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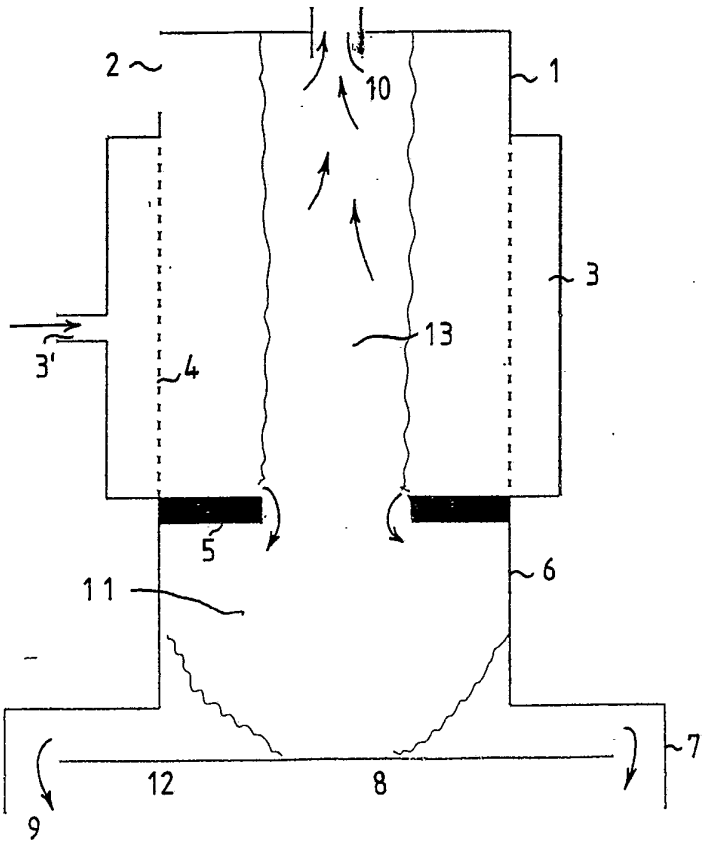
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(54) Title: FLOTATION CYCLONE

(57) Abstract

A flotation cyclone for flotation of small particles of less than 30 µm, comprising a cylinder (1) with an upper section, having a porous wall (4) and an extension (6) having a solid wall, said upper section being provided with an tangential inlet (2) and being covered with a lid, having a vortex finder (10) as a foam outlet, and being surrounded by a gas chamber (3) having a gas inlet (3'), surrounding said porous wall (4), and being provided at the lower end of said porous wall (4) with a weir (5), while the extension (6) of said cylinder, having a solid wall, is provided at its lower end with a liquid as a blocking device.



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# Flotation cyclone

The invention relates to a flotation cyclone, more specifically a flotation cyclone for small particles of less than 30 μm, as well as entities at the molecular level, such as molecules as such as well as ions.

Though various attempts have been made for separating particles by flotation, none of these have turned out to be satisfactory for efficient flotation of small particles of less than 30 μm. The present invention provides a flotation cyclone, capable of efficient flotation of such particles as well as entities at the molecular level, such as molecules as such as well as ions.

The invention relates to a flotation cyclone comprising a cylinder, in its upper section provided with a porous wall, having a tangential inlet for a liquid with the particles to be separated, a weir at the lower end of the porous wall, and a gas chamber surounding said porous wall. The cylinder has an extension beyond the porous wall downwards as a solid wall, provided at its lower end with water as a blocking device, which may be a bottom plate, whether or not adjustable, a cone, a float or similar.

The weir is the separation between the flotation section and the water/foam separating section of the apparatus. The water as a blocking device in said second section allows separation of foam from water. If a bottom plate is used, the cylinder will expand at its lower end to a larger width, causing water to act as a blocking device by appropriate positioning of the bottom plate.

The invention will now be elucidated with reference to the

accompanying drawings without limiting the invention thereto. In the drawings:

Fig. 1 shows a plan view of a flotation cyclone according to the invention, and
Fig. 2 shows a vertical cross-section of the flotation cyclone of Fig. 1.

In the drawings identical parts are referred to by identical reference numbers.

In Fig. 1 is shown a cylinder (1) with an inlet (2) for the material to be treated.

In Fig. 2 the cylinder (1) is shown with a tangential inlet (2), a gas inlet (3'), a porous wall (4), a weir (5), an extension with a solid wall (6), an expansion (7) and a bottom plate (8) with a liquid outlet (9) and a vortex-finder (10).

A liquid, optionally containing a surfactant, as a surfactant, if desired, may be added elsewhere, and having suspended therein small particles (of less than 30 $\mu$m), is introduced through a tangential inlet (2) into a cylinder (1),
comprising a porous wall (4), which is surrounded by a gas-chamber (3) with an inlet (3') around said porous wall (4). At the bottom of the cylinder (1) is a weir (5). The liquid in tangentially injected into the cylinder (1) with the porous wall (4), thus causing rotation. If desired a plurality of tangential inlets may be used. By means of the weir (5), which usually is of an annular shape, a properly controlled rotating liquid film is obtained. The angle of the weir (5) with the wall of the cylinder (1) can be a right angle, but may deviate therefrom. Through the gas-chamber (3) with the inlet (3') a gas, inert with respect

to the liquid, its contents and the apparatus, is introduced through the porous wall (4), thus providing a controlled injection of gas into the film. Preferably the gas pressure and the pores in the porous wall (4) are selected such that the gas bubbles formed are in the order of 0.05-1 mm in size. If desired the gas chamber (3) may be subdivided into segments, especially if the fraction of the

liquid with the wall would cause a rotational velocity gradient in the axial direction. this section of the apparatus is the flotation section.

The liquid passing the weir (5) flows into an area (11) of an extension (6) of cylinder (1), said extension (6) having a solid wall, provided with an expansion (7), thus allowing separation of the liquid from the foam. This latter section is the liquid/foam separating section. The area (11) is provided with an adjustable bottom plate (8), thus allowing liquid to act as a blocking device. The liquid, comprising non-flotated particles, is allowed to discharge from the flotation cyclone by way of an open area (12) between the bottom plate (8) and the outmost wall of the expansion (7). The bottom plate (8) should be positioned in such a way that some liquid is present over the outlet openings at all times in order to prevent gas (foam) from discharging at that end. It should be observed, that the shape of the separation area (11) is not relevant, as mentioned above.

The foam created in porous cylinder (1) comprising the flotated particles therein, will fill the void area (13) of said cylinder (1). The liquid as a blocking device, caused by the bottom plate (8), causes that the foam is compelled to emerge from the flotation cyclone by way of the vortex-finder (10). The length of said vortexfinder (10) may vary from as little as the thickness of the lid up to the full length of the porous wall or even longer. The void area

(13) acts as a foam draining chamber, thus increasing the selectivity of the flotation procedure.

The lid of the cylinder (1) is shown in Fig. 2, where the opening of the vortexfinder (10) has beem omitted.

With the flotation cyclone as outlined above an improvement in the separation yield of from 10% up to 30% or even higher may be achieved.

Example

A flotation cyclone according to the drawings was fed with a sludge containing leadsulfide (PbS) in an mount corresponding with 13000 ppm Pb. After treatment in the flotation cyclone the lead content had been removed for about 80%. In the remaining total of 40% of dry matter the concentration of Pb had been reduced to 4800 ppm Pb.

It will be obvious that the above apparatus may be modified or varied in various ways, such as for example by replacing the particles by molecules or ions, either alone or in combination without departing from the inventive concept.

Claims:

1. A flotation cyclone, comprising a cylinder (1), having a porous wall (4), provided with a tangential inlet (2), a gaschamber (3) with an inlet (3'), surrounding the porous wall (4) of the cylinder (1), at the lower end of said porous wall (4) a weir (5), an extension (6) of the cylinder (1), having a solid wall, provided at its lower end with a liquid as a blocking device.

2. A flotation cyclone according to claim 1, characterised in that the liquid as a blocking device comprises an expansion (7) at the lower end of the extension (6), an adjustable bottom plate (8), fitting in said expansion (7), thus forming liquid outlet (9).

3. A flotation cyclone according to claim 1 or 2, characterised in that the cylinder (1) is provided at its upper end with a foam outlet vortexfinder (10).

4. A flotation cyclone according to claim 2 or 3, characterised in that the bottom plate (8) is positioned in such a way that a liquid as a blocking device is maintained over outlet opening (9) during operation of the cyclone.

5. A flotation cyclone according to any one of claims 1-4, characterised in that the weir (5) has an annular shape.

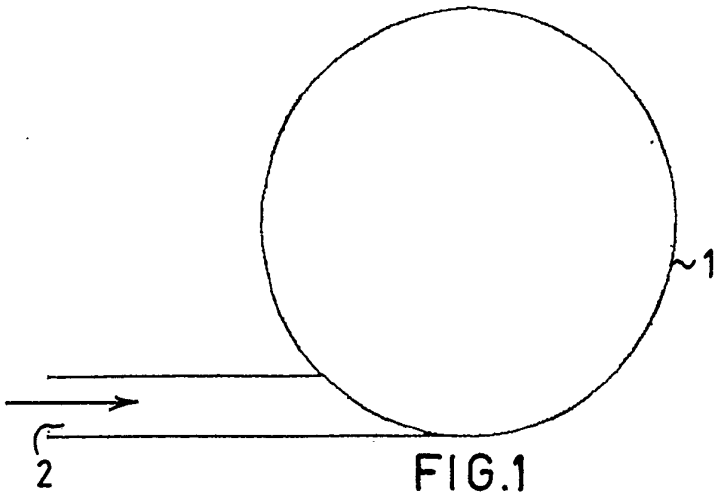



FIG.1

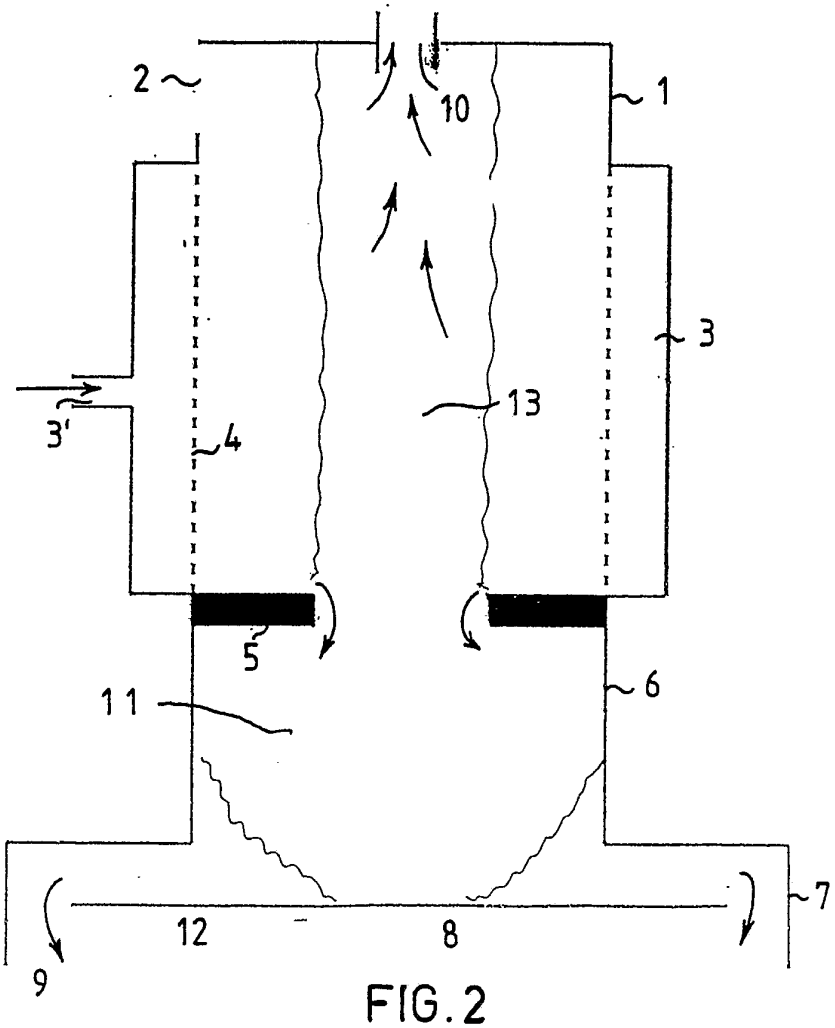



FIG.2

# INTERNATIONAL SEARCH REPORT

PCT/NL 91/00095

International Application No

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 B03D1/14 ; B04C5/14 ; B04C5/10

## II. FIELDS SEARCHED

Minimum Documentation Searched[7]

| Classification System | Classification Symbols |
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Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

## III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

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## IV. CERTIFICATION

| Date of the Actual Completion of the International Search | Date of Mailing of this International Search Report |
|---|---|
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# ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on
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