PROCESS AND APPARATUS FOR INDIRECT HEAT TRANSFER BETWEEN TWO LIQUID MATERIALS

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This invention relates to a method and means for transferring heat from one fluid to another, and has for its particular object the provision of a system in which heat can be transferred from one medium to another when both mediums have physical properties such that under the operating conditions they tend to deposit solid material on the heat transfer surfaces whereby it is necessary that both mediums be flowed through tubes which can be easily cleaned. In the appended claims both of these types of mediums will be referred to as materials which tend to deposit solid matter since such action usually accompanies decomposition.

A typical example of a heat exchange system to which the present invention is applicable is one in which heat is transferred from waste volatile material such as tar, distillation bottoms, or similar material in order to provide steam for process use. In such a system, it is usual to have the volatile material in the system in the liquid state at the lowest operating temperature, and that it have a sufficiently high boiling point to permit the operation of the unit at a practicable pressure. In a system in which the heating medium enters at a temperature of about 600–800°F, diphenyl has proven very satisfactory as an auxiliary medium. The medium selected for any given unit, of course, must boil at a temperature below that at which the heating medium enters the unit.

When the present invention is practiced with an auxiliary medium which is maintained in the liquid state throughout the heat exchange operation, there is no limitation upon the relative posi-
tions of the heat input chamber and the heat absorption chamber except when the circulation of the auxiliary medium is natural and dependent upon gravity, in which case it is obviously necessary that the heat absorption chamber be at a higher level than the heat input chamber.

The preferred embodiment of the present invention is illustrated in vertical longitudinal section in the accompanying drawing in which 1 and 2 are conventional tube and shell heat exchangers joined together by enlarged conduits 3 which are joined together at 4. In each of units 1 and 2, horizontal parallel tubes 5 are mounted with their ends secured in tube plates 6 and 7. Covering the ends of the tubes in plate 6 is a manifold 8 having on one side an inlet 9 and on the other side an outlet 10, and having a partition 11 mounted between the inlet and outlet points to divide its interior into two compartments, each of which has the same number of tube openings. Mounted over each plate 1 and covering the ends of the tubes secured therein is a manifold 12 providing intercommunication between the ends of the tubes. As is apparent, by employing additional partitions in heads 8 and 12 thus making suitable connections between the ends of the tubes mounted in plates 6 and 7, the medium passing through the tubes may be caused to travel the length of the shell several times before it leaves the unit, thus controlling the velocity of flow in the tubes.

In the arrangement shown on the drawing, the auxiliary medium completely fills the lower shell. In order to avoid entrainment of auxiliary liquid with the vapors evolved therefrom, a floating perforated plate 13 can be arranged in the passage formed by conduits 3. The heating medium passes through the tubes of the lower unit and the medium to be heated passes through the tubes of the upper unit. For example a cracking coltar entering the lower unit at a temperature of 780°F and at a rate of 72,000#/hr. of phenyl being the auxiliary medium, will leave the lower unit at a temperature of 640°F and will heat a reduced crude entering the upper unit at a temperature of 470°F and at a rate of 204,000#/hr. to a temperature of 505°F.

While the present invention has been described with particular reference to the exchange of heat between dirty, readily cokable oils, it is apparent that it is of general application. It is a fact, however, that the advantages attending the present invention become most significant when both the heating medium and the medium to be heated are of a nature to either deposit sediment, or decompose, or both; the single tube and shell heat exchanger being satisfactory where only one of the mediums is of such a character that it must be passed through readily cleanable tubes.

The nature and objects of the present invention having been described and a specific embodiment thereof given, what is claimed as new and useful and desired to be secured by Letters Patent is:

1. A process for indirect heat transfer between two liquid materials each of which tends to form carbonaceous deposits when heated comprising passing the hot liquid material through a series of narrow elongated passageways in heat exchange with a body of heat stable liquid in a shell, vaporizing said last mentioned liquid and conducting the vapors substantially freed of entrained liquid, into a second shell, passing the relatively cool liquid material through a series of narrow elongated passageways in said shell in heat exchange with said vapors, whereby they are condensed on said passageways, and returning the condensate to said liquid body.

2. A process according to claim 1 in which the liquids tending to form carbonaceous deposits when heated between which an indirect transfer of heat is accomplished are a hot cracking coaltar and a relatively cool reduced crude oil.

3. Apparatus for the indirect transfer of heat between two liquid materials tending to form carbonaceous deposits when heated by means of an auxiliary liquid heat exchange medium, comprising, in combination, a pair of heat exchanger shells disposed one above the other, an upwardly extending conduit of enlarged cross section on the lower shell and a downwardly extending conduit on the upper shell, which conduits are joined to form a passageway between them, a plurality of interconnected elongated passageways for a relatively cool liquid material disposed within said upper shell and a plurality of interconnected elongated passageways for a hot liquid material disposed within said lower shell, the passageways within each shell consisting of a plurality of manifold connected tubes in which the outer manifold of the bundle forms a closure for the shell within which it is contained, and provides a series of inlet and a series of outlet tubes in each bundle, and a body of a heat stable liquid heat exchange medium vaporizable at the temperature of the hot liquid material in said tube bundle contained in the lower shell and entirely covering the tube bundle therein.

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