129}$I measurement by neutron activation analysis and mass spectrometry are given in Fig. 1. Each step is discussed below.