

Method for cleaning filter devices of a module for filtering fluids, and module for carrying it out

Field of the invention

The invention relates to a method for cleaning filter devices of a module for filtering fluids,
5 and a module for carrying it out.

State of the art

Various filter systems are known which, for example for industrial purposes, filter fluids and divert the filtered fluid back. As a continuous filter operation is sought for industrial purposes in terms of maximum machine efficiencies, it is advantageous to minimize filter-cleaning times. In order to maintain a continuous filter operation despite occasional
10 outage of a filter, several filter modules can be used in parallel, which feed filtrate into a central header pipe. At the same time, the quantity of filtrate can be increased thereby. Such a filter system is disclosed for example in WO 2013/048801 A1. This comprises a filter module arrangement which comprises a container with a filtration cartridge arranged
15 in it and a header coupled to one end of the container, wherein the head contains a housing with an open upper end and a lower end as well as an end cap. A portion which fits a complementary structure, which is defined by the inside of the entire open upper end of the housing, so that it engages removably with the housing and the end cap, defines a passageway through which liquid can flow out of the container. The filter module
20 arrangement makes a manifold arrangement possible, which is used to convey liquids to and from a filter system which comprises several such modules. However, disadvantages of existing solutions for filter cleaning are that they are based on the principle of backwashing, thus the complex reversal of the flow direction and the use of filtrate to wash the filters against the main filter direction. The long paths owing to the principle
25 result in a large head loss in the pipe system and a poor fluid distribution, whereby the effectiveness of the process is reduced and thus process times are increased. This, combined with the use of filtrate, thus the product of the filter process, ultimately has the result that machine efficiencies are reduced. Efforts are being made to use filter systems with which backwashing can be effected inside a single flow space. In the process, the
30 backwashing path is reduced and a compact module with a filtrate-producing module region and a backwashed module region is provided. However, the flat membrane filters used in the process lead to a poor flow distribution, as the fluid flows in and out only over

a small proportion of the surface of the filter. A large part of the filter is thus insufficiently cleaned. Furthermore, the flow path of the filtrate which is fed into the module via the filtrate header pipe normally discharging the filtrate is also very long, which leads to large flow losses.

5 Presentation of the invention

The object of the invention is to provide a method for cleaning filter devices of a module for filtering fluids, and a module for carrying it out, with which the filter devices can be cleaned efficiently and cost-effectively. The fluid to be filtered is preferably a liquid, in particular water, wherein gas, for example nitrogen, can also be used for the cleaning method.

This object is achieved by a method according to claim 1 and by a module according to claim 7. Further features developing the invention are contained in the dependent claims.

In a method according to the invention for cleaning a filter device of a module for filtering fluids, the supply pipe leading to a module is split, with the result that simultaneously at least one first supply channel conveys a fluid to the filter device and at least one second supply channel discharges the fluid from the filter device. It is thus ensured that, when the fluid is being discharged through a supply pipe, the particles located in the filters are washed out by the fluid. In particular when the supplied fluid is filtered through the associated filter and guided into the filtrate space and from there exits again only through the filter belonging to the discharging supply pipe, this filter is cleaned extremely thoroughly. This also functions in the opposite direction. Thus when the fluid for cleaning the filter device is conveyed directly from the supply pipes to the filter device, a complex filling of a filtrate channel connected to the module is unnecessary. Furthermore, the path of the fluid and the number of elements through which the fluid flows are also minimized. Moreover, the simultaneous backwashing of one side and provision of filtrate at the outlet can also be achieved through skilful throttling. An advantage of the invention is that the usage of space is greatly reduced, as only one module is required, instead of two modules. Therefore, the outlay on connection is likewise reduced. Furthermore, specific backwashing methods, for example the cross-over backwashing method, can be carried out. A further advantage of the invention is that, through the reduction of the backwashing path, a poor flow distribution during the backwashing can be prevented. The fluid required for the backwashing is provided, in particular filtered, in the immediate environment in

which it is used. Thus, a more homogeneous flow distribution inside the module is established, with the result that very differently contaminated regions of the filter device are avoided and the blocking of the filter element membranes is reduced uniformly.

5 In the method for cleaning a filter device of a module for filtering fluids, a first supply channel preferably conveys fluid via the filter device to a second supply channel. Hollow fibre membranes are preferably used as filter elements. The filter device is cleaned by flushing the fluid past the inner walls of the fibres, without the fluid being filtered by the hollow fibre membrane in the process. Because the fluid is conveyed not through the filters, but past the filter membranes, the cleaning of the filters, although not as thorough,
10 is instead much quicker. In another preferred embodiment, the fluid is filtered through the filter device before being discharged through the at least second supply channel and cleans the filter during backwashing. The filter is thereby thoroughly freed of the particles.

In further methods according to the invention, the fluid is preferably filtered through the filter device before being discharged in the second supply channel. This ensures that the
15 part of the filter device to be cleaned is cleaned with filtrate. The cleaning thus becomes much more effective.

Method according to one of the preceding claims, furthermore comprising the step of closing one or more supply channels, in particular by means of a valve. The filters to be cleaned can be controlled very easily by the closing of single or several supply channels.

20 The filters of several modules connected to each other in series with the first and second supply channels can be cleaned at the same time, which configures the method more efficiently. Two or more modules can also be connected to each other in parallel.

In further methods according to the invention, the fluid is preferably filtered through the filter device before being discharged in the second supply channel. This ensures that the
25 part of the filter device to be cleaned is cleaned with filtrate. The cleaning thus becomes much more effective.

The invention also relates to a module for filtering fluids, comprising a supply pipe for conveying fluid, a filter device comprising a filter element, which is equipped to filter in each case the fluid conveyed by the supply pipe to the filter device, a filtrate space for
30 collecting the fluid filtered through the filter element and a filtrate channel, which collects the filtrate from the filtrate space and discharges it, wherein the supply pipe has at least

two supply channels separated from each other, and for each of these supply channels the filter device has a filter inlet region allotted to this one alone. This module makes the method according to the invention and the advantages described with it possible.

5 The filter element can comprise a hollow fibre membrane. These are suitable for both types of filter cleaning, which makes the module more flexible.

The supply channels are preferably at least partially formed of two separated tubes and/or as one tube in which the separation of the supply channels is formed by a separator. Furthermore, the module can comprise a head element, in which the supply channels are formed by chambers separated from each other and which adjoin the filter device.

10 The chambers preferably each have two connection openings, with the result that the fluid can flow into the chamber and at least partially also flow out. The connections between the at least one separator and the regions adjoining it are preferably sealed against the fluid by means of a sealing element.

15 At least one supply channel preferably has an indentation for discharging gas. This is of use in particular when the filters are cleaned or when filling with fluid for the first time. This indentation is formed on the upper side of the supply channel(s) (in relation to the direction of gravity).

20 The module furthermore comprises in particular a valve device with one or more valves, with which one or more supply channels and/or one or more filtrate channels can be closed. The flow direction of the fluid and thus the filters to be cleaned can thereby be controlled easily. The valve can be provided for example in the head region.

The modules simultaneously act as a header, in order to distribute the corresponding flows to the modules connected to each other in series, wherein the optionally present separation of the flows is preserved via modules arranged in series.

25 Brief description of the figures

Figure 1a shows a module according to the invention for filtering fluids with supply channels formed in one tube and separated by a separator;

Figure 1b shows a vertical sectional view of Figure 1a with a section taken perpendicular to the separator, in which both supply channels inside the module are visible;

Figure 1c shows a vertical sectional view of Figure 1a with a section taken parallel to the separator, in which both supply channels inside the module are visible;

- 5 Figure 2a shows a module according to the invention for filtering fluids with supply channels formed in two tubes.

Figure 2b shows a vertical sectional view of Figure 2a with a section taken perpendicular to the separating wall located in the module between the supply channels, in which both supply channels inside the module are visible;

- 10 Figure 2c shows a vertical sectional view of Figure 2a with a section taken parallel to the separating wall located in the module between the supply channels, in which both supply channels inside the module are visible;

Figure 2d shows an isometric view of two modules according to the invention connected in parallel for filtering fluids;

- 15 Figure 3a shows an abstract representation of the filtering process using a module according to the invention for filtering fluids.

Figure 3b shows an abstract representation of a variant of the method according to the invention for cleaning filter devices of a module for filtering fluids, in which fluid is supplied via at least one supply channel, then filtered through a filter element, then discharged for
20 cleaning another filter element and finally via at least one supply channel adjoining the other filter element;

Figure 3c shows an abstract representation of a variant of the method according to the invention for cleaning filter devices of a module for filtering fluids, in which the method shown in Figure 3b is carried out in the opposite direction;

- 25 Figure 3d shows an abstract representation of a variant of the method according to the invention for cleaning filter devices of a module for filtering fluids, in which fluid is supplied via a supply channel, then filtered through a filter element, then discharged for cleaning another filter element and finally via at least one supply channel adjoining the other filter

element, wherein the fluid-discharging supply channel is located in a module which is connected in parallel to the other module, in which the supply channel supplying the fluid is located;

5 Figure 3e shows an abstract representation of a variant of the method according to the invention for cleaning filter devices of a module for filtering fluids, in which the filter device is cleaned by flushing the fluid past, in that fluid is guided along the filter membrane, without being filtered; and

10 Figure 3f shows an abstract representation of a variant of the method according to the invention for cleaning filter devices of a module for filtering fluids, in which the method represented in Figure 3e is carried out with the difference that fluid is simultaneously supplied and discharged in one module.

Description of the preferred embodiments

First of all, a module 10 for filtering fluids will be described in the following, wherein directions always relate to the corresponding figures. A basic embodiment of a module 10 for filtering fluids comprises a supply pipe 14 for conveying fluid. The supply pipe 14 has at least two supply channels 12, which convey the fluid to a filter device 15. The supply channels can be formed as separate tubes or also inside one tube by a separating wall. The supply channels also comprise a separated region in a head element 18. The filter device 15 comprises several filter elements. The filter elements are preferably formed as a plurality of coiled flat membranes laid one on top of the other or hollow fibre membranes arranged next to each other, through which the fluid conveyed by the supply pipe is pushed and which then take up the constituents to be filtered out of the water. Hollow fibre membranes are particularly preferred. The at least two supply channels 12 separated from each other each have a filter inlet region of their own, at which the fluid enters the filter device 15.

The module 10 furthermore comprises a filtrate space 16 for collecting the filtrate, i.e. the fluid filtered through the filter element, and a filtrate pipe 17, which can have one or more filtrate channels and which collects the filtrate from the filtrate space 16 and discharges it. The filtrate channel can be arranged off-centre or centrally, wherein a greater flexibility of the combination of several modules 10 tends to result with the off-centre arrangement and better flow conditions in the single module 10 tend to result with the central arrangement.

In the embodiments represented here the filtrate space 16 is formed as a cylindrical container. The supply pipes can be provided both on the top and on the bottom, as represented by way of example in Figure 2d. Several different settings thereby result for the cleaning method which is described below.

5 The filtrate enters the filtrate pipe 17 through outlet openings in the wall of the filtrate space (not shown). These outlet openings are arranged on the filtrate space 16, preferably close to the fluid channel in the head element. The filtrate pipe 17 can be connected to the outlet openings by a connecting piece (not shown). Such connecting pieces are disclosed for example in the subsequently published European application with
 10 the application number EP 10 2020 116 184. The connection element is an independent element, but which can also be formed as part of the filtrate space 16, as part of the filtrate pipe 17 or part of the supply pipe 14, and in one piece with these. The connection element has for example two connecting flanges or connection points, to which tubes of the filtrate pipe 17 can be fastened. The connection element surrounds the filtrate space
 15 16 at the outlet openings in such a way that a wall in front of the outlet opening(s) forms a comparatively narrow gap. With the usual dimensions of such pipe arrangements, at the widest point, the gap is preferably 10 cm to 20 cm or less, possibly also only 7 cm or less. Furthermore, the gap preferably tapers, in particular from the position laid further away from the filter inlet region to the filter (thus e.g. upwards in Figure 1a), i.e. in the vicinity of
 20 the filter inlet region the gap is formed narrower, with the result that less fluid can flow out of the filtrate space 16 into the connection element directly at the filter inlet region. The gap is provided all round the outlet openings. However, at the points where there is no gap, no outlet openings are provided. The tube wall of the filtrate space 16, which is directed into the diameter of the connection element, which is connected to the filtrate
 25 pipe 17, has no outlet openings 42. A first embodiment of a module 10 for filtering fluids such as for example water is represented in Figures 1a to 1c. This preferred embodiment of a module for filtering fluids 10 comprises a supply pipe 14 for conveying fluid and a filter device 15 comprising a filter, which is equipped to filter in each case the fluid conveyed by the supply pipe 14 to the filter device 15. Furthermore, the module has a filtrate space 16
 30 for collecting the fluid filtered through the filter and a filtrate channel 17, which collects the filtrate from the filtrate space 16 and discharges it. The supply pipe 14 has at least two supply channels 12 separated from each other, and for each supply channel 12 the filter device 15 has a filter inlet region allotted to this one alone. The filter element 15 preferably comprises hollow fibre membranes, which in particular connect two filter inlet regions,
 35 which are provided for supply pipes 12 opposite in relation to the filtrate space 16. This

makes it possible in particular, if two modules 1 connected to each other in parallel are used, to clean the filter device by flushing the fluid along it, without filtering the fluid in the process. This preferred embodiment is represented schematically in Figures 3e and 3f. For example, higher fluid-conveying rates and higher fluid-conveying speeds can thereby
 5 be used.

In the module 10 shown in Figures 1a and 1b for filtering fluids, two supply channels 12 connected to the module are combined in a single tube. The separator 20 represented in Figure 1a also extends into the head region 18, with the result that the separated supply of fluid is ensured up to the filter device 15. The region between the separator 20 and the
 10 regions adjoining it is particularly preferably sealed against the fluid by means of a sealing element. Secondary flows are thus prevented and higher fluid-conveying rates and higher fluid-conveying speeds can be used. Such a seal can be for example an elastomer seal formed as a lip seal, flat seal or wedge. The sealing element can be glued or welded into the module. There is likewise the possibility of introducing the seal as a second
 15 component directly in the casting process. In a particularly preferred embodiment an elastomer seal is cast directly in the casting process into a corresponding cavity of the module consisting of thermoplastic, for example of polyurethane. Advantages accompanying this are a highly efficient production method and a high impermeability of the sealing element.

20 As an alternative to the combination of two supply channels 12, connected to one module 10 for filtering fluids, in a single tube, these can be connected via separate tubes, which is shown in Figure 2a. Unlike the connection of supply channels 12 combined in one tube, the production of the tubes is structurally less complex, as there is no need to use a lengthened separator 20 at great effort. Otherwise, the embodiment in Figures 2a-2d does
 25 not differ from the embodiment in Figures 1a-1c.

In the head region 18 of the module 10 for filtering fluids, the supply channels 12 are formed as chambers separated from each other, which adjoin the filter device 15. Such chambers are shown for example in Figures 1b and 2b. In particular, a more uniform introduction of the fluid into the filter element is thereby made possible.

30 Indentations 22 for discharging gas can be introduced in the supply pipes 12 of the module 10, in particular in the region of the chambers of the head element directed upwards, in order to promote the gas rising as a fluid with low density. The gas to be

discharged can be air for example, which is present for example in the pipes before they are filled with fluid for the first time, or also nitrogen used for cleaning. An advantage of these discharge indentations 22 is that the gas can be quickly and effectively removed from the pipes, and thus the flow behaviour of the fluid is favoured, in particular when the flow direction is changed owing to the cleaning.

Furthermore, a valve device comprising at least one valve can be provided, with which one or more supply channels 12 and/or one or more filtrate channels 17 can be closed. On the one hand, this makes it possible to implement specific backwashing methods, for example the cross-over backwashing method shown in Figure 3d. On the other hand, it is made possible to clean modules 10 connected to each other in series during the filtering process, in that contaminated fluid discharged by one module 10 is not conveyed to the next module 10, but rather the flow path is changed by corresponding valve positions in such a way that the contaminated fluid can optionally be temporarily taken out of the process. Furthermore, the use of a valve device makes it possible to react to a varying demand for filtrate in the process in the short term, by connecting an additional supply channel 12 in the case of increasing demand and disconnecting a supply channel 12 in the case of decreasing demand. In a particularly preferred embodiment the valve is provided in the head region, whereby flow paths can additionally be shortened. In principle, stop valves are not necessary. It is sufficient in the case of one or more supply channels 12 not to pump any fluid in or to convey any to the filter device 15. The fluid and/or the filtrate are then pushed, by the pump pressure of the conveying supply channels 12, through the filter into the not conveying supply channel(s) 12 and cleans it. With a valve controller, the supply channels can be blocked individually and the filters to be cleaned can be cleaned better and more quickly.

The head regions 18 can have not only inlet openings for the supply pipes, but also outlet openings, with the result that several modules can be connected in series. The supply pipes 12 thus convey the fluid to a plurality of filter devices 15 and filtrate spaces 16, which are arranged one behind another.

The module is represented schematically in Figures 3a-3f, wherein two filter devices and corresponding supply pipes are arranged opposite and thus parallel. This means that four supply pipes are provided here. By way of example, hollow fibre membranes are used as filter devices 15 here. The normal functional operation of the module 10 is represented in Figure 3a. The supply pipes 12 guide the fluid to the filter devices 15, where they are

pushed through the membrane and the particles of the fluid remain suspended in the filter. The thus formed filtrate is located in the filtrate space and is then taken away by the filtrate pipe 17.

5 The various cleaning methods can then be carried out with the described modules. A method according to the invention for cleaning filter devices 15 of a module 10 for filtering fluids comprises the supply and/or discharge of fluid to and/or from the filter device 15 via several supply channels 12. This means that at least one supply pipe 12 conveys the fluid to the filter device 15 and one supply pipe 12 discharges the fluid conveyed there. When the fluid is moved in the region of the filter device 15, it is either moved through a porous
10 region of the filter device 15, for example the membrane, and thus filtered or guided along the porous region and thus not filtered.

In the embodiments of the method shown in Figures 3b and 3c, the fluid is filtered. Here, the fluid exits a filter element of the filter device 15 in the direction of the filtrate space 16 via a first supply channel 12. Filtrate from the filtrate space 16 then enters a supply
15 channel 12 corresponding to it in the reverse direction via another filter element of the filter device 15 and in the process cleans the other filter element. These embodiments also function with only two supply channels in a design of the module which is not parallel.

A diagonal method is represented in Figure 3d. Here, four supply channels are provided, but only two opposite each other diagonally are used, the others are closed, for which
20 valves are used in particular. This makes it possible to clean particular filters in a targeted manner more efficiently. Of course, the flow direction can be reversed or the supply channels 12 open in Figure 3d can be closed and the closed ones opened in order to reverse the diagonal method.

An embodiment in which fluid is used for cleaning a filter device 15, but is not filtered, is
25 represented in Figures 3e and 3f. These embodiments function, in contrast to the other cleaning methods, only with a hollow fibre membrane, but not with a flat membrane. There, the fluid then does not exit the filter device 15 in the direction of the filtrate space 16, but flows through the hollow fibre membranes to the opposite filter inlet region of another supply pipe 12. The filter device 15 is cleaned by the fluid guided along the hollow
30 fibre membranes, in that the particles located in the hollow fibre membrane are taken up by the fluid.

In a preferred embodiment, in which fluid is used to clean a filter device 15, several modules 10 are connected to each other in series by the same supply channels 12. This makes it possible for the fluid to be able to flow into a chamber present in the head element of the module 1 and at least partially flow out. A supply channel 12 used in a module 10 for supplying fluid is particularly preferably used in another, subsequent, module 10, likewise for supplying fluid, in order that the contaminants present in the supply channel 12 used for discharging fluid do not contaminate a filter device following in the process. In order to make this embodiment possible, modules 10 with two openings for each supply channel 12 are necessary in order to supply some of the fluid supplied to the module 10 or discharged from the module 10 to the subsequent module 10 or to discharge it therefrom.

In a preferred embodiment, in which fluid is used to clean a filter device 15 and which is represented in Figure 3, several modules 10 are connected to each other in parallel by the same filter device 15. On the one hand, this makes it possible in particular to guide fluid along a filter device 15, without the fluid being filtered. On the other hand, in particular specific backwashing methods, for example the cross-over backwashing method, are thereby made possible in the region of a single filter device 15.

List of reference numbers

10	Module for filtering fluids
20	12 Supply channel
	14 Supply pipe
	15 Filter device
	16 Filtrate space
	17 Filtrate channel
25	18 Head region
	20 Separator
	22 Indentation

Claims

1. Method for cleaning filter devices (15) of a module for filtering fluids (10), the module comprising a supply pipe with at least two separate supply channels (12) that supply a fluid to a filter device (15), the filter device comprising a respective filter inlet region for each supply channel, a filtrate space and a filtrate pipe comprising one or more filtrate channels for receiving, and discharging, filtrate from the filtrate space, in which said supply channels (12) comprise at least a first supply channel for supplying fluid to the filter device simultaneously with at least a second said supply channel discharging fluid from the filter device.
2. Method according to claim 1, in which the fluid is conveyed unfiltered from the first supply channel (12) via the filter device (15) to the second supply channel.
3. Method according to claim 1, in which the fluid is filtered through the filter device (15) before being discharged through at least the second supply channel.
4. Method according to one of the preceding claims, comprising the step of closing one or more supply channels (12), in particular by means of a valve.
5. Method according to one of the preceding claims, comprising several modules (10) connected to each other in series with the first and second supply channels (12), such that the modules are cleaned at the same time.
6. Method according to one of the preceding claims, used on at least two modules (10) connected to each other in parallel.
7. Module for filtering fluids (10), comprising:
 - i. a supply pipe (14) comprising at least two separate supply channels for conveying a fluid to a filter device;
 - ii. the filter device (15) comprising a filter element, which is equipped to filter the fluid conveyed by each supply channel to the filter device (15);
 - iii. a filtrate space (16) for collecting the fluid filtered through the filter element; and

- iv. a filtrate channel (17), which collects the filtrate from the filtrate space (16) and discharges it;

characterized in that

the filter device (15) has a respective filter inlet region allotted to each supply channel, wherein said supply channels (12) comprise at least a first supply channel for supplying fluid to the filter device simultaneously with at least a second said supply channel discharging fluid from the filter device.

8. Module according to claim 7, in which the filter element comprises a hollow fibre membrane.

9. Module according to claim 7 or 8, in which the supply channels (12) are at least partially formed of two separated tubes and/or the separation of the supply channels (12) is formed by a separator (20) in one tube.

10. Module according to one of claims 7-9, comprising a head element, in which the supply channels (12) are formed by chambers separated from each other, which adjoin the filter device (15).

11. Module according to claim 10, in which the chambers each have two connection openings, with the result that the fluid can flow into the chambers and at least partially flow out.

12. Module according to claim 9, wherein connections between the separator (20) and the regions adjoining it is preferably sealed against the fluid by means of a sealing element.

13. Module according to one of claims 7-12, in which at least one said supply channel (12) has an indentation (22) for discharging gas.

14. Module according to claim 10, comprising a valve device comprising a valve, with which a said supply channel (12) and a said filtrate channel (17) can be closed.

15. Module according to claim 14, in which the valve is provided in the head region.