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3,404,722

DISPOSABLE RADIOACTIVE LIQUID WASTE CONCENTRATOR

Filed July 19, 1966

Fig. 1

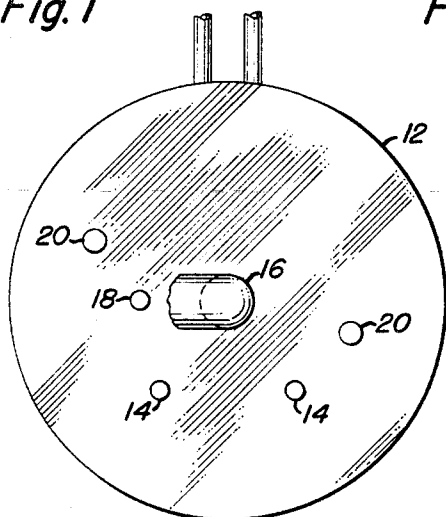


Fig. 3

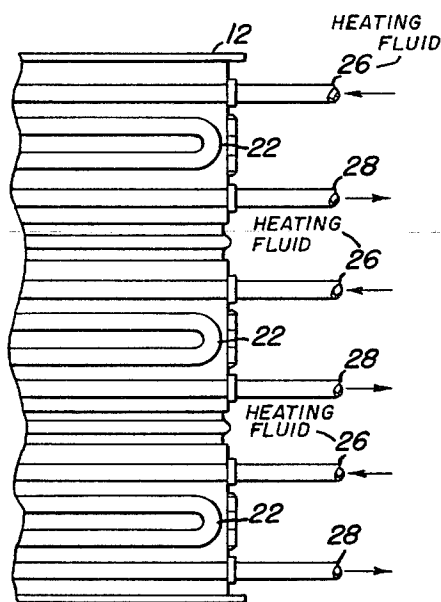


Fig. 2

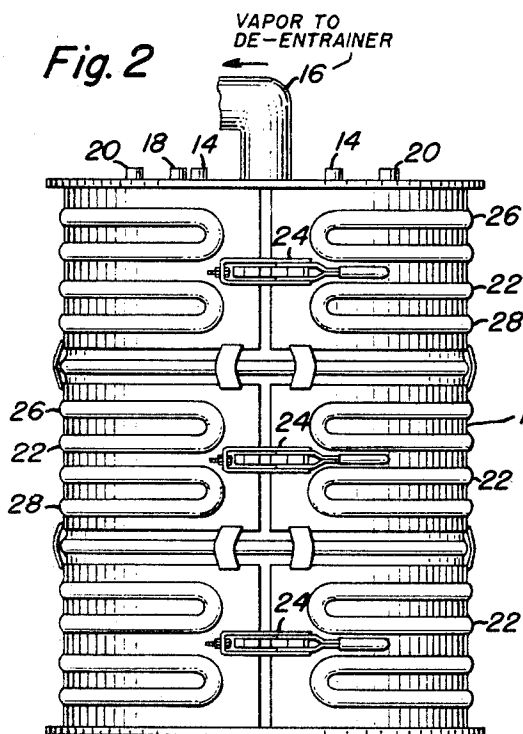
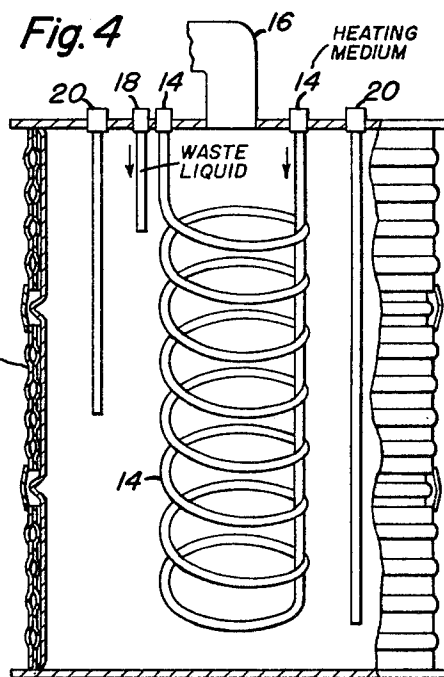


Fig. 4



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DISPOSABLE RADIOACTIVE LIQUID WASTE CONCENTRATOR

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4 Claims. (Cl. 159—23)

The invention relates to an apparatus for concentrating low-level liquid radioactive wastes. The treated liquid can be discharged to the environment; the concentrate is buried at designated burial sites.

Radioactive waste solutions are produced from all kinds of chemical separation processes of radioactive materials, from reactor operations and from research utilizing radioactive materials. These aqueous waste solutions may contain (1) radioactive fission products or induced activities in a dilute form (2) salts, such as nitrates, halides, or sulfates, and (3) reducing or oxidizing agents; as a consequence they may also contain decomposition products formed by a reaction of the reducing or oxidizing agents.

These dilute waste solutions as such are not suitable for disposal; they are too voluminous and hazardous for local disposal, and it is too costly to solidify and transport such large volumes. In the event of a container failure, radioactive liquids could gradually contaminate the environment by diffusion; burial of radioactive liquids is prohibited. It is therefore desirable to reduce the bulk of the waste solutions and to concentrate the radioactive materials to a high solids content by evaporation.

In accordance with my invention, the concentrator or evaporator vessel is very mobile; the unit may prove very useful and economical for atomic installations, hospitals, universities, and laboratories where the accumulation of liquid radioactive wastes is relatively small. In such places, the high cost of shipping wastes to central locations for concentration and disposal can be greatly reduced by the installation and use of this evaporation unit or by the periodic use of a portable unit. Moreover, it is believed that the use of disposable evaporation drums will greatly reduce the hazards and labor involved in handling the concentrated radioactive residues.

It is an object of this invention to provide an arrangement whereby a standard commercial oil drum is used as the evaporator vessel.

It is an object of this invention to provide an evaporator vessel for the evaporation of radioactive waste solutions in which the removal of accumulated radioactive scale and sludge is eliminated. The removal of radioactive scale from standard evaporators is costly, time consuming, and hazardous.

Another object of this invention is to provide a disposable evaporating vessel which will reduce the hazards and labor involved in handling radioactive residues.

It is finally an object of this invention to function the evaporating unit until an 80% solids content is collected in the evaporator vessel or disposable drum.

According to the invention, liquid evaporating apparatus comprises an upright disposable drum having a removable head which serves as the evaporator vessel. The removable head is a permanent part of the evaporating unit. The head has clamps, a waste influent, an immersion heater in thermal association therewith, liquid level controls, and a vapor outlet. Three pairs of heating jackets or mantles surround the exterior of the disposable drum and said heating units possess a heating fluid inlet and a heating fluid outlet for each jacket or mantle.

An embodiment of the invention will now be described with reference to the figures of the drawing accompanying the specification.

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FIGURE 1 depicts a top view of the unit's removable head.

FIGURE 2 depicts a front view of the disposable drum with individual connecting heating packets or mantles.

FIGURE 3 shows the heating fluid inlets and outlets of the heating jackets or mantles.

FIGURE 4 shows a cross sectional view of the interior of the drum with all its appendages or constituents.

The evaporation unit is based on the use of a commercial 55 gallon carbon steel disposable drum or oil drum as shown at 10 in FIGURES 2 and 4, which serves as the evaporator or concentrator body. The drum as shown at 10 is equipped with a removable head as shown at 12, FIGURE 1, which is a permanent member of the evaporation unit. The drum as shown at 10 is equipped with an internal steamheated coil 14, a vapor outlet 16, a radioactive waste influent 18, two liquid level controls 20, and eight clamps (not shown) that attach the drum 10 to the head 12 which are all permanent appendages of the head as shown at 12, FIGURE 1. The drum as shown at 10 in FIGURES 2 and 3 is equipped with three pairs of external steam-heated jackets or mantles 22 which are held tight against the drum 10 by means of a locking device 24. Each section of the external heating jacket or mantle 22 has a heating fluid inlet 26 and a heating fluid outlet 28.

The liquid level controls and the steam-heated jackets are commercial items, i.e. the "Level-Tek" liquid level controller from Robertshaw Controls Company, Anaheim, Calif., and the drum warmer model M55 from Tranter Manufacturing, Inc., Lansing, Mich.

The disposable drum, concentrator 10, is equipped with an internal steam-heated coil 14 and an external steam-heated jacket 22. The feed solution (radioactive waste) is stored in a feed tank and is pumped into the evaporator drum 10. The vapors from the drum 10 pass through a deentrainer and are cooled and condensed in a condenser, both of which are not shown. The condensed vapors are collected in an intermediate drum and are pumped periodically (automatically controlled) with a pump through activated carbon cartridges and ion exchange cartridges into a condensate tank. This condensed liquid product meets the required radioactive tolerance levels thus enabling it to be discharged through the daily used sewer system.

When the solution in the drum 10 is concentrated to a minimum of 80% solid contents, the drum 10 is disconnected from the permanent full removable head 12, the steam coil 14 is disconnected and dropped into the drum, absorbant vermiculite or cement is added to the drum to solidify any remaining liquid, and a conventional top is placed on top of the drum. The concentrated waste is now ready for final disposal.

It has been found that the evaporating unit should be operated at a neutral or slightly basic pH to avoid excessive corrosion. The pH adjustment of the solution in the feed tank is controlled by adding small amounts of concentrated NaOH or HCl through an opening in the cover of the feed tank.

The instruments incorporated in the unit provide for automatic or manual operation. The automatic safety devices assure safe operation. The main indicators and controls are located on a central control panel which is not shown.

It will be understood that this invention is not to be limited by the details given herein, but that it may be modified within the scope of the appended claims.

I claim:

1. Apparatus for concentrating low level radioactive wastes comprising:

(a) a single use evaporator vessel having a removable head

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- (b) said head having mounted thereon an influent inlet for radioactive waste, a vapor outlet, a steam-heated immersion heater and liquid-level sensors
 (c) an external cylindrical heating means encompassing said evaporator vessel
 (d) said last mentioned heating means having an inlet and outlet for the heating fluid.

2. Apparatus as set forth in claim 1 in which said evaporator vessel comprises a standard 55 gallon drum having one of its disc walls removed.

3. Apparatus for concentrating low level radioactive wastes comprising:

- (a) a single use evaporator vessel having a removable head
 (b) said head having mounted thereon an influent inlet for radioactive waste, a vapor outlet, a steam-heated immersion heater, and two liquid-level sensors
 (c) a plurality of pairs of cylindrical heating jackets encompassing said evaporator vessel in sealing relationship (with said evaporator vessel)

- (d) each of said heating jackets having an inlet and outlet for a heating fluid.

4. Apparatus as set forth in claim 3 in which said evaporator vessel comprises a standard oil drum having one of its disc walls removed.

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