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A Portable Concentrator for Processing Plutonium Containing Solutions*

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Many DOE facilities that have handled large quantities of aqueous plutonium solutions are being deactivated. Draining and flushing of the equipment used to process these solutions (piping, tankage, gloveboxes, ventilation ducts, etc.) are expected to generate substantial quantities of liquids containing accountable quantities of plutonium. A portable, modular unit is needed that can process a variety of these solutions with minimal systems reactivation. This unit would be capable of handling acidic and basic solutions and slurries with plutonium concentrations ranging up to 100 grams per liter. The system must also be criticality safe and be capable of producing high decontamination factors (i.e. low contamination levels in the distillate).

Artisan Industries, Inc. (Waltham, MA) manufactures a compact, horizontal agitated-film concentrator called a Rototherm (see Fig. 1). This unit is designed to concentrate liquid streams to a high-solid-content slurry. Steam is typically used to heat the concentrator body, where an internal bladed rotor creates a thin turbulent film on the evaporator surface, causing the liquid to vaporize. The vapor then flows into the vapor/liquid separation region, where entrained liquid is removed from the vapor stream by mesh pads.

The Rototherm's horizontal design with internal rotor allows it to evaporate solutions to high-solid content. Rototherms have been used to concentrate streams containing foaming detergents, alkaline permanganate, ammonium citrate, boric acid, sodium nitrates, carbonates, sulfates, hydroxides, and aluminates. Feeds have ranged from 0.01% total solids (dissolved plus suspended) to greater than 35% total solid. Capabilities for evaporating 98+% of the water present in a single pass have been demonstrated. Thus, considerable volume reduction is possible. In general, Rototherms can be operated continuously without shut downs for cleaning and maintenance, making them very attractive for radioactive service, where maintenance and cleaning are difficult.

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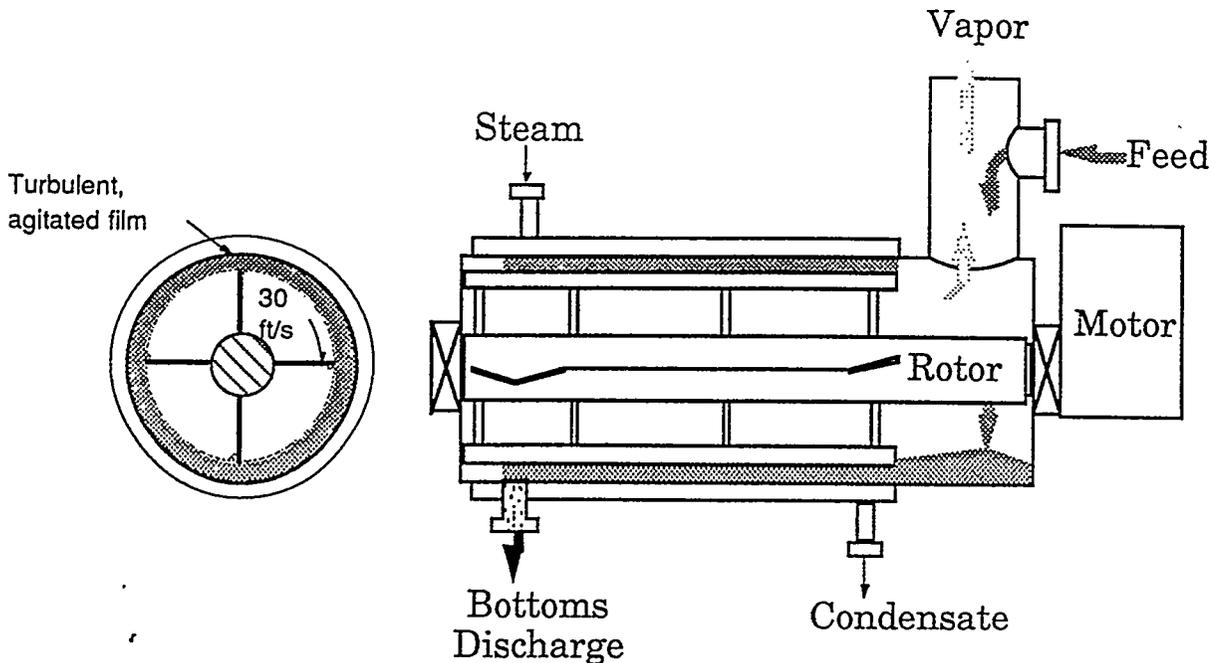


Fig. 1. Artisan Rototherm Concentrator.

The Rototherm is designed for minimal solution holdup. This makes it ideal for processing solutions where criticality is a concern. The entire unit can easily be made criticality safe by geometry by keeping all pipe diameters less than 15 cm (6 in.). A criticality-safe unit has been built for the Rocky Flats Plant.

The glovebox or lightly shielded concentrator system is being designed to be portable (modular), efficient, criticality safe by geometry, and self contained (only electrical power required) to generate a distillate product that is essentially free of activity. An initial design of such a system is shown in Fig. 2. Because of the criticality safety requirement, the diameter of the Rototherm body is expected to be less than 15 cm (6 inches). Typical throughput for units of this size (5 ft^2 heat transfer surface area) is about 170 L/hr. Decontamination factors in the range of 10^6 - 10^7 are expected with this system.

Another area of interest to potential users is the processing of decontamination solutions that will be generated throughout the DOE complex. One such area is in the decontamination of the gaseous diffusion plants. The use of gaseous reagents to clean these systems is expected to be very slow; treatment times on the order of 6 months may be common. Use of aqueous decontamination solutions would greatly speed up the cleanup process, but aqueous waste treatment systems are not available in these facilities. Use of a portable concentrator to recycle reagents and minimize waste generation may be very applicable.

Results from simulant tests to determine the applicability of this unit for these types of service are discussed. In addition, the conceptual design for a portable concentrator system is described.

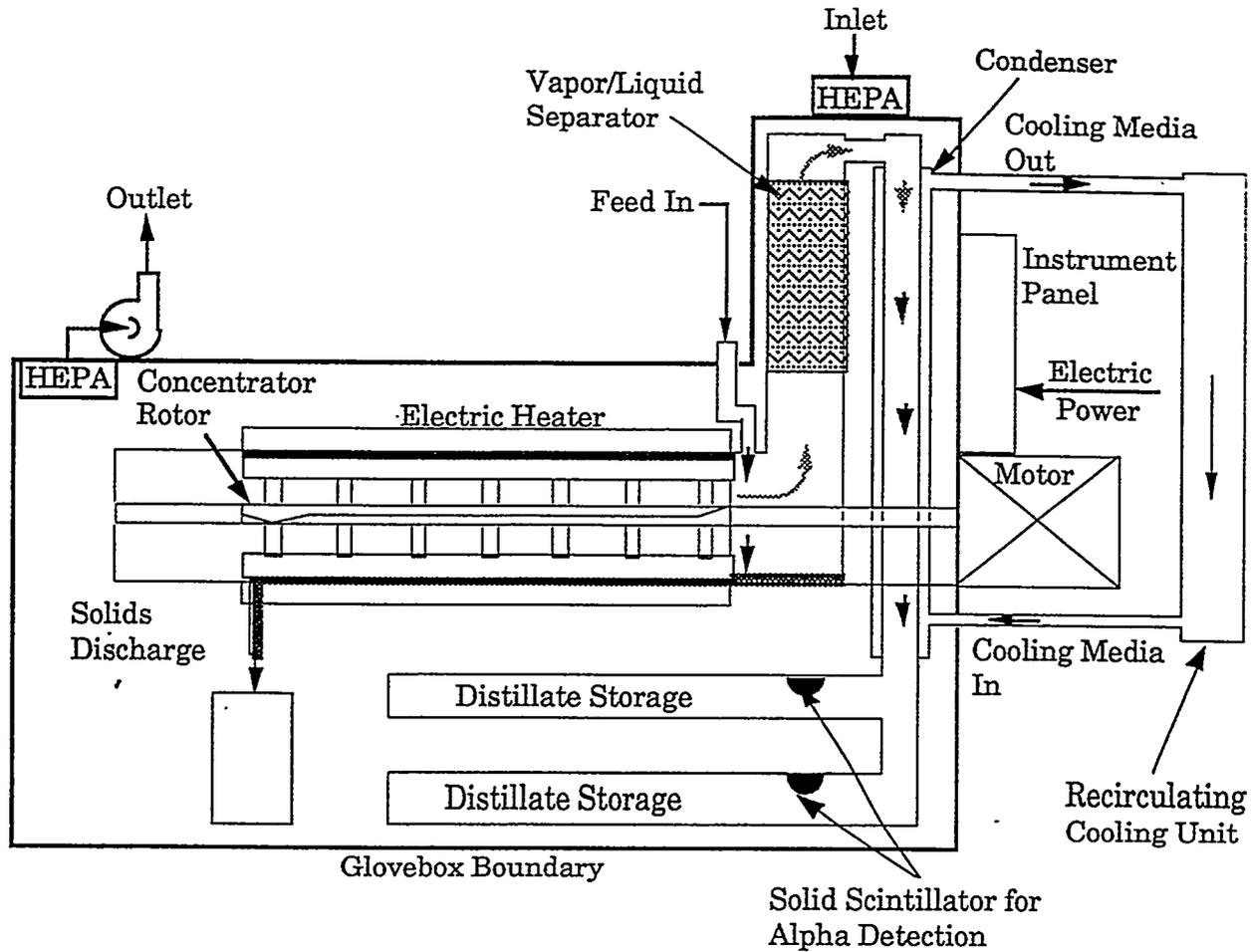


Fig. 2. Initial Concept, Mobile Concentrator System

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