

AN APPARATUS FOR THE SEPARATION OF SOLIDS FROM FLOWING LIQUID

This invention relates to methods of and apparatus for separating floating and suspended solids from a flowing liquid using continuous deflective separation, and particularly, but not solely non-mechanical methods and apparatus.

There are many applications where it is desirable to separate solids from a flowing liquid including:

1. Separation of solids from stormwater.

In many areas of Australia, and in countries other than Australia, stormwater is directed to waterways and seas. Stormwater is a major carrier of solid pollutants such as plastics, cans, tree branches and animal faeces, amongst others to waterways and seas.

Endeavours have been made to limit the passage of at least some of these materials. One method used is by having grates across outlets from the drains but these have generally been unsatisfactory because the size of the grate must be such as to enable water to pass even if material is held against the grate by water pressure so it has been necessary that the grate be of substantial opening size. Also, even such grates can be blocked and it is essential to provide a flow path

around or over the grate to prevent build up of water upstream in the drain system. A second alternative proposed has been the use of systems, such as cyclones and dynamic separators, to remove the waste. Whilst these can be efficient, they are too expensive to be used in the whole of a stormwater system.

2. Separation of liquid from sewage.

A major difficulty with many sewage plants is the sheer volume of liquid to be handled. This is aggravated where a "mixed" system, that is a system which carries both sewage and storm water is used. In many cases, sewage plants could handle more sewage if the quantity of liquid delivered therewith could be reduced, if, for example, liquid was removed from sewage before it enters trunk sewers. This has not been considered feasible.

Also, there are regions where stormwater and sewage are received by the same system. This can cause difficulties where there are heavy rains which overload the system as it is undesirable to permit raw sewage to pass to overflow.

3. Removal of pollutants from industrial wastes.

Many industrial plants must pay prohibitive rates to discharge polluted liquids into sewers. It would be most desirable to separate a part of the pollution before the waste is delivered

to sewers and this would provide economies both to the plant and to the authority if this cost of the early removal of polluted matter was less than the cost of cleaning up pollution later.

4. Separation of solids from liquid in industrial applications including food processing.

The principal object of the invention is to provide non-mechanical methods of and apparatus for separating floating and suspended solids from flowing liquids.

The invention, in its broadest sense, comprises a means for the separation of solid matter from a liquid including a perforated separation panel through which the liquid is adapted to pass and which prevents the passage of the solid matter of a size larger than a predetermined size characterised in that when solid matter becomes located against the panel, the flow of liquid along the face of the panel on which the solid matter is located will tend to cause it to move from the panel so that the panel is self cleaned and does not become obstructed by the solid matter.

In a specific aspect, the invention provides a non-mechanical method for separating solids from a flowing liquid by utilising the energy of the flowing liquid on the inlet side, a separation panel in the path of the fluid flow and so

arranged that the liquid is deflected thereby, which deflection causing larger suspended solids to a collection sump or the like. At the same time, the liquid flow across the separation panel prevents the panel from clogging. Liquid containing some finer suspended solids can pass through the panel to the outlet side. Floating solids are retained in the collection sump behind a flow direction baffle and can be prevented from inadvertent delivery during high flow conditions by a high level baffle located adjacent the top of the separation panel.

The invention also provides an apparatus for the separation of solids from a flowing liquid which apparatus has an inlet and an outlet for the liquid, a separation panel in the path of flow between the inlet and the outlet, the panel presenting a closed face in the direction of flow but apertures therethrough at an angle thereto, liquid being able to pass through the apertures whereas solids are caused to pass over the face thereof.

The arrangement is such that even solids smaller than the size of the apertures can be caused to move past the apertures either because of the inertia of the solids, or the action of gravity, or both.

In this specification, where we refer to water flow, this is intended to include relative water flow and thus there can be

circumstances where the separation plate is moving as well as, or instead of, the water.

In order that the invention may be more readily understood, reference will be made to the accompanying drawings, which show certain examples of the invention.

In the drawings:

Figure 1 is a plan view through one example of separator made in accordance with the invention;

Figure 2 is a vertical section along line a-a of Figure 1;

Figure 3 is a vertical section along line b-b of Figure 1;

Figure 4 is a view along arrow "4" of Figure 1;

Figure 5 shows a vertical section through a second example of a separator according to this invention;

Figure 6 shows an enlarged detail of the vertical section through the separation panel;

Figure 7 shows an example of an installation in a channel or river of separation panels for the removal of solids from a flowing liquid and subsequent collection and

storage;

Figure 8 shows an enlarged section a-a through the holding chambers;

Figure 9 shows an enlarged horizontal section through the separation panel;

Figure 10 shows an enlarged elevation of the separation panel viewed in the direction of flow of the channel in Figure 9 at view "10" with the openings substantially closed to view;

Figure 11 shows an enlarged elevation of the separation panel from the angle giving maximum open space, in Figure 9 at view "11";

Figure 12 shows a side elevation view of a system which can remove water from sewage whilst permitting the solid matter to proceed, and is a view along line 12-12 of Figure 13;

Figure 13 shows a plan view of the system of Figure 12;

Figure 14 is a view along line 14-14 of Figure 13;

Figure 15 is a view along line 15-15 of Figure 13;

Figure 16 shows a cylinder driven mechanically in a direction opposed to the protruding deflective segments of the separation apparatus causing deflection of particulant matter away from the device while allowing liquid to pass through via the openings;

Figure 17 shows a mechanically driven apparatus with internal deflective segments and openings;

Figure 18 shows a longitudinal vertical section through a further embodiment of the invention;

Figure 19 shows an enlarged detail of the section through the lower separation panel of Figure 18;

Figure 20 shows a longitudinal vertical section through another example of this invention which has a water filled solids collection sump;

Figure 21 shows an enlarged detail of the section through the upper separation panel of Figure 20;

Figure 22 shows a plan view of an arrangement using a separation plate of the invention, together with a dynamic separator whereby the volume of water relative to solid material can be restricted; and

Figure 23 shows a section along line 23-23 of Figure 22.

Referring first to Figures 1 to 4 we illustrate an apparatus which is a gross pollutant trap placed in line in, say, a stormwater drain.

Before describing this in detail, the invention is equally applicable to major applications, such as in open channels, feeders or trunk stormwater drains or can be used in smaller applications such as in car parks. In the first type of application, the apparatus can be cast in situ or could be fabricated from pre-cast components, in the second could be of a pre-cast construction.

The type of apparatus illustrated in Figures 1 to 4 can be considered a larger construction and, in this case, the apparatus can be retro-fitted into a stormwater system and preferably in an area which gives reasonable access.

The apparatus has a containment sump 10 which, as shown, is contiguous with a separation chamber 16. The sump 10 is located beside the original position of the stormwater drain, which is broken to provide an inlet 11 into and an outlet 12 from the separation chamber. As the sump has to be cleaned at intervals, the size of the sump is such as to give a required interval between cleaning and to allow recirculation of liquid

into the separation chamber. It can vary in form and dimensions to suit specific site and project requirements.

The separation chamber has the separation panel 13 which is preferably a stainless steel plate, as will be described hereinafter, and which acts to separate the inlet 11 from the outlet 12. Parallel to the separation panel there may be a containment and flow direction baffle 14 which can be basically parallel to and spaced from the separation panel. This baffle 14 must be arranged to allow recirculation and may preferably extend from the top of the chamber to contain floatables and to below the bottom of the separation plate to permit recirculation.

A high level baffle 15 can be provided to retain floatables during extreme conditions.

As illustrated, the separation panel 13 is perforated but is formed so that it presents to the incoming liquid a closed face. As can be seen from Figure 6, the panel can be deformed so that there are a number of surfaces 20 which are directed towards the flow and which have therebehind a number of apertures 21, which pass through the panel. A formation such as this is possessed by expanded mesh.

There are other ways in which the separation panel may be formed, including the use of a series of bars or flat rods

which are located to provide a closed face to the flow but with apertures located behind and between these.

It is preferred, in this and the other embodiments to be described that the closed face, as a whole, presents a positive angle to the flow of liquid. The preferred angle will vary with different applications of the invention and can be close to being directly across the flow to being substantially parallel to the flow.

On liquid entering through the inlet, the sump 10 is first filled and then the liquid is then caused to move along the separation panel 13, and is constrained to this movement by the containment and flow direction baffle 14.

As there is effectively an hydraulic head between the inlet 11 and the outlet 12, whilst there will be movement of the liquid and any entrained solid material along the panel 13, there will be movement of liquid through the apertures 21, to the outlet 12. The solid material will, if it strikes the panel, tend to move along the panel by the forward momentum of the liquid and down the panel, by gravity. Should solid material larger than the apertures strike the surface, the forward movement of the liquid provides a self-cleaning of the surface of the panel so there is little or no tendency for blockage. The apparatus can thus be left for substantial periods with confidence that the panel will not become blocked, it only be

necessary that the sump is cleaned at intervals before it is over-filled with solid material.

Because of the form of movement, we have found the arrangement such that not only is all solid material larger than the apertures in the panel retained, but much that is smaller.

The sold material is carried through to the sump where it tends to drop under gravity and whilst some material, particularly light material, can be moved past the separation panel more than once. The liquid which enters the sump tends to move in an arcuate manner and most of the material falls into the sump after its first movement therethrough and before it is again passed along the face of the separation panel.

Floatables will also be held in the sump. However if upstream control of floatables, say by the provision of similar apparatus at major sources such as take away food outlet carparks, is good, there may not be great quantities of floatables to be retained.

In order to maintain the apparatus, it is only necessary to empty the sump 10 at intervals to prevent excessive build up of solid matter in the sump.

Under extreme conditions, say flood or near flood conditions, it will be seen that the apparatus of the invention will not

act as a source of difficulties. The apparatus can be so designed as to carry as much liquid as the inlet stormwater drain.

If, say because of poor maintenance and the build up of solid in the sump, an overflow can be provided over the top of the separation plate. For these conditions, we provide the high level baffle 15 which extends from just below the top of the separation plate to the top of the flow diverter baffle and acts to retain floatables.

Referring now to Figures 5 and 6, we illustrate a simple construction which utilises the invention and can be used in open channels or the like.

The liquid containing suspended and floating solids enters through inlet 24 into the separation chamber 23. The chamber is divided into inlet and outlet sides by a separation panel 22 fixed at the lower edge to the outlet side of the chamber 23, and inclined at an angle towards the inlet 24. Again the panel 22 presents a closed surface to the incoming liquid but, as described in relation to the previous embodiment, liquid can pass through the panel 22 and to the outlet 25.

The panel 22, the sides of the inlet 24 and the inlet sides of the chamber 23 extend to a height above surface sufficient to prevent any floating solids from crossing over to the outlet

side of the chamber 23.

The panel 22 can be skewed to one side to aid the movement of floatable materials off to the side and away from the panel.

Again, as previously discussed, the separation panel 22 is constructed with a series of segments 20 which are angled when the panel is in its required orientation and thus provide a substantially solid face opposing the liquid flow and a corresponding series of substantially horizontal openings 21 that allow the liquid to pass up and through the panel 22 to the outlet side of the chamber 23 and thence to the outlet 25.

The substantially horizontal orientation of the openings 21 in the panel 22, combined with the general downward liquid flow over the inlet side of the panel, discourages clogging and blocking of the openings by the suspended solids. A large portion of the kinetic energy of the suspended solids is dissipated as they are deflected and forced down at the panel causing them to settle down to the collection sump 26 at the bottom of the chamber 23. These solids can also be caused to move to the side as well as down.

The collected solids are removed periodically by manual or mechanical means.

Referring now to the embodiment of Figures 7 to 11. This

embodiment shows use of the invention as a boom or the like extending across a waterway or channel. The separation panel 31, which can be in one piece or made up of overlapping segments, is placed in the flowing liquid at an angle so as to deflect suspended and floating solids to the side collection chamber 32. The panel 31 preferable extends far enough below surface level to catch floating and near-surface suspended solids. It can, in the case of a channel or river installation as shown in Figure 6, be supported by a tensioned cable 33 anchored to the bank 34 at one end and to a substantial pylon 35 set in the channel, at the other end. It may be continuous across the width of the river or as shown in Figure 6 only project part way across, being placed at a strategic location near a bend to maximise the amount of solids caught.

The collection chamber 32 has an opening 36 to the channel which although normally being open, is periodically closed by a mechanical operated door 37 to prevent further ingress of liquid and solids. When this door 37 is closed, the mechanically operated door 38 to the stockpiling chamber 39 is opened, allowing all the liquid and solids from the collection chamber 32 to enter. When the collection chamber 32 is empty, the door 38 to the stockpiling chamber 39 is closed and the door 37 to the channel is opened again allowing ingress of liquid and solids to the collection chamber 32.

The stockpiling chamber 39 contains a removable basket 40 open at the top made of similar material to the separation panel, thus allowing the liquid to pass through the basket to the lower part 41 of the stockpiling chamber from whence it is removed and discharged to the channel by mechanical means such as a pump 42. Solids are retained in the basket 40 which can be removed and emptied periodically. Both chambers are covered by removable lids 45.

The separation panel 31 in this example is an expanded metal stainless steel plate placed in a substantially vertical plane and angled to the direction of flow so that the solid segments 43, Figure 9, form a substantially closed face when viewed from the direction of flow causing solids to be deflected along the direction of the panel 31. The liquid passes freely through the openings 44, Figure 11, in the panel and continues, unimpeded by the panel 31, in the flow.

Figures 12 to 15 show a system whereby liquid can be removed from sewage so that the sewage, together with enough liquid to act as an effective carrier thereof can be passed to a main sewer, possibly through a pumping station, and the liquid can be passed to a treatment plant whereby it can be treated either to a stage in which it can be used, for example, for watering or even to a stage in which it become potable.

It will be appreciated that the capacity of sewers and

treatment plants are limited by the amount of liquid passing therethrough or thereinto. If the amount of liquid can be restricted, this will enable effectively greater capacities than would otherwise be the case.

Sewage is often passed through pumping stations and if there is to be separation of the liquid from the solid material, it is necessary that such separation occurs before any pumping which tends to homogenise the material.

The system of Figures 12 to 15 includes a channel 100 which carries the liquid/solid mixture and on one side of this there is a separation panel 101 which can have the same properties of the panels described earlier herein.

On the side of the panel 101 away from the channel 100 there is a liquid receiving area 102 which has an outer wall 103.

The outer wall 103 defines the volume of material which can pass through the screen and the tapering shape aids in the maintenance of similar surface gradients on each side of the plate 101.

If the volume of flow is sufficient, it may be desirable to have separation panels on each side of the channel and the location of the other separation panel and its receiving area and wall are illustrated in broken line in Figure 13.

The outer wall has an outlet 104 which may be closed by gates 105 and 106. The gate 105 effectively controls the head in the channel 100 as liquid will pass through the plate 101 and reach the level of the top of the gate 105 before any liquid is passed to the outlet 104. The gate 106 aids in the control of the size of the outlet and thus the characteristics of the flow. Specifically, this can control the effective head and thus ensures that the flow through the channel is such as to ensure that the screen 101 is self cleaning.

Referring now to Figure 16, the apparatus 61 is placed in liquid 64 containing particulate matter and rotated as shown at 63 in a direction so as to produce relative movement and deflection by the protruding segments 68 while allowing liquid to pass through the surface 62 of the apparatus by way of the openings 67. Liquid is removed from inside the cylinder 66. The apparatus is rotated about its centre 65.

It may be preferred that the liquid 64 is also be caused to move relative to the apparatus to obtain the best operation.

Referring to Figure 17, the apparatus 69 has a conical shape and rotated at its axis 70 at an angle downward showing the openings 73 to be closed to a perpendicular view from the inside of the apparatus 69. Liquid containing particulate matter 74 enters at the smaller opening 77 and passes over the inside surface of the apparatus 78. The protruding deflective

segments 72 as shown in detail 71 cause particulate matter to pass down along the inside surface of the apparatus and exit at the larger opening 76 while liquid is able to pass around the deflective segments 72 through the openings 73 and downward away from the apparatus 75. This process is aided by its rotation 79.

Referring to Figures 18 to 21, we provide an apparatus which, whilst using the principle of the invention, highlights the effect of gravity on liquid movement through the separation panel.

In this embodiment, the liquid/solid mixture enters through the inlet 81 into the upper part of the inlet side of the separation chamber 95, passing over a substantially horizontal spreader plate 82 to allow the flow from the restricted inlet 81 to spread out towards the sides of the chamber. It then passes over the direction plate 83 which is curved to further spread the flow to the width of the chamber and direct the flow towards the upper separation panel 84. The spreader plate 82 and the upper separation panel 84 are substantially tangential to the curved flow plate 83 at its top and bottom edges respectively.

In this example of the invention the separation panel 84 is made from expanded metal sheets. The openings 91 in the panel are individually in a substantially vertical plane while the

connecting solid segments 92 have a positive downward slope in the direction of flow. They form a series of small downward sloping steps over which the larger solids are directed, by the action of gravity and force of the flowing liquid, to the solids collection sump 86 at the base of the panel 84. There may be a solids straight or curved transition panel 85 at the base of the separation panel 84 to aid in clearing the panel of certain types of solids.

The layer of liquid closest to the separation panel 84 is subject to pressure by the action of gravity and the pressure of the overlying blanket of liquid and at each step in the panel 84 a portion of the liquid passes through the openings 91 to drop to the outlet collection sumps 89 below and thence to the outlet 90.

The solids collection sump 86 has on at least one side a backward sloping separation panel 87 fixed to the outlet side of the sump 86. This lower separation panel 87, is formed with a series of vertical or backward sloping solid segments 94 that provide a substantially solid face to solids in the sump 86, and a corresponding series of substantially horizontal openings 93 that allow the liquid and finer suspended solids to pass through the panel 87 under the action of water pressure, and thence to the outlet sump 89 and the outlet 90.

A solid deflection panel 88 may be located below the lower portion of the upper separation panel 84, sloping down from the top edge of the transition panel 85 to cover the lower separation panel 87. Liquid and finer suspended solids dropping down from the upper separation panel 84 are directed to the outlet collection sump 89 and thence to the outlet 90.

In another, similar, example of the invention, shown in Figure 20, the solids collection sump 100 is divided into inlet and outlet sides by the lower separation panel 87 fixed at its lower edge to the outlet side of the sump 100 and inclined back at an angle towards to lower edge of the transition panel 85. The portion of liquid that reaches the sump 100 is forced by water pressure through the lower separation panel (formed with openings and solid segments as in the previous example), into the outlet side of the sump 100, over the lip 101 of the sump 100, into the outlet collection sump 89 and thence to the outlet 90. In all other ways this embodiment of the invention is the same as described in the previous embodiment.

The embodiment of Figures 22 and 23 show the use of the concept of the invention together with a dynamic separator. This embodiment can be particularly useful for a mixed system of sewage and stormwater. As previously mentioned, such systems normally carry the sewage load and this can be multiplied many times when there is, say a heavy storm. Sewage treatment plants may well not have the capacity to cope

with the increased flow and there can be a loss of raw sewage and any stormwater carried debris.

In the embodiment, under normal conditions, the inlet 110 will carry sewage and any stormwater which will enter the chamber 112 and thence to the dynamic separator 115. In this the sewage and water will pass through aperture 116 to outlet 117.

Under conditions where there is greater flow, where there is substantial stormwater, then the liquid and entrained solids which come through the inlet 110 move along the separation plate 113 which acts as described in the previous embodiments, water will pass through the plate 113 whilst the entrained solids will be moved along the surface of the plate to the dynamic separator 115. Thus there is a restriction on the quantity of water which enters the dynamic separator. With this increased flow, too, there will be a build up of the solids adjacent the centre of the dynamic separator and these, together with the entrained water, will move to the centre, by vortex action, and will pass through the outlet 116. The remainder of the water will tend to be displaced by further incoming water, it will move about the baffle 114 and will tend to re-enter chamber 112.

The capacities of the chamber 112 and the dynamic separator 115 can be selected to enable the maximum outlet of the separator to be the maximum acceptable at the sewage treatment

plant and the maximum throughput such as to enable the apparatus to cope with anticipated maximum flows.

We claim:

1. A means for the separation of solid matter from a liquid including a perforated separation panel through which the liquid is adapted to pass and which prevents the passage of the solid matter of a size larger than a predetermined size characterised in that when solid matter becomes located against the panel, the flow of liquid along the face of the panel on which the solid matter is located will tend to cause it to move from the panel so that the panel is self cleaned and does not become obstructed by the solid matter.
2. A method for separation of solids from a flowing liquid by utilising the energy of the liquid including a separation panel located in the path of movement, the panel, in the direction of movement of liquid, presenting a closed face to the flow of liquid and having, at an angle to the direction of movement, a plurality of apertures therethrough through which the liquid can pass whilst solid material entrained therein is caused to move along the face of the panel, the arrangement being such that the face of the panel is self cleaning.
3. A method as claimed in claim 2 wherein the means for achieving this method comprise a flowing liquid with suspended and/or floating solids; a separation chamber



divided into inlet and outlet sides by the separation panel which is a downwardly angled; and a collection sump at the bottom of the separation chamber wherein solids separated by the barrier from the flowing liquid collect and which can periodically be removed by manual or mechanical means.

4. A method as claimed in claim 3 wherein the separation panel extends to a height above the surface of the flowing liquid, sufficient to prevent any floating solids from crossing over to the outlet side of the chamber.
5. A method as claimed in claim 2 having a source of flowing liquid; the separation panel being placed at an angle to the direction of flow such that the openings are substantially closed when viewed from the direction of flow and the deflective force caused by the configuration and orientation of the panel directs solids out of the main flow to a storage or collection area to the side while the liquid is able to flow freely around the deflective segments of the panel and through the openings in the panel.
6. A method as claimed in claim 5 wherein the separation panel is located in a separation chamber and there is a flow direction baffle spaced from the separation panel to maintain flow generally along the face of the panel and



to direct the liquid and retained solids towards the storage or collection area and so arranged that the liquid in the storage area can pass therearound to re-enter the separation chamber.

7. A method as claimed in claim 6 wherein the flow direction baffle extends above the separation panel to retain floatable materials from recirculation.
8. A method as claimed in any one of claims 5 to 7 wherein there is a high level baffle to retain floatables during extreme conditions.
9. A method as claimed in any one of claims 5 to 8 wherein the separation panel is of strong, rust-resistant material such as perforated expanded metal plate or moulded plastic and the chambers are primarily constructed of strong solid materials such as re-enforced concrete.
10. A method as claimed in claim 5 or claim 9 when appended to claim 5 wherein the separation panel, supported by cables, pontoon, piles or other similar supports is placed either totally or partially across a channel or river at an angle to intercept and deflect floating and suspended solids along the face of the panel to a collection area out of the main flow and wherein the



collection area comprises two chambers, the first being an area open to the channel for ongoing temporary holding of solid material and the second which tapers off the first chamber, is deeper than the first so as to facilitate the stock piling of material entering from the first chamber and wherein mechanical means are used to open and close both chambers to facilitate the movement and stockpiling of solid materials and wherein water is mechanically removed from the second chamber allowing periodic removal of dry stock piled material.

11. A method as claimed in claim 2 including a source of flowing liquid with suspended and/or floating solids; a separation panel comprising a cylinder mechanically rotated around its axis passing through the centre of the ends thereby creating relative movement required for its function and so placed that its axis lies at approximately 90° to the path of the flow of the liquid; and so wherein particulant matter is deflected away from the apparatus by the deflective surfaces protruding from the exterior of the cylinder, while allowing entry of liquid through the openings and wherein the liquid is drawn off from within the cylinder thereby allowing the further continuous entry of liquid into the cylinder.
12. A method as claimed in claim 2 including a source of flowing liquid with suspended and/or floating solids; a



mechanically driven separation apparatus which is of conical shape with the deflective surfaces protruding inwards and its central axis angled so as to present a closed face when viewed downward from the inside of the apparatus and so placed that its axis is slightly angled down from the path of the flow of the liquid and that the liquid flows in through the narrower end of the apparatus; and wherein the rotation of the apparatus and the closed face, when viewed from a downward direction, cause the solid matter to pass along the inside face and exit at the larger diameter end.

13. A method as claimed in claim 2 including a source of flowing liquid with suspended and/or floating solids passing along a channel or pipe which has on either or both walls a separation plate which presents a closed surface in the direction of motion of the liquid but openings at an angle thereto and wherein a portion of the liquid can pass through the plate and be channelled away thus be separated from the rest of the liquid and solid matter which continues to flow along the channel or pipe.
14. A method as claimed in claim 13 wherein the plate(s) are so located that no liquid passes therethrough until the flow of liquid and its entrained solids reaches a predetermined minimum.



15. A method as claimed in claim 13 or claim 14 wherein the outlet is provided with at least one gate or the like so that the height of the opening into the outlet and/or its total size can be adjusted to provide the required height of the incoming liquid before there is passage through the plate to the outlet and to control the hydraulic head of the liquid.
16. A method as claimed in claim 2 having a source of flowing liquid; the separation panel being placed at an angle to the direction of flow such that the openings are substantially closed when viewed from the direction of flow, the arrangement being such that at flows below a pre-determined flow, the water and solids are deflected into a separator, through which the material passes, and when the flow is above the pre-determined flow, the liquid and solids pass along the separation plate, the solids and some of the liquids pass to the separator and the remainder of the liquid passes through the plate to an outlet.
17. A method as claimed in claim 16 wherein there is a containment baffle adjacent the separation plate which directs the flow to the separator and which is so located that excess water from the separator can be returned to repass the separation plate.



18. A method as claimed in claim 2 including a source of flowing liquid; an inlet for the liquid; a separation chamber divided into inlet and outlet sides by the separation plate which so orientated that liquid action and gravitational force prevent the openings from being blocked by solids; a solids collection sump in the inlet side for larger solids and floatables with a reverse sloping lower separation panel; a collection dish on the outlet side for liquid and smaller suspended solids; and an outlet and wherein the liquid travels over the separation panel which allows liquid and fine suspended solids to pass through the panel to the outlet and meanwhile larger solids and floatables are pushed down the panel to the collection sump by gravity and the action of the remainder of the liquid and wherein remaining liquid that reaches the sump passes through the reverse-sloping lower separation panels and to the outlet.
19. A method as claimed in claim 18 wherein the lower part of the separation panel is covered by a solid barrier transition panel and above and approximately parallel to the reverse-sloping lower separation panel is another solid deflection panel; to ensure that liquid and finer suspended solids dropping down from the upper separation panel are directed to the outlet in the liquid collection sump.



20. A method as claimed in claim 19 wherein the solids collection sump is lowered to form a wet collection sump and wherein the solids sump is divided into inlet and outlet sides by the reverse-dumping lower separation panel which is fixed at its lower edge to the outlet side of the sump and inclined back at an angle to the transition panel and wherein the liquid which reaches the solids collection sump is forced by water pressure through the lower separation panel to the outlet in the liquids collection sump.
21. An apparatus for the separation of solids from a flowing liquid which apparatus has an inlet and an outlet for the liquid, a separation panel in the path of flow between the inlet and the outlet, the panel presenting a closed face in the direction of flow and having apertures therethrough at an angle thereto, liquid being able to pass through the apertures whereas solids are caused to pass along the face thereof.
22. An apparatus as claimed in claim 21 wherein the arrangement is such that even solids smaller than the size of the apertures can be caused to move past the apertures because of the inertia of the solids,
23. An apparatus as claimed in claim 21 or claim 22 wherein the arrangement is such that even solids smaller than the



size of the apertures can be caused to move past the apertures because of the gravitational force thereon.

24. An apparatus as claimed in any one of claims 21 to 23 wherein the solids which are moved past the separation panel pass to a sump or the like from which they can be removed.
25. An apparatus as claimed in claim 24 wherein the solids are positively carried to the sump by means of the liquid in which they are entrained.
26. An apparatus as claimed in either claim 24 or claim 25 wherein the separation plate is in a separation chamber and wherein there is a flow direction baffle located generally parallel thereto which baffle whilst controlling the flow of the liquid into the sump also permits re-circulation thereof past the separation plate.
27. An apparatus as claimed in claim 26 wherein there is a high level baffle to control floatable solids under extreme conditions.
28. An apparatus for the separation of liquid from a flowing liquid which has entrained solids passing along a channel or pipe which apparatus has at least one separation panel in the wall of the channel or pipe, the panel presenting



a closed face in the direction of flow but apertures therethrough at an angle thereto, liquid being able to pass through the apertures whilst the remaining liquid and the solids are caused to pass beyond the panel.

29. An apparatus as claimed in claim 28 wherein the separation panel is so located to permit the passage of all the liquid and entrained solids when the quantity of these is below a predetermined minimum.
30. An apparatus for the separation of solids entrained in a liquid from a flowing liquid which has entrained solids passing along a channel or pipe which apparatus has an inlet and an outlet for the liquid, a separation panel in the path of flow between the inlet and the outlet, the panel presenting a closed face in the direction of flow and having apertures therethrough at an angle thereto, liquid being able to pass through the apertures, a separator in connection with the inlet so that below a pre-determined flow, the liquid passes to the separator and above this flow liquid passes along the separation plate, liquid being able to pass through the apertures whilst the remaining liquid and the solids are caused to pass to the separator.
31. An apparatus as claimed in claim 29 or claim 30 wherein the separator is a dynamic separator or a vortex



separator.

32. A method substantially as herein described with reference to the accompanying drawings.
33. An apparatus substantially as herein described with reference to the accompanying drawings.

