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METHOD AND APPARATUS FOR PREVENTING STAGNATION NEAR THE REBOILER OF A DISTILLATION TOWER

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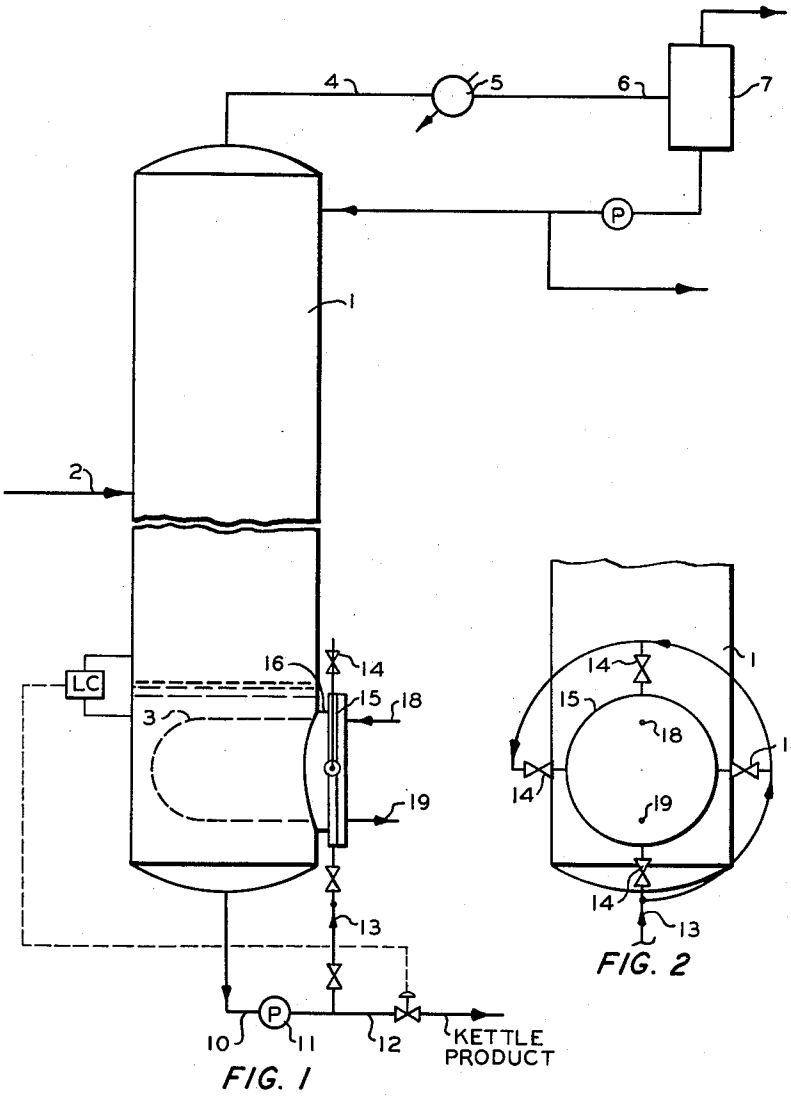


FIG. 1

FIG. 2

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METHOD AND APPARATUS FOR PREVENTING STAGNATION NEAR THE REBOILER OF A DISTILLATION TOWER

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This invention relates to improved distillation means and improved method of operating distillation. In one of its aspects, the invention relates to the provision of means for injecting into a stagnant area of a distillation means a liquid or fluid which will prevent, by flushing out said area, the deposition of undesirable materials which may be in said distillation means or which may be formed therein under the conditions of operation. In another of its aspects, the invention relates to a method of stripping, distilling, and/or fractionating a liquid tending to form undesirable deposits such as polymer upon portions of apparatus employed, rendering dismantling or servicing difficult due to "cementing in" of the removable parts by said polymer or other material which comprises flushing spaces into which and areas onto which said polymer or other material tends to deposit by cycling at least a portion of the liquid in the operation to said spaces and/or areas. More specifically, the invention relates to method and means in a system in which butadiene is recovered from furfural solvent comprising injecting into the nozzle area of the stripper tower in which the recovery is being effected, a portion of the kettle product so that there is avoided deposition of polymer in the nozzle which ultimately can result in "cementing in" of a tube bundle inserted into the stripper through and positioned in said nozzle.

The invention has general applicability as indicated herein. It is now described with respect to actual plant practice effected in the recovery of butadiene from furfural solvent.

Prior to this invention, and for a considerable length of time, it was standard practice to "wedge loose" or to "wedge out" the bundles of steam heating tubes which are inserted into furfural stripper towers through nozzles or apertures, the bundles being positioned in and through said apertures during operation since the tube bundles had become "cemented in" due to hydrocarbon polymer formed within the stripper tower nozzle. Often times, "wedging out" the tube bundles resulted in physical damage to the tube bundles and consumed a great deal of time. I have now conceived that the polymer deposition can be avoided by flushing out, as it were, the nozzle area of the stripper by recycling to the space in the nozzle, in which a portion of the tube bundle is placed, a portion of the kettle product through one or more injector means thus to prevent deposition of polymer by motion or turbulence of the liquid being heated in the kettle of the tower in the space essentially comprised within the nozzle of said tower.

It is an object of this invention to provide a method of improved distillation and/or fractionation method. Another object of this invention is to provide an improved stripping, distillation, or fractionation means. A further object of this invention is to prevent deposition of materials or polymers within a stripping, distillation or fractionation means in those areas or spaces of said means wherein, due to stagnant conditions existing, "cementing in" of otherwise removable parts of the apparatus will occur. It is a further object of this invention to provide an improved furfural stripping means suitable for the recovery of butadiene and related hydrocarbons from furfural and/or a related solvent. A still further object of this

invention is to provide a method for the recovery of butadiene and related hydrocarbons from furfural and/or other solvents.

Other aspects, objects, and the several advantages of the invention are apparent from a study of the disclosure, the drawings, and the appended claims.

According to the invention there is provided a method for stripping a component from a solution in a heated stripping zone in an area of which undesirable deposition of a material tends to occur which comprises injecting into said area at least at one point thereof, a fluid or liquid stream obtained from within said zone thus to cause sufficient movement in said area to prevent deposition therein of any material already in or which may be formed in said zone. Also according to the invention there is provided an apparatus for stripping of a component from a solution which comprises a stripping means and means for injecting a fluid into said stripping means at an area in which stagnation of fluid therein normally occurs. One form of apparatus, according to the invention, is schematically illustrated in connection with the drawings. Other forms of apparatus can be designed by one skilled in the art in possession of this disclosure and having studied the same. The fluid or liquid which is injected into the stripping operation to avoid deposition of, say, polymer therein, as in the case of stripping butadiene from furfural, is now preferably a portion of the kettle product. However, streams for recirculation to the kettle nozzles or other areas can be fresh furfural, recycled furfural, or othe suitable streams taken from other columns as well as recycled kettle product in the operation of the furfural stripping column or zone herein described. It is also within the scope of the invention to inject a hydrocarbon vapor or gas to cause sufficient motion or turbulence to accomplish the desired result. Thus, the invention, in its broadest form, is not limited to the use of recycled kettle product.

Herein and in the claims, the term "stripping" is intended to include also distillation, fractionation, and other related operations.

In the drawing, FIGURE 1 diagrammatically illustrates a cross section of an elevational view of an embodiment of the invention as it is applied to a furfural stripper in which butadiene is stripped from furfural, the cut being taken along the axis of the column. FIGURE 2 is an outside view of the column when viewed from a point just outside the tower nozzle.

Referring now to the drawing, the invention is illustrated in connection with the stripping of butadiene from a furfural solvent. Furfural, which has been employed to extract butadiene from a hydrocarbon stream containing it, is fed to tower **1** by pipe **2**. A tube bundle reboiler **3** is disposed in the foot or kettle portion of the column as shown. The bundle is immersed in the liquid in the bottom of the tower and this liquid is maintained at a temperature of approximately 330° F. at a pressure of approximately 60 to 70 p.s.i.g. Butadiene is recovered overhead by pipe **4**, cooler-condenser **5**, pipe **6**, and received in receiver **7**. Kettle product is essentially furfural containing traces of polymer and hydrocarbon and is withdrawn by pipe **10**, pump **11**, and valve pipe **12** to storage or for reuse, as desired. According to the invention, a portion of the kettle product is recycled to the bottom portion of the tower through pipe **13** into the aperture or nozzle through which the tube bundle is inserted into the column through at least one, but preferably several, strategically disposed injector pipes to prevent deposition and therefore, stagnation of the kettle liquid in the column nozzle, thereby avoiding substantial deposition or coating of polymer onto the tube bundle, its related equipment, or on the tower nozzle portion.

The recycled kettle product is passed through valves **14**

into and through flange **15** of the tower nozzle, directly adjacent the tower side of the tube sheet so that the entire area or annulus **16** within the tower nozzle as well as the space within the tube bundle portion lying within the tower nozzle will be consequently flushed, preventing deposition. Pipes **18** and **19** are inlet and outlet, respectively, for heating steam supplied to the tube bundle.

In one such installation in actual plant practice, eight man-hours minimum was spent in loosening or starting the tube bundle out from the nozzle of the column. Frequently the force needed to remove such a bundle was so great that physical damage to the bundle resulted. That is, the bundle was either weakened or damaged. Following installation of the circulating system of the invention the bundles have been very easy to remove and no extra time has been spent "getting them started." It had earlier been necessary to "wedge out" the bundles, and this practice could be discontinued. Furthermore, the time period between bundle changes, it was found, could be lengthened by 10 to 20 percent and polymer depositions often extended out on the portion of the bundle within the nozzle, which earlier had been completely blocked by polymer to virtually cement the tube bundle therein, was reduced from 3 cubic feet to less than 1 cubic foot on a visually extended basis.

The advantages of the invention are made more apparent by the following data given by way of specific example to illustrate the scale on which the invention was actually used.

Example

Stripper feed rate ——gallons per hour—	8,250
Kettle product rate ——do——	5,500
Kettle temperature ——° F—	330
Kettle pressure ——p.s.i.g—	60–70
Recycle rate to the nozzle through each of four injectors ——gallons per minute—	5
Feed rate:	
Furfural ——gallons per hour—	5,500
Hydrocarbon, 92% butadiene ——do——	2,750

While in the foregoing example certain flow rates and other important conditions have been stated in connection with one embodiment of the invention it will be obvious to those versed in the art in possession of this disclosure that other conditions are within the scope of this disclosure and the appended claims.

The essential criterion for establishing an injection rate is adequate movement without wasting power or polymer tending to form and to deposit away from the nozzle area or flange on a tower for ultimate removal with the kettle product and, therefore, from the system.

A presently contemplated range of rates for a column operation as described herein is about 15 gallons per minute to about 40 gallons per minute with a four injection operation.

In lieu of separate injections, other means of circulation of the kettle product or other material can be provided. For example, it is within the scope of the invention to position a spray ring within the nozzle surrounding the tube bundle therein and/or to inject the flushing material through an aperture which may be provided in the tube sheet or in means attached to the tube sheet.

One skilled in the art in possession of this disclosure will appreciate that the invention is applicable generally to stripping or other operations wherein polymer or other depositions tend to occur in the separation of materials as herein described. Indeed, it is within the scope of the present invention to recycle the kettle product or to pump some other material into other portions of the tower in which depositions may occur either continuously or periodically as the case may require or as it may be desirable to do. Thus, there has been provided, according to the present invention, a neat manner of avoiding depositions and plugging within a stripping, distillation or fractionation tower or other unit substantially as described.

Reasonable variation and modification are possible within the scope of the foregoing disclosure, the drawing, and the appended claims to the invention the essence of which is that there have been provided a method and means for injecting a kettle product stream and/or a stream within a tower or other stream or material into the kettle of such a tower at such a place or places at which equipment tends to be cemented in the tower due to polymer or other deposition tending to occur in stagnant areas formed by the construction of said tower, the method consisting essentially in pumping in through a jet nozzle, spray ring, or other suitable means a stream or streams and of a velocity such that said areas will be flushed periodically or continuously as desired and the means or apparatus consisting essentially of means for obtaining the said stream from within said tower, as from the kettle portion or from a plate therein, pump means, and said jet means, etc.

I claim:

1. In a method of removing by evolution of vapors a component from a body of a liquid which upon heating tends to form an undesirable deposit in a region of a heating zone in a vessel which is heated by submerging a heat exchanger in said body of a liquid, resulting in a region of liquid stagnation within said body of liquid adjacent the wall of said vessel and said heat exchanger permitting said undesirable deposit in said region, which comprises removing from said zone a portion of said liquid and forcibly injecting the removed liquid into said region of liquid stagnation, thereby eliminating said region of stagnation.

2. In a method for stripping a component from a body of a liquid which upon heating tends to form an undesirable deposit in a region of a heated stripping zone in a vessel to which heat is supplied by passing heat into said body of liquid by a liquid-submerged heating zone in a stagnant region removed from normal path of flow of liquid in said zone permitting undesirable deposition in said region which comprises injecting into said stagnant region at least at one point thereof, a fluid stream, obtained from within said stripping zone, thus to cause sufficient movement in said region to prevent deposition in said region of any material already in or which may be formed in said zone.

3. A method of operating the reboiler section of a distillation tower in which polymer deposition tends to occur at a stagnant portion of a body of liquid in said section, said portion being removed from the normal path of flow of liquid in said section, which comprises injecting into said stagnant portion of liquid in said section a portion of a stream which has been removed from said tower.

4. A method of operating the reboiler section of a distillation tower in which polymer deposition from the body of liquid in said section tends to occur at a stagnant portion of said section, said portion being removed from the normal path of flow of liquid in said section, which comprises injecting into said stagnant portion of said section a stream of a fluid which is compatible with the liquid in said reboiler section.

5. A method for the recovery of butadiene from a body of liquid containing furfural in a stripping zone which is heated by a heat exchanger element which is inserted into said zone from a peripheral locus thereof and is in said liquid in said zone and which must periodically be removed therefrom for servicing and which tends to become cemented-in in said zone at stagnant regions of said zone at said peripheral locus at which it has been inserted, and removed from the normal path of flow of liquid in said zone, which comprises withdrawing a portion of liquid kettle product from said zone and injecting the same to at least one point in the body of liquid at which said cementing-in tends to occur which renders difficult the removal of said heat exchanger element.

6. A stripping means comprising a stripping column,

means for removing overhead from said column, means for removing product from the foot of said column, an opening formed in the wall of said column adapted to receive and to retain and receiving and retaining in said wall by at least one of its ends a tube bundle heat exchanger, means for passing a heat exchange fluid through said heat exchanger, and means for injecting a fluid into the space formed within said opening and about said heat exchanger

as it is encompassed within said opening when received in said opening.

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