WSRC-MS-96-0385
CONF-961103--4

# A Programmable Autosampler for a Field Deployable Tritium Analysis System

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A document prepared for ANS WINTER MEETING: SPECIAL SESSION ON IN-SITU TRITIUM MONITORING at Washington from 11/10/96 - 11/15/96.

DOE Contract No. DE-AC09-89SR18035

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## Introduction

The analysis of tritium in environmental water samples typically involves collecting water from the field source, transporting the samples to a laboratory, processing the samples, and finally analysis with a liquid scintillation counter. This technique is both labor-intensive and costly. Personnel at the University of Georgia's Center for Applied Isotope Studies (CAIS) are developing a field deployable tritium analysis system that offers remote control capabilities, coupled with sensitivities comparable to laboratory-based liquid scintillation counting systems. (1) Researchers in the Environmental Technology Section of the Savannah River Technology Center, in cooperation with Sampling Systems, Inc. are developing a fully programmable, remotely operated, fixed volume, automatic sampler for use with the field deployable tritium analysis system currently under development at CAIS.

## Description

The autosampler is designed to collect 50 mL water samples on-demand from up to 8 ports. By limiting the sample volume, minimum quantities of radionuclides or other contaminants are removed from the source which reduces the amount of waste generated by the analysis process. The sampling apparatus is designed to pre-filter the water with a size-exclusion frit, prior to introduction to the on-line purification system. The anions, cations, and organic impurities in the sample are then removed by passing through a commercially available cleanup column. Multiple columns are housed in a pneumatically actuated carousel that has a 16 cartridge capacity. An aqueous sample is pumped through a column at a rate of ~ 5 mL per minute to decrease load time. The first 20 mL aliquot of eluent is automatically discarded, and the subsequent 10 mL fraction is delivered to a sample reservoir equipped with a capacitive level-sensing device. The remainder of the eluent is automatically diverted to waste. Once the meniscus sensing apparatus is triggered, an output signal is sent to the tritium analysis system, which then prompts a valve/pumping sequence to transfer the purified sample to the counting cell for liquid scintillation counting. Figure 1 shows a schematic of the autosampler.

## Experimental

The commercially available "Tritium" columns (EIChroM Industries, Inc.) were tested for their applicability to automated use in the proposed field sampler. The columns are designed to remove the matrix elements from solution, resulting in a column effluent similar in complexity to a sample that had been prepared for tritium analysis by distillation. Capacity studies showed that column performance did not significantly degrade with sample

volumes up to 50 mL, even when starting with a seawater matrix saturated with chlorinated hydrocarbons, under gravity flow conditions (about 0.5 mL/minute). At flow rates greater than 10 mL/minute, however, some break through of matrix ions was evident. A flow rate of 5 mL/minute was thus chosen as optimum for column performance and sample throughput. As the resin in the columns is stored in water, the first several milliliters of sample eluting from the column is somewhat diluted. Laboratory studies showed that an equilibrium was established after 15 mL of sample had passed through the column. It was therefore decided to discard the initial 20 mL of sample through the column to avoid the dilution effect. A typical tritium analysis operation requires 10 mL of sample so that at least one duplicate analysis can be run from a single 50 mL sample.

## Conclusions

A remotely operated system has been developed to collect a limited-volume sample and perform on-line sample purification for tritium analyses from multiple collection sites. Pneumatically operated stainless steel samplers were found to operate satisfactorily upon remote activation. A one-step purification system was developed to remove all impurities which interfere with the tritium analysis by liquid scintillation methods. Field testing has confirmed the operation of the system. The autosampler may act as a stand-alone device, and is enclosed in a rugged, field portable case equipped with wheels for ready transport. The sampling/purification system weighs approximately 40 pounds.

## References

1. J. E. Noakes, J. D. Spaulding, M. P. Neary, University of Georgia and M. S. Wasyl, Packard Instrument Company, "Development of a Remotely Operated, Field Deployable Tritium Analysis System for Surface and Ground Water Measurements", ANS Transactions, Washington, DC Winter Meeting, 1996.

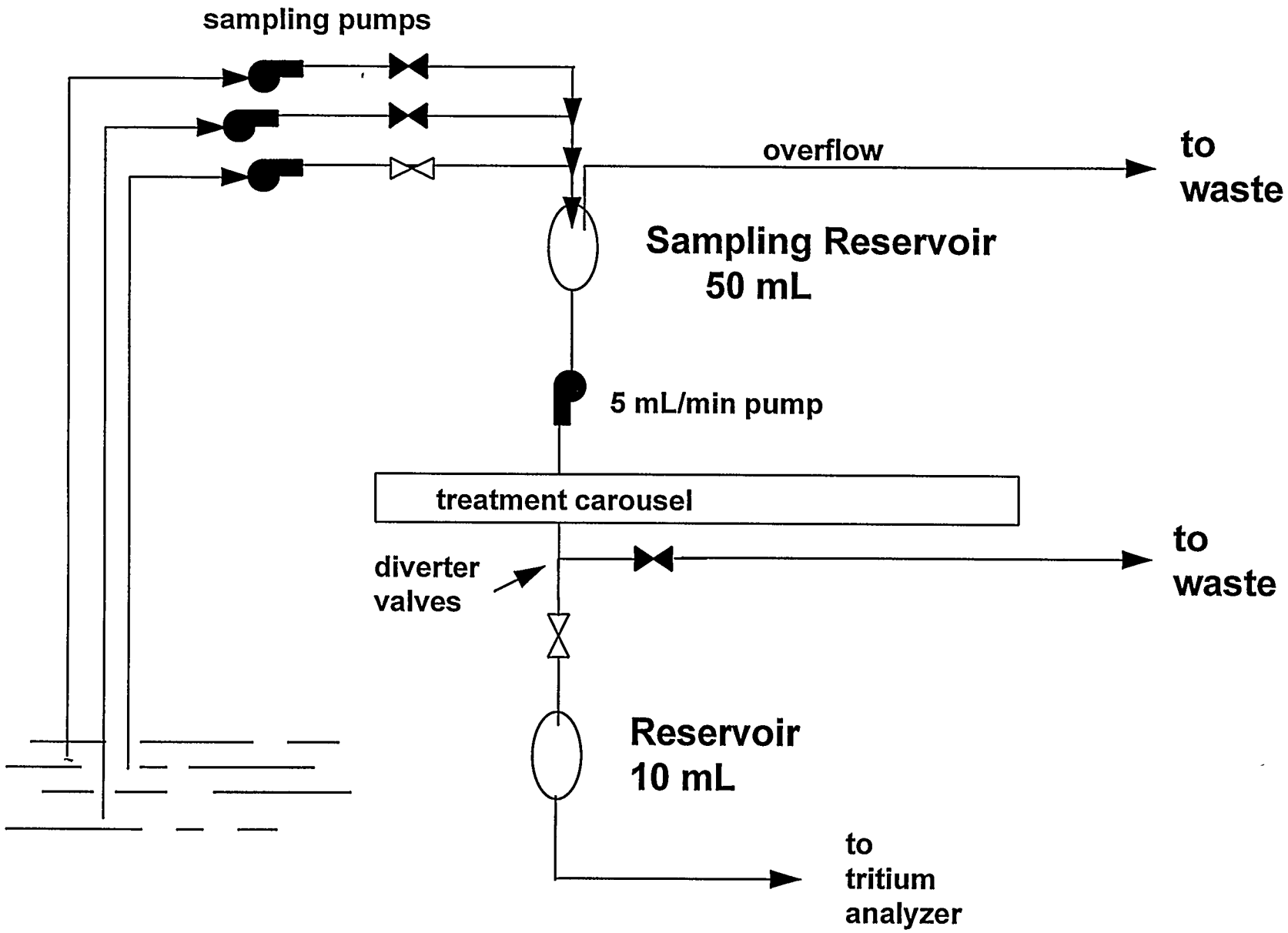


Figure 1. Multi-port autosampler and water treatment system.