Simple Technique for the Measurement of ^{131}I in Water Samples via NaI Detector

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One of the most unequivocal ways to ascertain the rates and pathways through a hydrological system and to link specific sites of contamination to discharge points is via artificial tracers. We are currently using I-131, as well as other natural and artificial tracers, as a groundwater tracer in the Florida Keys. Ultimately, we hope to provide information on the pathways and fate of wastewater-borne nutrients which are continually discharged into the karst limestone strata.

Radio-iodine (I-131) was considered an excellent tracer for this work since (1) it has extremely low detection limits, especially on a atomic (molar) basis; (2) the sensitivity is high; (3) it has a relatively short half-life (8.04 days), completely disappearing from the system; and (4) is considered conservative under the conditions present. In order to use this isotope in the field, it was necessary to develop a procedure that was simple, quick, and inexpensive. Majority of the present procedures use an ion-exchange column and determine the I-131 yield gravimetrically or consider the recovery to be quantitative. However, increased ionic strength of a solution may inhibit accurate estimation of the yield using these methods. Since most of the water we would be analyzing would be saline, a different approach had to be taken. The procedure described in this presentation was originally designed to be used with geothermal waters of moderate salinity and allows for the measurement of I-131 using I-129 as a reference for the recovery.

Water samples containing I-131 and a known amount of I-129 are put through a series of oxidation/reduction steps to adjust the oxidation state of the radioactive and stable iodine carrier (**Figure 1**). Once in the correct oxidation step, the iodine is then precipitated as AgI in a slightly acidic solution. Depending on the matrix of the sample, other silver compounds may co-precipitate with the iodine. Many of these may be redissolved during the filtration process. In addition to the radiometric determination of the recovery, samples may be filtered through preweighed filters for a gravimetric yield determination.

Flow Chart for I-131 Analysis

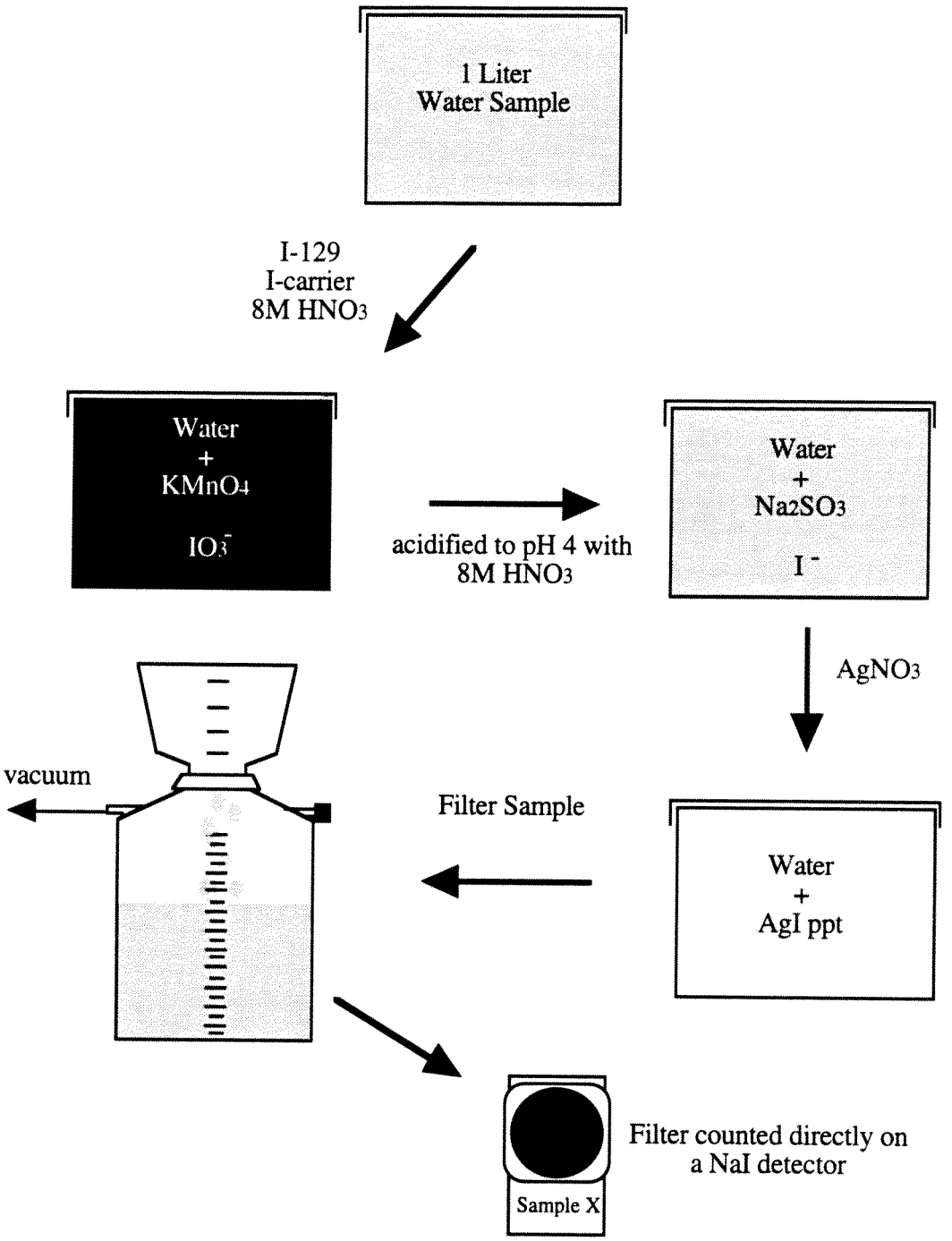

Figure 1: Flow chart for I-131 analysis.

Filtered samples can then be counted on a NaI detector for the quantification of both I-131 and I-129 (**Table 1**). A simple equation may be used to estimate the number of I-131 counts in the I-129 counting region. Taking the low energy I-131 counts into consideration, the radiometric yield can be and the I-131 sample activity may be estimated. This presentation will show complete details of the procedure described here and present relevant data from a field experiment using I-131 as an indicator for groundwater movement.

Table 1: Energies and corresponding abundance of relevant gamma emissions from I-129 and I-131.

I-129		I-131	
Energy (keV)	Abundance (%)	Energy (keV)	Abundance (%)
29.46	20.4	29.46	1.42
29.78	37.8	29.78	2.64
33.61	10.2	284.30	6.06
34.606	2.42	80.18	2.62
39.57	7.5	364.48	81.2