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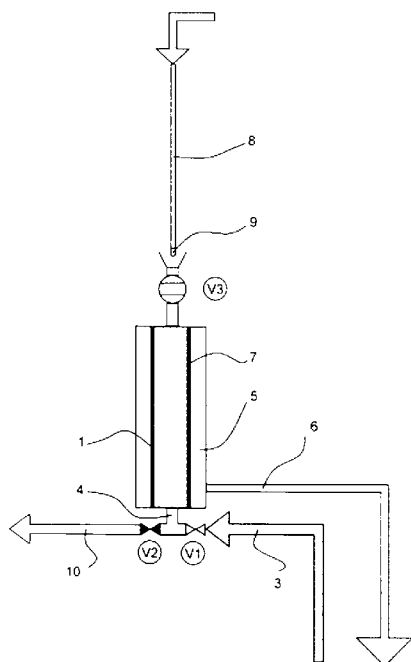
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(54) Title: METHOD AND FILTER DEVICE FOR FILTRATION OF A LIQUID

[Fig. 1]



(57) Abstract: A description is given of a method as well as a filter device for filtration of a liquid containing suspended solid particles, said method comprising a filtration stage wherein the liquid is fed under pressure into a porous, tubular filter (1) causing the liquid to permeate outwardly as a filtrate through the filter and the solid particles to be deposited as a ring-shaped filter cake (7) on the inner side of the filter, and a cleaning stage wherein the filtration process is temporarily stopped and the filter cake (7) is removed from the inner side of the filter. The method and the filtration device are characterized in that a cleaning fluid during the cleaning stage via a number of nozzles (9) provided inside the filter (1) is injected in direction towards the inner side of the filter. Hereby is obtained a quick and efficient cleaning of the filter, hence avoiding blockage of the filter, the possibility of shorter filtration cycles resulting in higher levels of filtration efficiency, a low pressure drop across the filter and hence accelerated flow of filtrate and prolonged lifetime of the filter, leading to lower maintenance costs. This is primarily due to the fact that substances including solidified scales which cause blockage of the filter will be effectively removed by directing jets of a cleaning fluid directly against the inner side of the filter, and hence directly against these substances.

Description

Title of Invention: METHOD AND FILTER DEVICE FOR FILTRATION OF A LIQUID

- [1] The present invention relates to a method for filtration of a liquid containing suspended solid particles, said method comprises a filtration stage wherein the liquid is fed under pressure into a porous, tubular filter causing the liquid to permeate outwardly as a filtrate through the filter and the solid particles to be deposited as a ring-shaped filter cake on the inner side of the filter, and a cleaning stage wherein the filtration process is temporarily stopped and the filter cake is removed from the inner side of the filter. The invention also relates to a filter device for carrying out the method.
- [2] Methods and filter devices of the above mentioned kind are generally known and are widely used in industries involved in the separation of solids and liquids, such as alumina refineries, sugar manufacturing plants, paper mills etc. The type of filter most commonly used today is the so-called backflush filters wherein the operating principle of the cleaning stage involves that the flow direction of the liquid through the filter is temporarily reversed, causing the filtrate to be forced through the filter from the outside and inward, thereby purging the deposited filter cake from the inner side of the filter. Given the need for the filter in backflush filters to be flexible, the cleaning stage in such filters operates at a comparatively low pressure which means that the cleaning of the filter cloth will not always be sufficient. This problem is particularly pronounced in instances where the liquid to be filtered contains substances such as flocculants which cause blockage of the filter cloth and had given rise to major problems in existing alumina refineries. Because of the insufficient cleaning efficiency, and hence the frequently repeated shutdowns for cleaning thus required, the specific filtration efficiency of the filters of the backflush type used hitherto is not as high as desirable. In addition to such long time periods during which the filter is inoperative, this known filter type has the disadvantages that the filter cloth has a relatively short lifetime, that it is very labour-intensive and that it may cause serious health and safety problems for the operating personnel. Also back-up filter units may be required to provide additional filtration capacity during the cleaning process of a filter unit.
- [3] It is the purpose of the present invention to provide a method as well as a filtration device for filtration of a liquid containing suspended solid particles, by means of which the aforementioned disadvantages are eliminated or at least significantly reduced.
- [4] This is obtained according to the present invention by a method of the kind mentioned in the introduction, and being characterized in that a cleaning fluid during the cleaning stage via a number of nozzles provided inside the filter is injected in

direction towards the inner side of the filter.

- [5] Hereby is obtained a quick and efficient cleaning of the filter, hence avoiding blockage of the filter, the possibility of shorter filtration cycles resulting in higher levels of filtration efficiency, a low pressure drop across the filter and hence accelerated flow of filtrate and prolonged lifetime of the filter, leading to lower maintenance costs. This is primarily due to the fact that substances including solidified scales which cause blockage of the filter will be effectively removed by directing jets of a cleaning fluid directly against the inner side of the filter, and hence directly against these substances.
- [6] Any suitable fluid selected from the group consisting of liquids and gases can be used as a cleaning fluid. It is preferred that the cleaning fluid comprises a liquid, preferably filtrate from the process per se, condensate or pure water, which may be mixed with various chemicals in order to promote the cleaning process.
- [7] In order to optimize the cleaning of the filter it is preferred that the cleaning fluid is injected in a direction towards the inner side of the filter across its entire length, which may either be done successively from one end of the filter to the other end or simultaneously across the entire length of the filter. The cleaning fluid may appropriately be injected in the direction towards the inner side of the filter using a lance protruding axially into the filter during the cleaning stage. The lance may be formed with nozzle openings near its free end protruding into the filter and be continuously moved during the cleaning process from one end of the filter to another. Alternatively, the lance may be formed with nozzle openings over a length corresponding to the length of the filter and be retained in the axial direction during the cleaning process. During the cleaning process the nozzles and/or the lance may advantageously in both embodiments be rotated about the longitudinal axis of the lance. During the filtration process the lance may be fully retracted from the filter by means of an appropriate valve mechanism or it may remain inside the filter. In the latter case it is preferred that the nozzles of the lance are adequately covered during the filtration process to prevent clogging of the nozzles.
- [8] The filter cake, and particularly the substances, causing blockage of the filter may be completely jammed and, therefore, it is preferred that the cleaning fluid is injected in direction towards the inner side of the filter at a cleaning pressure of minimum 2 bar, appropriately minimum 10, preferably at least 100 bar and most preferably at least 1000 bar.
- [9] The filter device for carrying out the method according to the present invention comprises at least one porous, tubular filter wherein the liquid to be filtered during a filtration stage is fed under pressure causing the liquid to permeate as a filtrate outwardly through the filter and the solid particles to be deposited as a ring-shaped

filter cake on the inner side of the filter, and means for stopping the filtration process during a cleaning stage for removing the filter cake from the inner side of the filter, and being characterized in that it comprises a number of nozzles being provided during the cleaning stage inside the filter for injecting a cleaning fluid in direction towards the inner side of the filter.

- [10] The nozzles for injecting the cleaning fluid, which comprises liquid and/or gas, in direction towards the inner side of the filter may be provided in a lance which protrudes axially into the filter during the cleaning stage and comprising a channel for conveying the cleaning fluid to the nozzles.
- [11] In one embodiment the lance may be formed with nozzle openings near its free end protruding into the filter. In this embodiment the nozzle openings are preferably provided evenly distributed around the periphery of the lance, and the lance is preferably formed so that it can be continuously moved from one end of the filter to the other during the cleaning process.
- [12] In an alternative embodiment the lance may be formed with nozzle openings over a length corresponding to the length of the filter and be retained in the axial direction during the cleaning process.
- [13] In order to obtain that the injected cleaning fluid hits the maximum possible area of the inner side of the filter and thus an enhanced cleaning efficiency, the nozzles and/or the lance in both above mentioned embodiments may advantageously comprise means for rotation of the nozzles and/or the lance about the longitudinal axis of the lance during the cleaning process.
- [14] During the filtration process the lance may be completely retracted from the filter or it may remain inside the filter. In the former case the filter device comprises an appropriate valve mechanism, such as a ball valve, for safe insertion and retraction, respectively, of the lance. In the latter case it is preferred that the filter device comprises appropriate means for covering the lance nozzles during the filtration process to prevent clogging of the nozzles.
- [15] The filter device further comprises means for injecting the cleaning fluid in direction towards the inner side of the filter at a cleaning pressure of minimum 2 bar, appropriately minimum 10, preferably at least 100 bar and most preferably at least 1000 bar.
- [16] Due to the fact that the filter device according to the present invention is not based on the backflush principle the filter itself will not undergo changes in its shape during the cleaning process but will remain in a fixed position. This makes it possible to use other materials for the filter than for the traditional backflush filters which typically utilize filter bags or candles manufactured from flexible materials. The filter for use in the filter device according to the invention may thus be manufactured from woven steel fabrics, sintered or laser cut filter media or similar materials, resulting in a substantial

improvement in the longevity of the filter, hence reducing the filter replacement intervals, while allowing a higher cleaning fluid pressure for the cleaning process. Alternatively, obtaining the same effects, the filter may be made of a punched plate cylinder with a woven filter cloth or needle felt type cloth on top, both manufactured from textile filtration fabrics.

- [17] The filter device may be formed as an arrangement of single filter tubes in clusters, possibly entailing need for only one of several clusters to be withdrawn from operation for cleaning. This is a distinct advantage over the existing filter types in that it will substantially reduce the need for installing additional filtration area.
- [18] The filter or a cluster of filters may appropriately be surrounded by a collection chamber for collecting and diverting the filtrate.
- [19] The invention will now be explained in further details with reference to the drawing, being diagrammatical, and where
- [20] Fig. 1 shows a filter device according to the invention during a filtration stage, and
- [21] Fig. 2 shows the filter device in Fig. 1 during a cleaning stage.
- [22] Shown in Figs. 1 and 2 is a filter device comprising a porous, tubular filter 1 in which the liquid to be filtered is introduced via a duct 3 through an opening 4 at one end of the filter 1. During the filtration stage shown in Fig. 1, the liquid is forced outwards as a filtrate through the filter 1 to a collection chamber 5 from which the filtrate is diverted via a duct 6, while the solid particles are deposited as a ring-shaped filter cake 7 on the inner side of the filter 1.
- [23] After the filter cake 7 has reached a size necessitating cleaning of the filter, the filtration process is stopped by closing a valve V1 so that the pressure in the filter 1 is released and the liquid level in the filter is lowered. During the cleaning stage shown in Fig. 2, the valves V2 and V3 will then be opened, said valves being fitted at separate ends of the filter 1, and a lance 8 is subsequently introduced into the filter 1 via the valve V3 and is led at an even velocity in direction towards the other end of the filter 1 as indicated by the arrow 11. The shown lance 8 comprises a number of nozzles 9 at its free end protruding into the filter 1 through which nozzles a cleaning fluid is injected in direction towards the inner side of the filter 1 and hence in direction towards the filter cake 7 which will thus be dislodged from the filter causing it to drop/be flushed towards the opening 4 from which the filter cake mixed with the cleaning fluid will be diverted via the valve V2 and a duct 10. When the lance 8 has been fully introduced to the opposite end of the filter, it is retracted relatively quickly whereafter it may perform an additional cleaning cycle or it will be completely retracted from the filter 1. Once the cleaning process is completed, with the lance extracted and the valves V2 and V3 closed, the filtration process is restarted by opening the valve V1.

Claims

- [Claim 1] A method for filtration of a liquid containing suspended solid particles, said method comprising a filtration stage wherein the liquid is fed under pressure into a porous, tubular filter (1) causing the liquid to permeate outwardly as a filtrate through the filter and the solid particles to be deposited as a ring-shaped filter cake (7) on the inner side of the filter, and a cleaning stage wherein the filtration process is temporarily stopped and the filter cake (7) is removed from the inner side of the filter, **characterized in** that a cleaning fluid during the cleaning stage by means of a number of nozzles (9) provided inside the filter (1) is injected in direction towards the inner side of the filter.
- [Claim 2] A method according to claim 1, **characterized in** that the cleaning fluid comprises filtrate from the process per se, condensate or pure water.
- [Claim 3] A method according to claim 1, **characterized in** that the cleaning fluid is injected in direction towards the inner side of the filter over its length successively from one end of the filter to the other end.
- [Claim 4] A method according to claim 1, **characterized in** that the cleaning fluid is injected in direction towards the inner side of the filter over its entire length and simultaneously over the entire length of the filter.
- [Claim 5] A method according to claim 1, **characterized in** that the cleaning fluid is injected in direction towards the inner side of the filter by means of a lance (8) protruding axially into the filter (1) during the cleaning stage, said lance (8) being formed with nozzle openings (9) near its free end protruding into the filter (1) and being continuously moved from one end of the filter to the other during the cleaning process.
- [Claim 6] A method according to claim 1, **characterized in** that the cleaning fluid is injected in direction towards the inner side of the filter by means of a lance (8) protruding axially into the filter (1) during the cleaning stage, said lance (8) being formed with nozzle openings (9) over a length corresponding to the length of the filter and being retained in the axial direction during the cleaning process.
- [Claim 7] A method according to claim 5 or 6, **characterized in** that the nozzles (9) and/or the lance (8) are rotated about the longitudinal axis of the lance.
- [Claim 8] A method according to any of the claims 1-7, **characterized in** that the

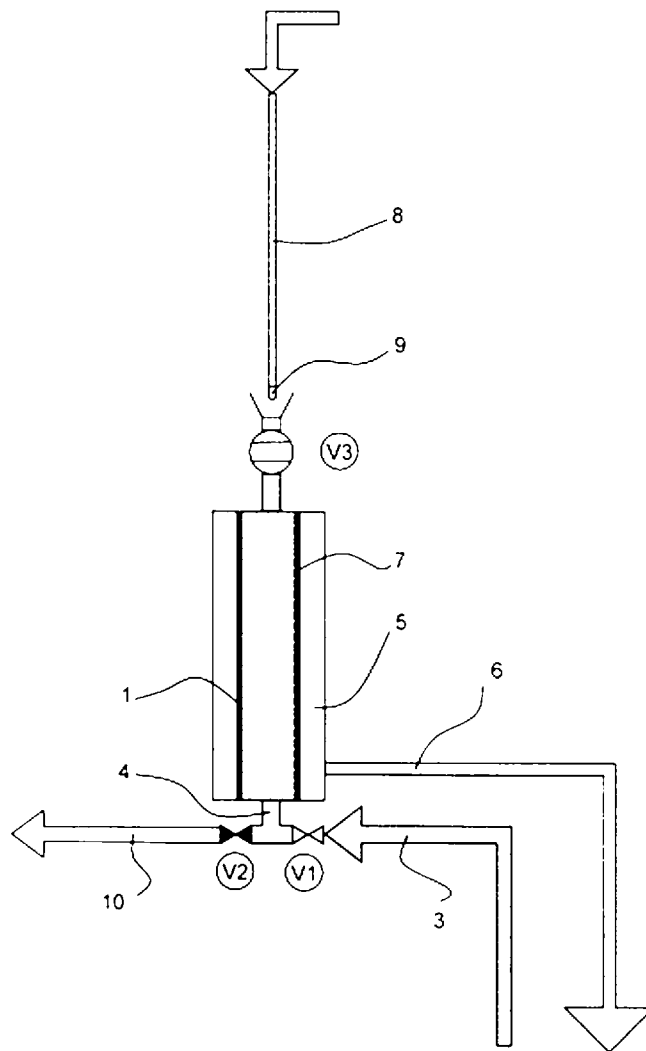
cleaning fluid is injected in direction towards the inner side of the filter at a cleaning pressure of minimum 2 bar, appropriately at least 10, preferably at least 100 bar and most preferably at least 1000 bar.

- [Claim 9] A filter device for carrying out the method according to claim 1, said filter device comprising at least one porous, tubular filter (1) wherein the liquid to be filtered during a filtration stage is fed under pressure causing the liquid to permeate as a filtrate outwardly through the filter and the solid particles to be deposited as a ring-shaped filter cake (7) on the inner side of the filter and means (V1) for stopping the filtration process during a cleaning stage for removing the filter cake (7) from the inner side of the filter, **characterized in** that it comprises a number of nozzles (9) being provided inside the filter (1) during the cleaning stage for injecting a cleaning fluid in direction towards the inner side of the filter.
- [Claim 10] A filter device according to claim 9, **characterized in** that the nozzles (9) for injecting the cleaning fluid in direction towards the inner side of the filter are provided in a lance (8) which protrudes axially into the filter (1) during the cleaning stage.
- [Claim 11] A filter device according to claim 10, **characterized in** that the lance (8) is configured with nozzle openings (9) near its free end protruding into the filter (1).
- [Claim 12] A filter device according to claim 11, **characterized in** that the nozzle openings (9) are provided evenly distributed about the periphery of the lance (8) and in that the lance (8) is formed so that it can be continuously moved from one end of the filter to the other end during the cleaning process.
- [Claim 13] A filter device according to claim 10, **characterized in** that the lance (8) is formed with nozzle openings (9) over a length corresponding to the length of the filter and being retained in axial direction during the cleaning process.
- [Claim 14] A filter device according to any of the claims 9-13, **characterized in** that the nozzles (9) and/or the lance (8) comprise means for rotation of the nozzles (9) and/or the lance (8) about the longitudinal axis of the lance during the cleaning process.
- [Claim 15] A filter device according to any of the claims 10-14, **characterized in** that it comprises a valve mechanism (V3), such as a ball valve, for safe insertion and retraction, respectively, of the lance (8).
- [Claim 16] A filter device according to any of the claims 10-14, **characterized in**

that the lance (8) remains in the filter during the filtration process and in that the filtration process comprises means for covering the nozzles (9) of the lance during the filtration process to prevent clogging of the nozzles.

- [Claim 17] A filter device according to any of the claims 9-16, **characterized in** that the filter device comprises means for injecting the cleaning fluid in direction towards the inner side of the filter at a cleaning pressure of minimum 2 bar, appropriately at least 10, preferably at least 100 bar and most preferably at least 1000 bar.
- [Claim 18] A filter device according to any of the claims 9-17, **characterized in** that the filter 1 is manufactured from woven steel fabrics, sintered or laser cut filter media or similar materials.
- [Claim 19] A filter device according to any of the claims 9-17, **characterized in** that the filter 1 is made of a punched plate cylinder with a woven filter cloth or needle felt type cloth on top, both manufactured from textile filtration fabrics.
- [Claim 20] A filter device according to any of the claims 9-19, **characterized in** that it is configured as an arrangement of single filter tubes in clusters.
- [Claim 21] A filter device according to any of the claims 9-20, **characterized in** that the filter (1) or a cluster of filters (1) is surrounded by a collection chamber (5) for collecting and diverting filtrate.

[Fig. 1]



[Fig. 2]

