

METHOD AND APPARATUS FOR SUPPLYING AND DISTRIBUTING COMPOSITE LIQUIDS TO A LAMINAR SEPARATION APPARATUS

The present invention relates to laminar separation methods and apparatus and, more particularly, to new and improved methods and apparatus of this character embodying simple yet highly effective means for supplying and distributing a composite liquid such as a suspension or emulsion uniformly to the respective separation channels in the apparatus.

In conventional laminar separation apparatus, separation of sediment from a suspension or of liquids in an emulsion is accompanied by supplying the suspension or emulsion to a plurality of separation passages formed between a plurality of parallel, spaced apart plates, all inclined with respect to a horizontal plane. In operation, the sediment in the suspension or the heavier liquid in the emulsion sinks downwardly in the separation passages, flows past the lower edges of the plates, and is removed at the bottom of the separation apparatus, while the remaining liquid flows upwardly and is eventually discharged

through outlets at the upper ends of the plate passages.

The influent suspension or emulsion is usually supplied to the separation passages via a distributor positioned close to the plates so that the influent supplied therefrom is allowed to flow into the passages between the plates. Preferably, the distributor is positioned laterally of a plate array or between two plate arrays and is provided with side walls, so that the influent is forced downwardly and enters the passages between the plates some distance below the top edges of the latter. The influent enters the distributor via an inlet from above, or preferably laterally.

For a complete utilization of the capacity of the laminar separation apparatus, it is of the utmost importance to obtain an even and uniform distribution of the influent composite liquid to the separation passages. In prior apparatuses, however, it has been difficult to accomplish this result. To begin with, the influent entering the distributor is highly concentrated and also undirected. This tends to overload certain separation passages positioned some distance from the inlet pipe, while other closer as well as more remote separation passages receive too low a load. Load in this respect relates to the amount of suspension or emulsion per unit time flowing into a separation passage. In some cases, certain separation passages do not receive any influent from the distributor; instead only clarified liquid enters the separation passage from the outlet of the distributor. Optimum oper-

ation obtains when the influent flow is evenly and uniformly distributed over all of the separation passages.

According to one aspect of the present invention
5 there is provided a separation apparatus comprising a plurality of spaced apart parallel plates inclined to the horizontal and forming a plurality of separation passages therebetween each having upper and lower outlets and a distributor for delivering influent composite liquid to
10 the separation passages, the distributor having an inlet for influent composite liquid and an outlet extending across said plurality of plates so as to communicate with the plurality of passages at a location between their upper and lower outlets, the distributor including a
15 plurality of obstacle means arranged to subject the stream of influent composite liquid entering the distributor through the distribution inlet to a plurality of deflections to cause deceleration of the stream and cause the influent composite liquid to be distributed
20 uniformly into said passages from the distributor outlet.

According to another aspect of the present invention there is provided a method for separating an influent composite liquid in a laminar separation apparatus having a plurality of parallel plates inclined
25 with respect to a horizontal plane and forming a plurality of separation passages therebetween each having upper and lower outlets and a distributor for delivering influent composite liquid to the separation passages, the distributor having an inlet for influent composite liquid
30 and an outlet extending across said plurality of plates so as to communicate with the plurality of passages at a location between their upper and lower outlets, the improvement comprising decelerating the stream of

influent composite liquid entering the distributor through the distributor inlet by subjecting the stream to a plurality of deflections to dissipate the kinetic energy thereof and cause the influent composite liquid to
5 be distributed uniformly into said passages from the distributor outlet.

Reference is now made to the accompanying drawings, in which:-

Figure 1 is a side view, with the side wall
10 partially broken away, showing a portion of a laminar separation apparatus embodying the invention;

Figure 2 is an end view, partially broken away, of the laminar separation apparatus of Figure 1, as viewed from the left in Figure 1;

15 Figure 3 is a view in longitudinal section, taken along the line 3-3 of Figure 2 and looking in the direction of the arrows;

Fig. 4 illustrates in perspective view one form of flow modifying baffle array according to the invention;

Figs. 5 and 6 are side views illustrating other forms of flow-modifying baffle arrays according to the invention; and

Fig. 7 is a perspective view illustrating still another form of baffle array according to the invention.

As shown in Figs. 1, 2 and 3, a representative laminar separation apparatus according to the invention has a separation chamber 10 and an outlet portion 11 comprising a funnel-shaped trough 12 into which separated liquid or sediment descends and is pumped out by a conventional pump means 13 as indicated by the arrow 14. Mounted in the separation chamber 10 are a plurality of parallel, spaced apart plates which are inclined to the horizontal and form separate separation passages 16 therebetween. Separation takes place in each separation passage 16, independently of the other separation passages, in such manner that the solid particles in a suspension or the heavier liquids in an emulsion sink to the upper surface of the lower plate in each passage and thereafter slide down therealong to the trough 12. The clarified liquid ascends adjacent to the upper plate in each passage 16, as indicated by the arrows 17 in Fig. 2, and flows out through openings 18 in a horizontal plate 19 at the upper ends of the plates 15 to enter a channel 20 positioned in the upper portion of the laminar separation apparatus. The channel 20 is provided with an outlet opening 21 for discharge (arrow 22)

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of the clarified liquid from the laminar separation apparatus.

The influent composite liquid such as a suspension or emulsion is supplied (arrow 23) to the laminar separation apparatus via an inlet 24 to a distributor 25 which extends between two plate arrays 26 and 27. A channel 20 is positioned above each plate array and the influent flows laterally into the arrays 26 and 27 as illustrated by the arrows 28.

According to the invention, a plurality of obstacles in the form of plate baffles 29 are positioned in one or more arrays in the distributor 25. In the particular embodiment shown in Figs. 3 and 4, the baffles are placed in two vertical arrays 30 and 31 that are spaced apart alternately in the flow direction of the influent suspension or emulsion entering through the inlet pipe 24 with the broad side of each baffle facing the flow. In this embodiment, the arrays 30 and 31 are displaced vertically so that the baffles in one array 30 face the gaps between the vertically spaced apart baffles in the other array 31, thus forming a plurality of tortuous passages through which the influent is caused to flow. In this way, the influent flow is decelerated and is divided into a plurality of flow components which change directions several times, as illustrated by the arrows 32 in Fig. 3.

In the modified baffle arrangement shown in the embodiment of Fig. 5, the spacing between the arrays 30 and 31 of flow modifying baffles according to the invention

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is successively increased in the direction of flow of the influent. This provides more tortuous passages at the inlet end of the distributor 25, assuring greater uniformity of distribution of the influent between the flow passages 16 for certain applications.

5 If so desired, the baffles 22 can be suitably shaped or oriented to guide selected flow components of the influent in desired directions. As illustrated in the modified baffle arrangement of Fig. 6, the baffles 33 of one array may be in the form of angle irons disposed with the apices facing towards the flow, while other arrays may comprise flat baffles 34 and 35 inclined in either direction with respect to the flow.

10 Alternatively, as shown in Fig. 7, the arrangement of obstacles may comprise an array of plates 36 spaced apart in the influent flow direction and provided with openings 37. To provide the necessary tortuous path for the influent, the openings 37 in successive plates are laterally displaced with respect to the openings 37 in the preceding plate. Also, guide means may be provided for deflecting the flow.

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CLAIMS

1. In a method for separating an influent composite liquid in a laminar separation apparatus having a plurality of parallel plates inclined with respect to a horizontal plane and forming a plurality of separation passages therebetween each having upper and lower outlets and a distributor for delivering influent composite liquid to the separation passages, the distributor having an inlet for influent composite liquid and an outlet extending across said plurality of plates so as to communicate with the plurality of passages at a location between their upper and lower outlets, the improvement comprising decelerating the stream of influent composite liquid entering the distributor through the distributor inlet by subjecting the stream to a plurality of deflections to dissipate the kinetic energy thereof and cause the influent composite liquid to be distributed uniformly into said passages from the distributor outlet.

2. A separation apparatus comprising a plurality of spaced apart parallel plates inclined to the horizontal and forming a plurality of separation passages therebetween each having upper and lower outlets and a distributor for delivering influent composite liquid to the separation passages, the distributor having an inlet for influent composite liquid and an outlet extending across said plurality of plates so as to communicate with the plurality of passages at a location between their upper and lower outlets, the distributor including a plurality of obstacle means arranged to subject the stream of influent composite liquid entering the distributor through the distribution inlet to a plurality of deflections to cause deceleration of the stream and cause the influent composite liquid to be distributed uniformly into said passages from the distributor outlet.

3. Apparatus according to Claim 2 including a plurality of arrays of obstacle means spaced both in the direction of the influent flow into the distributor and across the

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direction of influent flow, in which the spaces between obstacle means in the arrays that are spaced across the direction of influent flow are obstructed by obstacle means in a succeeding cross flow obstacle means array in the

5 direction of influent flow.

4. Apparatus according to Claim 3 in which the obstacle means are disposed in arrays that are spaced apart both in the direction of influent flow and in the direction normal thereto and the spaces between adjacent obstacle means in

10 each of the arrays that are spaced apart across the direction of influent flow are obstructed by obstacle means in the next succeeding cross flow array in the direction of influent flow.

5. Apparatus according to Claim 3 or Claim 4 in which

15 the spacing between the obstacle means in the arrays that are spaced apart in the direction of influent flow increases successively with distance in the direction of influent flow, at least for obstacle means closest to the distributor inlet.

6. Apparatus according to Claim 2 in which the obstacle

20 means comprises a plurality of baffles disposed normal to the direction of influent flow.

7. Apparatus according to Claim 2 in which the obstacle means comprises a plurality of baffles which are shaped to guide and change the direction of influent flow.

25 8. Apparatus according to Claim 7 in which the obstacle means comprises a plurality of angle-iron shaped baffles.

9. Apparatus according to Claim 7 in which the obstacle means comprises a plurality of baffles disposed at an angle to the direction of influent flow.

30 10. Apparatus according to Claim 2 in which the obstacle means comprises a plurality of plates having laterally displaced openings.

11. A method of laminar separation substantially as described with reference to the accompanying drawings.

35 12. Apparatus for laminar separation substantially as



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described with reference to and as illustrated in any of the accompanying drawings.

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