March 14, 1972 J. A. HUNTER ET AL 3,649,470

HOT BRINE SEEDING TECHNIQUE TO INCREASE FLASHING EFFICIENCIES IN MULTISTAGE FLASH EVAPORATORS

Filed Jan. 28, 1970

FIG. 1

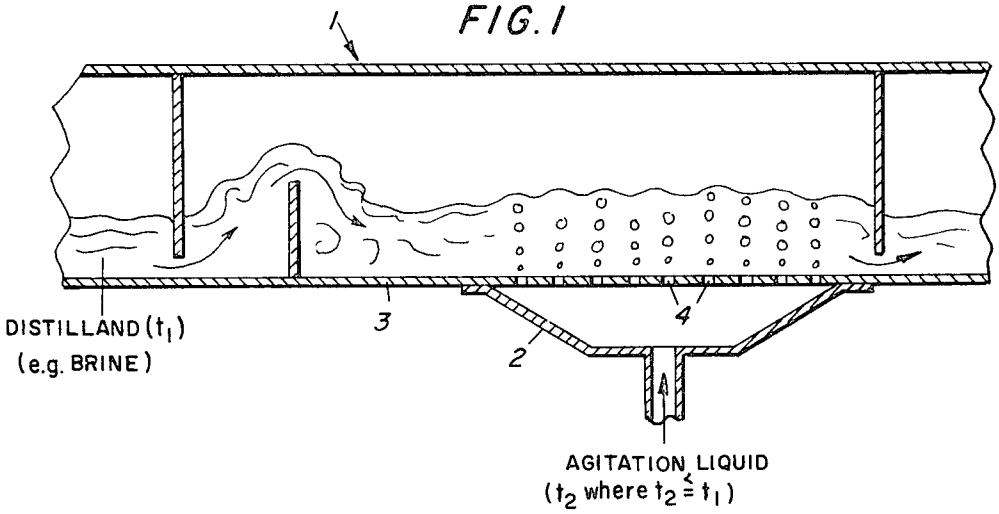


FIG. 2

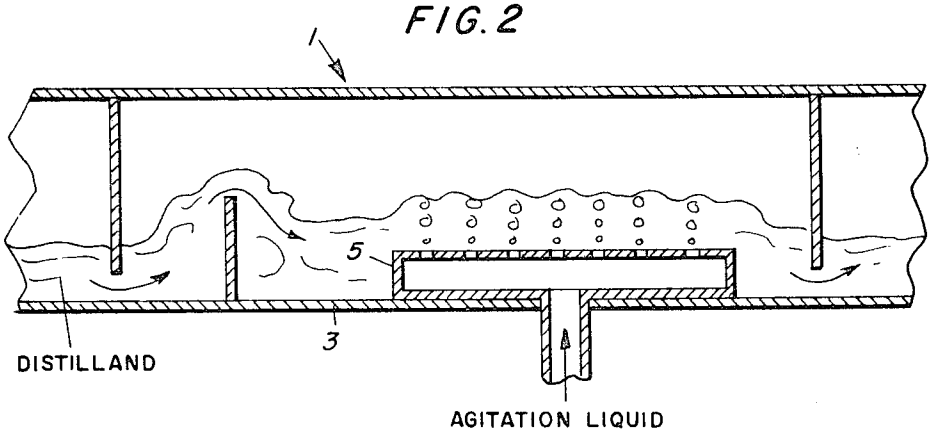
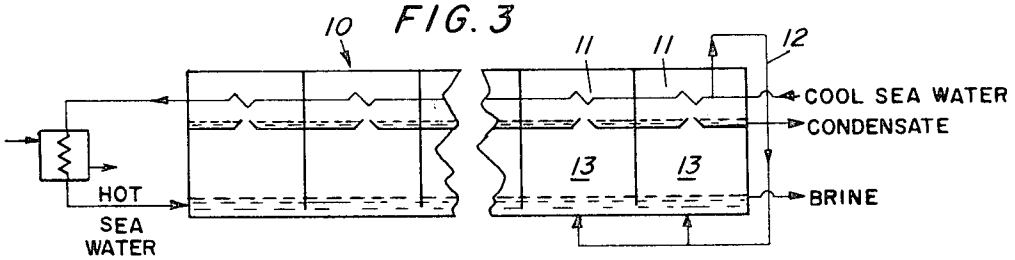


FIG. 3



JACK A. HUNTER
FREDERICK W. GILBERT
INVENTORS

BY Ernest S. Cohen
M. Howard Silverstein

ATTORNEYS

United States Patent Office 3,649,470 Patented Mar. 14, 1972

3,649,470

HOT BRINE SEEDING TECHNIQUE TO INCREASE FLASHING EFFICIENCIES IN MULTISTAGE FLASH EVAPORATORS

Jack A. Hunter, La Jolla, Calif., and Frederick W. Gilbert, Old Saybrook, Conn., assignors to the United States of America as represented by the Secretary of the Interior

Filed Jan. 28, 1970, Ser. No. 6,641
Int. Cl. B01d 3/00, 3/02; C02b 1/04
U.S. Cl. 203—11 10 Claims

ABSTRACT OF THE DISCLOSURE

To enhance flashing in a stage of multistage flash distillation unit, small amounts of liquid, at the same or a lower temperature than the distilland in the stage, are injected below the level of the distilland.

This invention relates to the operation of a multistage flash evaporation or distillation system.

In the high temperature stages of a multistage evaporator where the pressure differential between adjacent stages is significantly high, flashing vapor is released with explosive-like force. In this region the evaporator will operate at almost 100% flashing efficiency. As the distilland travels down the evaporator train to successive low temperature stages, the pressure differential between adjacent stages decreases. With this reduced pressure differential, the flashing becomes less violent and incompete flashing occurs whereby substantially less distillate is produced in comparison to calculated amounts on a theoretical basis. Tests have shown that in these lower temperature stages a vertical temperature gradient exists within the body of distilland in each stage, with the hottest portion of the liquid being along the bottom of the body.

Heretofore, to reduce this gradient and to achieve better mixing and breaking up of these thermal layers in the distilland, baffles, weirs and other turnoved devices have been employed in an attempt to get the hottest layer to the surface where vapors can be more readily released.

I have now discovered that such agitation and turnover can be accomplished by simply injecting into the lower portion of the distilland in a particular stage a small amount of liquid at a temperature equal to or lower than the average distilland temperature in the stage. The liquid is injected transversely to the direction of flow of distilland, and is directed toward the distilland-vapor interface in the stage. Any liquid which will not adversely effect the products of distillation or evaporation can be employed. Preferably the liquid is distilland from another part of the system. Such liquid when injected acts as an agitating medium and produces turnover of distilland in the evaporator, and results in improved flashing efficiency. It is important that the injected liquid be at a temperature no higher than the average distilland temperature in the stage. Otherwise there is a significantly less increase in efficiency. When the liquid is warmer than the distilland, it is believed that the liquid vaporizes too readily and thereby loses some of its ability to act as an agitating and turnover medium.

It is therefore an object of the present invention to increase flashing efficiency in a multistage flash evaporator. Another object is to achieve distilland turnover without the use of mechanical devices. Other objects and advantages will be obvious from the following more detailed description of the invention taken in conjunction with drawings in which:

FIG. 1 is a cross-sectional view of an embodiment of an apparatus suitable for carrying out the process of the present invention;

FIG. 2 is a cross-sectional view of an alternative embodiment of the apparatus; and

FIG. 3 is a schematic of a distillation system employing the present invention.

In the practice of the invention, as shown in FIG. 1, the liquid is conveyed to the evaporator stage **1** by, for example, a manifold **2** attached to the bottom wall **3** of the evaporator, and enters the evaporator through orifices **4** in the bottom wall, or, as shown in FIG. 2, the liquid is conveyed to the stage through an orificed pipe **5** submerged in the bottom portion of the distilland in the evaporator. The orifices direct the liquid transversely to the flow of distilland, and toward the distilland-vapor interface in the stage. Preferably, the angle of injection is approximately 90° to the direction of distilland flow and to the distilland-vapor interface. Only very small quantities of liquid are required, e.g., it is fed at a rate equal to from about 1 to 5 volume percent of the total flow rate of liquids (distilland plus agitation liquid) to the evaporator, preferably about 1.5 to 2.5%.

The temperature of the agitation liquid should not be more than about 8° C. (14.4° F.) cooler than the average temperature of the distilland in the stage so that desired heat balances are not disturbed. On the other hand, the liquid should not be at a temperature higher than the distilland temperature so that its ability to agitate the distilland is not minimized. Preferably, the liquid is about 2 to 5° C. (about 3.6 to 9° F.) cooler than the average distilland temperature.

If the liquid is obtained from a source under a higher pressure than the pressure in the evaporator stage, a pump need not be employed for injection. For example, in a long tube vertical-multistage flash combination system as shown in a technical report entitled "C. F. Braun Company Conceptual Design of a 150 mgd LTV Desalting Plant" (printed by the U.S. Government Printing Office), small quantities of distilland from one of the higher pressure stages of the long tube vertical evaporator sections can be fed as the agitation liquid to one of the lower pressure evaporator sections of the multistage flash system. In an ordinary multistage flash system **10** as shown in FIG. 3, a small quantity of the cooling medium passing through the condenser tubes **11** can be tapped off and fed through conduit **12** as the agitating liquid to the evaporator sections **13** in the system. Alternatively, any of the intermediate collection vessels which contain distilland or distillate at requisite cooler temperatures can be employed as the source of agitating liquid to the evaporator sections in the system.

The following example illustrates the effectiveness of the present invention.

EXAMPLE

A multistage flash unit was run under substantially identical conditions a number of times, except that in some of the operations agitation liquid 3° C. cooler than the distilland was injected into distilland in one of the stages at a rate equal to about 1.5 to 2.5 volume percent of the total flow rate of feed to said stage. Flashing efficiency was measured by determining the difference between the temperature of the vapor in the stage and the liquid leaving the stage. The closer this difference is to zero, the greater the flashing efficiency. During the tests, by employing the process of the present invention, this temperature differential was reduced by as much as 20% in comparison to operating without agitation liquid.

Since flashing efficiency is increased by the present invention, more water is produced for a given amount of heat transfer surface and vessel size. This in turn reduces the capital cost of a plant for a specified design capacity.

The invention is particularly suitable for distilling sea water or other saline water.

What is claimed is:

1. In a process for evaporating distilland in a multistage flash evaporation process wherein the distilland passes generally horizontally through and flashes in consecutively lower temperature and pressure stages, wherein flashing efficiency is less than 100% in at least one of said stages, the improvement comprising injecting small amounts of liquid as an agitating medium into distilland in said at least one evaporator stage of said multistage flash process, said liquid being at a temperature no higher than the average temperature of distilland in said stage, said liquid being injected into said distilland at a point below the level of distilland in said stage, said liquid being injected upwardly and transversely to the distilland flow in said stage, and being directed toward the distilland-vapor interface in said stage, said liquid being injected at a rate equal to about 1 to 5 percent by volume of the total liquid feed rate to said stage; and wherein said liquid has substantially the same composition as said distilland.

2. The process of claim 1 wherein said liquid is at a temperature no more than about 8° C. cooler than said average distilland temperature in said stage.

3. The process of claim 1 wherein said liquid is distilland from another part of said evaporation process.

4. The process of claim 1 wherein saline water is being distilled in said evaporation process.

5. The process of claim 2 wherein said liquid is about 2 to 5° C. cooler than said average distilland temperature.

6. The process of claim 5 wherein said liquid is injected at a rate equal to about 1.5% to about 2.5% by volume of the total liquid feed rate to said evaporator stage.

7. The process of claim 6 wherein said liquid is distilland from another part of said evaporation process.

8. The process of claim 7 wherein saline water is being distilled in said evaporation process.

9. The process of claim 4 wherein said liquid is about 2 to 5° C. cooler than said average distilland temperature.

10. The process of claim 3 wherein said liquid is about 2 to 5° C. cooler than said average distilland temperature.

References Cited

UNITED STATES PATENTS

1,766,863	6/1930	Wecker	202—173
3,207,677	9/1965	Colton et al.	203—11 X
3,427,227	2/1969	Chamberlin	203—11 X
3,442,765	5/1969	Levite	203—11 X
3,532,152	10/1970	Cartinhour	203—11 X

NORMAN YUDKOFF, Primary Examiner

J. SOFER, Assistant Examiner

U.S. Cl. X.R.

202—173; 203—88