TITLE OF INVENTION

FILTRATION ASSEMBLY WITH BACK WASHING CAPABILITY AND THE METHOD OF FILTRATION/BACK WASHING USING THE SAME

TECHNICAL FIELD

The present invention relates generally to water purification and more particularly to a novel filtering system where filtering clothes which are expandable and have a hairy side are employed. The filtration system allows repeated back washing and the filtered water is clear, and the solid contents of discharge are high. The filtration system provides improved efficiency in filtration process with more frequent occasional back wash process. The combination of an intermittent pump and the sagging filter cloth drops the particle in the sludge and greatly reduce the blockage of the filtering clothes.

BACKGROUND OF THE INVENTION

Filtration is the process of separating suspended solid matter from a liquid, by causing the latter to pass through the pores of a filter. For solid/liquid and/or solid gas separation, filtering process is one of the main processes to use.

In practise, a great amount of filter cartridges are used in the filtration process. The used filter cartridge will be choked after a period of time and all such choked cartridge cannot be reused. In general, the core and filament of a choked cartridge are still in good condition. The solid trapped in filament cannot be easily removed. Accordingly, in filtration process, filter cartridge is a huge consumable part in industries. While the present invention, the filament is only one layer of cloth. The choked particle is on the surface of the one layer cloth. It is very easy to be washed out. The filtering efficiency is maintained by multi-layer bag. The outer layer overlap to multi-layer and trap the choked particle. When back wash, the overlapped cloth will open wide. The solid particle will be released. The back wash is very efficient.

The current practice on the disposal of the choked cartridge is to incinerate but this practise has caused secondary plastic pollution. In the market, there are some systems than can back wash the filter cartridge for several times. The major part of the solid that trapped in the filter

For a more complete understanding of the present invention and the advantages thereof, reference should be made to the following Detailed Description taken in connection with the accompanying drawings in which:

FIG. 1 is a schematic diagram, partly in section, showing a current used filtering system.

FIG. 2 is a schematic diagram, partly in section, showing cross flow in reducing cake thickness of a conventional filtering system.

FIG.3 is another conventional filtering system, showing expansion of disc at back wash.

FIG. 4 is a schematic view showing a preferred embodiment of a filtration assembly (100) with back washing capability for slurry in accordance with the present invention.

FIG. 5 is a cross section view showing the plurality of the steel cores (20) in the central tank compartment (120) in accordance with the present invention.

FIG. 6 is a cross section view showing the structure of the tank (10) in accordance with the present invention, wherein a plurality of steel cores (16) are located within the centre tank compartment (120) of the tank (10).

FIG. 7 is a flowchart showing the process of filtering in accordance with the present invention.

FIG. 8 is a flowchart showing back washing process in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference is made herein to the attached drawings. Like reference numerals are used throughout the drawings to depict like or similar elements of the back washable filtering system. For the purposes of presenting a brief and clear description of the present invention, the preferred embodiment will be discussed as used for back washable filtering system, where solid on the filtering cloth and the filtering aids of the system loses support and thus drops to the bottom of the tank in the course of back wash process. The figures are intended for representative purposes only and should not be considered to be limiting in any respect.

FIGS. 1 – 3 schematically show some of the conventional types of filtering systems available in the market that are used in industries.

Referring now to FIG. 4, there is shown schematically a preferred embodiment of a filtration assembly (100) with a slurry pump to provide back washing capability for slurry in accordance with the present invention. The filtration assembly (100) comprises (i)

a cylindrical tank (10) having a top plate (60) and a bottom plate (60') mounted across the tank (10) ; (ii) a plurality of elongated steel cores (20) with perforated outer surface; (iii) an enclosure (16) being mounted to enclose the plurality of steel cores (20); (iv) a first filtering cloth (11) mounted concentrically and dangling to the cylindrical tank (10); (v) a second filtering cloth (12) with a plurality of hairy elements being used to enclose the steel enclosure (16); and (vi) a third (13) and a fourth (14) filtering cloth each mounted individually to each of the steel cores (20). In the preferred embodiment, the slurry pump of the filtration assembly (100) provides intermittent flow of the slurry, and the third filtering cloth (13) and the fourth filtering cloth (14) are used to trap finer particles in the slurry. The third and fourth filtering cloths (13, 14) mounted to the steel cores (20) can be easily changed after a period of use by removing the top plate (60).

In the preferred embodiment, the tank (10) of the filtration assembly (100) is substantially cylindrical and is divided into three compartments by the top plate (60) and the bottom flange (60'). The three compartments (110, 120, 130) include an upper tank compartment (110), a central tank compartment (120) and a lower tank compartment (130). The lower tank compartment (130) is a funnel shape which is ended with a discharge outlet (24) mounted with a discharge valve (24'), as shown in FIGS. 4 and 5.

The upper tank compartment (110) and the central tank portion (120) which are separated by the top plate (60) are in fluid communication. The central tank compartment (120) and the lower tank compartment (130) separated by the bottom flange (60') are in fluid communication. At the lateral side of the central tank compartment (120), one or more feed inlets (82) having a control valve (82') are provided. The feed includes the slurry to be filtered by the filtration assembly (100). The feed inlet (82) is acted as an entrance of slurry or feed into the central tank compartment (120) in the course of filtering process by the filtering system (100) in accordance with the preferred embodiment of the present invention. The discharge outlet (24) is provided at the lower tank compartment (130) such that any filtered sludge processed by the filtration system (100) will then be discharged, and the discharge is controlled by the discharge valve (24') mounted thereto.

The structure of the lower tank compartment (130) is a funnel shape design which facilitates the collection of sludge and allows the formation of cyclone effect enhancing the settlement of sludge when the slurry enters the tank (10) in the course of filtering process. The discharge outlet (24) is provided with the control valve (24') which controls the flow of sludge out from the tank (10) by pressure gauge. The control valve (24') opens occasionally to maintain the pressure in the cylindrical tank (10). The plurality of steel cores (20) are employed in the preferred embodiment and are used in the filtering process of the present invention. As shown in the figure, the steel cores (20) and the relative position thereof are shown. The

The third (13) and the fourth (14) filtering cloth encompass the steel cores (20) at the outer surface of thereof. The slurry flowing in to the tank (10) to be filtered will enter to the space formed between the first filtering cloth (11) and the tank (10) which will form a pulse circumferential crossflow to the groove (103) to generate a whirlpool, a partial of the particle from the slurry will be settled as sediment, and is then filtered by the first filtering cloth (11) and then by the second filtering cloth (12), and the filtered water then passes through the third and fourth filtering cloth (13, 14), and enters the steel cores (20) to be delivered by the slurry pump. The slurry is filtered by the first filtering cloth (11) and the second filtering cloth (12), and particles in the slurry will be trapped by the hairy elements of the second filtering cloth (12) and third filtering cloth (13). As a result of the hairy elements, the second filtering cloth (12) remains its functionability as clotting of the slurry is minimized, a backwash to the third, second and first filtering cloth, and any clotted particles on the filtering cloth (11, 12, 13, 14) will completely drop off, and therefore the filtering efficiency of the filtering cloth is maintained after the particles are disposed off from the surface of the filtering cloth (11, 12, 13, 14). The plurality of the steel cores (20) are arranged in a concentric arrangement, and other forms of arrangement is also applicable. The filtering cloths (11, 12, 13, 14) are single layered, and the slurry on the surface of the filtering cloths (11, 12, 13, 14) can be easily removed.

In accordance with the present invention, the slurry pump (242) generates compressed air to generates intermittent flow of slurry and to trigger a back flow of the filtered water to cleanse away the particles that adhered to the surface of the filtering cloths (11, 12, 13, 14). The slurry pump (242) is a pulse flow type pump which generates intermittent flow of slurry in the filtration process, and the particles in the slurry are being removed in the course of back washing by the compressed air. The compressed air of the tank (10) is controlled and regulated by a control valve (30) (as shown in FIGS, 4 & 5) to the cylindrical tank (10). The steel enclosure (16) is a structure for the second filtering cloth (12) to cling onto during filtration process. The surface of the steel enclosure (16) is also perforated which allows water to pass through. The second filtering cloth (12) is squeezable and deformable without excessively reducing the surface of the filtering cloth (12).

Referring to FIG. 4, the bottom portion of the cylindrical tank (10) is a funnel shaped structure of the lower tank compartment (130) which causes a cyclone effect when slurry enters the cylindrical tank (10). A water outlet (22) having a control valve (22') is provided to the upper tank compartment (110) of the cylindrical tank (10) to allow delivering of water after the slurry has been processed, and the water level in the cylindrical tank (110) is higher than the water outlet (22) generate back pressure. In accordance with the present invention, all the filtering cloths (11, 12, 13, 14) are deformable filtering cloth or knitted expandable having a plurality of pores thereon which is

changeable in shape of the holes in the course of the back wash process and filtering process, and the particles adhered onto the filtering cloths (11, 12, 13, 14) are removed upon expanding of the filtering cloth.

FIG. 5 is a cross section view showing the plurality of the steel cores (20) in the central tank compartment (120) in accordance with the present invention.

In the preferred embodiment of the present invention, the slurry or feed containing particles enters via the feed inlet (90) into the central tank compartment (120), and the feed or slurry is filtered by the filtering cloth (11, 12). The particles in the slurry or feed are trapped onto the filtering cloth (11, 12) and the filtrate is further filtered by the filtering cloth (13, 14) and the filtrate finally reaches the upper tank compartment (110) and is then discharged via the water outlet (22) with the control valve (22') mounted at the side of the upper tank compartment (110).

When compressed air from the compressed air supply (30) enters the tank (110) to start a back wash process by purging with air via the upper tank compartment (110), the control valves (22', 82') are closed, the compressed air will cause the filtering cloths (14, 13, 12, 11) to expand and hydrophilically release the adhered particles. The filtering cloths (11, 12, 13, 14) are made from knitted expandable material, and therefore the compressed air will cause the filtering cloths (11, 12, 13, 14) to expand and stretch out. The expansion of the knitted expandable filtering cloths (11, 12, 13, 14) will cleanse away the particles that adhere to the surface of the filtering cloths (11, 12, 13, 14), and discharged via the sludge outlet (24), thereby the filtering system (100) functions efficiently without blockage of the filtering cloth (11, 12, 13, 14).

FIG. 6 is a cross section view showing the structure of the tank (10) in accordance with the present invention, wherein a plurality of steel cores (16) are located within the centre tank compartment (120) of the tank (10), and the filtering cloths (11, 12, 13, 14)) are arranged in concentrically within the tank (10). As shown in the figure, the hairy filtering cloth (12) is supported by the steel enclosure (16) and the grooves (103) provided at the internal wall of the tank (10) generates whirlpool to sediment particle. In the course of a back washing process, the compressed air supply is turned off and cleaned water is passing out from the water outlet (22). As shown in the figure, the upper tank compartment (110) is provided with the water outlet (22) with a control valve (22'). The water outlet (22) is used to discharge the filtrate of the filtration process. In the course of filtration using the filtration system (100), the control valve (82') on the slurry inlet (82) disposed at the side of the tank (10) is opened, and the slurry enters via the slurry inlet (82). The control valve (24') at the sludge discharge outlet (24) is closed. The larger particles in the slurry will drop before they touch the first filtering cloth (11)

as a result of the cyclone effect of the tank (10). The larger dropped particles are collected at the slurry outlet (24). The central tank compartment (120) of the tank (10) is made from a transparent material if necessary to monitor the condition of the filtering cloth (11, 12, 13, 14) and the process of filtration, such that the solid contents in the tank (10) can be monitored and discharged by opening the sludge discharge outlet (24). In the preferred embodiment, a second feed inlet can be mounted to increase the efficiency for filtering slurry with high solid content and/or high viscose solution. In the preferred embodiment and as shown in FIG. 4, the bottom tank compartment (130) is a funnel shaped structure which produces a cyclone effect when slurry enters the tank (10).

In accordance with the present invention, the method of water filtration for slurry comprises the steps of:

(a) implementing a pulse circumferential flow of the slurry to settle particles by a plurality of grooves (103) along the internal surface of a cylindrical tank (10);

(b) passing the slurry with the particles via a first filtering cloth (11) within the cylindrical tank (10) and the first filtering cloth (11) and filtered the slurry to remove the particles in the slurry, wherein the filtrate passes to a second filtering cloth (12);

(c) trapping further particles of the slurry via by the second filtering cloth (12), wherein the particles are trapped by a plurality of hairy elements on the second filtering cloth (12); and

(d) passing the filtered water from step (c) to a plurality of steel cores (20) individually covered with a third filtering cloth (13) and a fourth filtering cloth to obtain filtrate which is clear and the filtered particles on the third and fourth filtering cloth (13, 14) being accumulated, and is then come out from the water outlet (22).

The steps of back washing of a filtration system for slurry having a cylindrical tank mounted with a discharge valve at the bottom thereof, and an air compressed air supply device, comprise

(a) increasing compressed air from the air supply device to at least 3 bar in pressure to increase air being dissolved in the slurry;

(b) opening the discharge valve (241) mounted at the bottom tank compartment (130) of the cylindrical tank (10);

(c) flushing air and water onto the sludge clinging to the steel cores (20); and

(d) expanding the fourth, the third, the second and first filtering cloth (14, 13, 12, 11) to open the overlapping of the filtering cloths (14, 13, 12, 11) and blowing away the particles adhered on the surface of the filtering cloths (11, 12, 13, 14);

(e) discarding the accumulated particles collected at the bottom of the cylindrical tank (10).

In the present invention, in the course of back washing a compressed air is used in the back wash process and the filtering cloths (14, 13, 12, 11) are expanded and sludge is thus separated and dropped through the expandable knitted cloth.

In accordance with the present invention, the compressed air used in the back washing steps has a pressure larger than that of the incoming slurry, and the filtering cloth is being expanded and the particles of the slurry that trapped on the filtering cloths will be released. The compressed air pressure can promote air to dissolve in water and the air bubbles in between the particles will separate the particles apart and provide a cleaning effect. The second filter cloth (12) vibrates corresponding to the intermittent flow triggered by the pulse flow type pump operation, and the backwash pressure, thereby particles of the slurry onto the filter cloth drop off therefrom. Due to the fact that a portion of the particles drops to the bottom of the tank (10), the filter cloths (11, 12, 13, 14) has a lighter filtering load.

The intermittent slurry pump provides compressed air to the upper tank compartment (110). The water level in the tank is higher than the outlet (22). The compressed air forces the water in the tank and forms a back pressure. When the pressure in the tank (10) reaches about 2.5-3 bars, the back pressure is maintained, and the control valve (24') opens for about 10 seconds to generate back flow release of the filtering cloths (11, 12, 13, 14) and drop the particles of the sludge to the bottom compartment (130).

In the present invention, the first filtering cloth (11) is more sagging as compared to the third and fourth filtering cloth (13, 14). The sagging first filtering cloth (11) and the third filtering cloth (13) are functioned as a filter aid in the course of filtering and back wash process of the filtering system (100). The compressed air formed in the upper tank compartment (110) from the pulse flow type pump is employed to generate vibration in the short backwash process of the filtration process.

In accordance with a preferred embodiment of the present invention, a pressure gauge is mounted to the upper tank compartment (110) as well as the lower tank portion (120) to give a reading of the pressure of the upper tank compartment (110) and the pressure of the lower tank compartment (120). The pressure gauge coordinates with the control valve (24') to cause frequent back wash.

The back wash of the first filtering cloth (11) is effectively cleansed the sludge as well as the particles adhered there in by expansion of the first filtering cloth (11) thus the efficiency of filtering process is improved.

FIG. 7 is a flowchart showing the process of filtering in accordance with the present invention. Slurry water flows through the slurry inlet (90) and through the first and second filtering cloths (11, 12). After that the filtrate enters the third filtering cloths (13) and (14), and enters to the steel core (20). Filtrate is then entering the upper tank compartment (110) and is then discharged at the water outlet (22). The water via water outlet (22) is filtered and clear water.

FIG. 8 is a flowchart showing back washing process in accordance with the present invention. First, all the valves of the tank (10) have to be shut off, and compressed air at a pressure of 3 bar passes into the upper tank compartment (110). The valve (24') at the bottom compartment (130) is opened and water and air flush the sludge from the steel cores (20). The compressed air will expand or stretch the fourth filtering cloth (14) and the third filtering cloth (13) and is then to the steel enclosure (16). The second filtering cloth (12) and the first filtering cloth (11) are forced to expand and all particles on the filtering cloth are flushed to the bottom tank compartment (130) of the tank (10).

Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims.

CLAIMS

1. A filtration assembly for slurry capable of providing back washing capability comprising

(a) a cylindrical tank (10) having a plate (60) at one end thereof, said plate (60) being mounted across the cylindrical tank (10), and having a cone-shaped bottom (19), wherein the cylindrical tank (10) has an internal surface (101) and an outer surface (102), and the internal surface (101) of the cylindrical tank (10) is provided with a plurality of groove (103) in axial direction along the internal surface (101) thereof;

(b) a plurality of steel cores (20) with perforated outer surface and being fixed perpendicular to the plate (60) at the center thereof and removable for maintenance service ;

(c) an enclosure (16) being mounted to enclose the steel cores (20);

(d) a first filtering cloth (11) mounted concentrically and dangling to the cylindrical tank (10) with one edge of the first filtering cloth (11), and another edge of the filtering cloth (11) being attached perpendicularly to the plate (60); wherein the first filtering cloth (11) is an expandable yarn which is expandable when the filtering cloth (11) is being stretched, and an intermittent slurry pump (242) connected to the cylindrical tank (10) provides intermittent flow of the slurry to press and to vibrate the first filtering cloth (11) intermittently, wherein the intermittent flow throws out a partial of the particles of the slurry that adhered onto the surface of the first filtering cloth (11);

(e) a second filtering cloth (12) being used to enclose the steel enclosure (16) being tied onto the enclosure (16);

(f) a plurality of third and fourth filtering cloth being used to enclose each of the core (20) by tightening the filtering the cloth onto the core (20) at the outer surface thereof; thereby the slurry to be filtered enters a space formed between the first filter clothe (11) and the tank cylindrical tank (10) to form a pulse circumferential crossflow to the groove to generate a whirlpool, a partial of the particle from the slurry will be settled as sediment, and is then filtered by the first filtering cloth (11) and then by the second filtering clothe (12), and the filtered water then passes through the third and fourth filter cloth, and enters the steel cores (20) delivery, the slurry is filtered by the first filtering cloth (11) and the second filtering cloth (12), and particles in the slurry will be trapped by the hairy elements of the second and third filtering cloth, due to the hairy elements the second filtering cloth (12) remains its functionability as clotting of the slurry is minimized, a backwash to the fourth, third, second and first filtering cloth, and any clotted particles on the filtering cloth (11, 12, 13) will completely drop off, and therefore the filtering efficiency of the filtering cloth is maintained after the particles are disposed off from the surface of the filtering cloth, and the particles of the slurry are

continuously removed via a control valve (241) in responding to the combination interaction of the intermittent pumping and the deformation of the filtering cloths (11, 12, 13, 14).

2. The filtration assembly for slurry as set forth in Claim 1, wherein the plurality of the steel cores (20) are arranged in a concentric arrangement.

3. The filtration assembly for slurry as set forth in Claim 1, wherein the intermittent slurry pump generates compressed air at the cylindrical tank (10) to trigger a back flow of the filtered water to cleanse away the particles that adhered to the surface of the filtering cloths (11, 12, 13, 14).

4. The filtration assembly for slurry as set forth in Claim 1, wherein the filtering cloth (11, 12, 13, 14) are single layered, and the slurry on the surface of the filtering cloth can be easily removed.

5. The filtration assembly for slurry as set forth in Claim 1, wherein the intermittent slurry pump is a pulse flow type pump which generates intermittent flow of slurry in the filtration process.

6. The filtration assembly for slurry as set forth in Claim 5, wherein the intermittent slurry pump provides filtered water and compressed air in the tank (10), and the water level in the tank (10) is higher than the level of water outlet (22), the compressed air causes the water in tank (10) to back wash, and the particles adhered onto the filtering clothes (11, 12, 13, 14) are being removed in the course of back pressure generated by the compressed air.

7. The filtration assembly for slurry as set forth in Claim 1, wherein the valve (24') opens when the pressure in the cylindrical tank (10) reaches about 2.5-3 bars.

8. The filtration assembly for slurry as set forth in Claim 1, wherein the steel enclosure (16) forms a structure for the second filtering cloth (12) to cling on to during filtration process and to release from during back wash process.

9. The filtration assembly for slurry as set forth in Claim 8, wherein the second filtering cloth (12) is squeezable and deformable without excessively reducing the surface of the second filtering cloth (12).

10. The filtration assembly for slurry as set forth in Claim 1, wherein the bottom portion of the cylindrical tank (10) is a funnel shaped structure causes a cyclone effect on the slurry when the slurry enters the cylindrical tank (10), and the plurality of groove (103) on the internal surface of the tank (10) will cause the formation of many whirlpool precipitate particles which reduce the load of the filtering cloths (11, 12, 13, 14).

11. The filtration assembly for slurry as set forth in Claim 1, wherein the filtering cloths (11, 12, 13, 14) are deformable filtering cloth or knitted expandable having a plurality of pores thereon which is changeable in shape of the holes in the course of the back wash process and filtering process also, and the particles adhered onto the filtering cloths (11, 12, 13, 14) are removed upon expanding of the filtering cloths (11, 12, 13, 14).

12. The filtration assembly for slurry as set forth in Claim 1, wherein in the course of back washing process, the first filtering cloth (11) is for filtering the slurry after the slurry passes through the second filtering cloths (12) and the third filtering cloth (13) is used for the filtering of the slurry after the slurry passes through the forth filtering cloth (14), and in the course of back washing process the first filtering cloth (11) and the third filtering cloth (13) are expanded and the particle thereon are released.

13. A method of water filtration for slurry comprising the steps of:

(a) implementing a pulse circumferential flow of the slurry to settle particles by a plurality of grooves along the internal surface of a cylindrical tank;

(b) passing the slurry with the particles via a first filtering cloth within the cylindrical tank and the first filtering cloth overlapped and filtered the slurry to remove the particles in the slurry, wherein the filtrate passes to a second filtering cloth ;

(c) trapping further particles of the slurry via by the second filtering cloth overlapped, wherein the particles are trapped by a plurality of hairy elements on the second filtering cloth, and the hairy elements open at back wash process; and

(d) passing the filtered water from step (c) to a plurality of steel cores (20) individually covered with a third filtering cloth (13) and a fourth filtering cloth to obtain filtrate which is clear and the filtered particles on the third filtering cloth (13) and the fourth filtering cloth are removed.

14. The method of water filtration for slurry of claim 13, wherein an compressed air supply device is used in the back wash process.