The Continuous Backwash Upflow Sand Filter is different from the fixed bed filter in the past. There is no need to shut down 1-2 times a day in order to clean the intercepts on the filter bed. The raw water enters the filter bed from the bottom of the filter and contacts the filter bed fully upward. The suspended
matter is intercepted in the filter bed, and the clean water is discharged by the overflow weir at the top. Quartz sand, which retains pollutants, is cleaned by lifting the bottom gas stripper to the top sand washer. Because air, water and sand rub violently under the action of compressed air, the debris intercepted by sand is washed out. The washed sand is added to the filter bed by gravity from top to bottom, and the washing water is discharged through a separate sewer to complete the whole sand washing process.

Operators can directly observe the sand washing process and adjust it according to the operation to achieve the best filtering effect. Maintenance and management are simple and easy to operate.

The Continuous Backwash Upflow Sand Filter is suitable for

1. Reclaimed water reuse
2. Paper making, printing and dyeing, water use in metallurgical industry
3. Oily Wastewater from Oilfield Ports
4. Recycling of cooling water
5. Water for Food Industry
6. Upgrading and Reforming of Traditional Filter System
7. Electroplating Plant (Removal of Heavy Metals)
8. Municipal Wastewater Treatment Plant (Phosphorus Removal/Suspended Solid SS/BOD/COD)
I. Work process

1.1. Filtration

Raw water enters the conical diversion channel (2) from the intake pipe (1) and then into the filter bed (3). When raw water passes through the filter bed, suspended matter is intercepted by sand and turned into clean filtered water. The filtered water passes through the overflow weir (4) and flows out of the filter by the outlet pipe (5).

The types and properties of raw water are different, and the sand used for filters is also different. Homogeneous quartz sand with effective diameter of 0.9 mm and uniformity coefficient of 1.4 is commonly used. For oily wastewater or raw water containing binders, homogeneous quartz sand with effective
diameter of 1.2 mm and uniformity coefficient of 1.4 is used. Accordingly, the air requirement of sand pump should be increased by 1.5-2 times.

1.2. Sand washing

The sand contaminated by suspended solids goes down to the sand collecting box (7) through the channel formed by the tapered sand distributor (6) and the inclined surface of the filter. The sand collected by the sand collecting box is transported by the sand lifting pump (8) to the sand washing device of the upper washing tank (10). The contaminated sand first rubs violently with water and air in the process of lifting. In the air separator (9), air separates from sand and water, while sand decreases through the channel (11) of the sand washing device due to gravity. The cleaning water (part of the filtered water) flows from the lower part of the sand washing device to the channel through the cleaning pipe. The sand is washed when they are in contact with each other. Clean sand is redistributed evenly to the center of the filter bed. Washed water is discharged through a drainage device. Cleaning drainage can be adjusted by regulating weir of drainage device up and down to reach the most suitable amount.

As mentioned earlier, the operator of the cleaned sand (returning to the top of the filter bed) can observe directly, so the process of sand washing and management are timely and convenient. The measured curvature of sand on the surface of the filter bed is usually 32-33 degrees. The curvature of natural sand is about 35 degrees, but the filter sand with uniform coefficient of 1.4 is
easy to slip.

II. Accessory equipment

2.1. Pretreatment of Raw Water

If there are large impurities or foreign bodies in the raw water, it will affect the sand movement of the filter bed, and even block the intake pipe, sand pump, sand washing device and so on. Therefore, pretreatment equipment should be added before the filter according to the water quality to pretreat the raw water. If the water quality is good, it can also enter the filter directly.

2.2. Sand collecting box

Below the inclined surface of the filter, there is a sand collecting box (7). The sand collecting box includes a connecting pipe, a screen, a drainage valve and a control ring for controlling the sand feeding amount of the sand collecting box. The upper part of the ring is slightly higher than the lower part of the inclined part. Therefore, a sand film will be formed between them, which can prevent the wear of the lower part of the inclined part. The material of the control ring is wear-resistant reinforced polyethylene, which can be replaced.

2.3. Sand pump

The contaminated sand is collected into the sand collecting box and lifted to the sand washing device by the sand lifting pump. The lower end of the sand pump is inserted into the nozzle of the sand collecting box, which is fixed by rubber pipe and pipe clamp. There is an air injection chamber at the lower end of the sand pump. After the compressed air is injected, a mixture of sand,
water and air is formed. The sand is sent to the air separator of the sand washing device. The air separator is equipped with an end cover to prevent water and air from overflowing together.

Compressed air is required for the operation of sand pump. The pressure required for compressed air is 4-6 kg/cm².

Sand lifting pipe is made of ultra-high molecular polyethylene. Unlike other plastic pipes, it can not be bonded with glue. It can only be fixed by rubber pipe and pipe clamp.

2.4. Sand washing device

The sand washing device consists of an outer cylinder and an inner cylinder. The inner part of the outer barrel has a ring (sand washing ring), while the inner barrel has a ring on the outside. The outer cylinder of the sand washing device is arranged in the upper cleaning tank, while the inner cylinder is arranged in the outer cylinder. The lower end of the inner cylinder is
supported by the lower guide ring and the upper end is supported by the upper guide ring. The upper guide ring is equipped with an air separator. The sand washing ring of the outer cylinder intersects the sand washing ring of the inner cylinder, thus forming a labyrinth channel between the inner cylinder and the outer cylinder.

The contaminated sand is lifted from the sand collecting box to the air separator to separate the air, and then slowly descends into the labyrinth channel to remove the dirt on the surface of the sand. The filtered water on the upper part of the filter bed passes through the washing pipe and enters the labyrinth passage from the lower part of the washing device. This part of the washing water flows up and down the passage to clean the slowly falling sand.

The sand washing device of the continuous sand filter is different from the filter in the past. Its length is longer and the angle of the sand washing ring varies from top to bottom. Therefore, a small amount of washing water can achieve a good cleaning effect. The reason why the washing water can flow from the upper part of the filter bed to the sand washing device is the water level difference between the water surface and the regulating weir. The sand washing device of quicksand filter has wider channel and less water loss than previous filters, and sand can be cleaned with less water level difference.

The amount of sand lifting and washing water is adjusted according to the concentration and nature of suspended solids in water. If the speed of sand lifting is too fast, the amount of sand in the channel will increase, resulting in
serious pressure loss of sand washing device; if the amount of sand lifting is too small, the suspended matter in raw water can not be fully filtered. If the amount of washing water is too small, the sand can not be cleaned adequately; if the amount of washing water is too large, it will cause excessive outflow of washing water.

2.5. Air Control Device

Air control devices generally supply compressed air with a pressure of more than 4 kg/cm$^2$ (usually 5-7 kg/cm$^2$). Compressed air cannot contain water or oil. The air control device is equipped with a pressure regulating device.

The pressure of the pressure regulating device is usually set as follows:

<table>
<thead>
<tr>
<th>Model</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-05 ~ P-10</td>
<td>1.5~2 kg/cm$^2$</td>
</tr>
</tbody>
</table>

The regulated air passes through the solenoid valve to the air flowmeter (with the regulator). If there is only one sand filter, the pressure switch can be
set at the position where the inlet pressure of solenoid valve can be detected. In this way, when the pressure of compressed air is lower than the set value, the pressure switch starts and alarms, while stopping the supply of compressed air. In addition, when the pressure control valve or solenoid valve fails, it can also alarm and stop the supply of compressed air.

III. Parameter table

<table>
<thead>
<tr>
<th>Model</th>
<th>Filter area (m²)</th>
<th>Filter layer Depth (m)</th>
<th>Volume (m³/h)</th>
<th>Diameter (mm)</th>
<th>Wastewater discharge (%)</th>
<th>Equipment height (mm)</th>
<th>Maximum air consumption m³/h (0.4MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KCS-05</td>
<td>0.5</td>
<td>1.5-2.0</td>
<td>3 ~ 5</td>
<td>800</td>
<td>5-10</td>
<td>3500 ~ 4000</td>
<td>2</td>
</tr>
<tr>
<td>KCS-10</td>
<td>1</td>
<td>1.5-2.0</td>
<td>5 ~ 10</td>
<td>1150</td>
<td>5-10</td>
<td>4300 ~ 4800</td>
<td>2.5</td>
</tr>
<tr>
<td>KCS-15</td>
<td>1.5</td>
<td>1.5-2.0</td>
<td>10 ~ 15</td>
<td>1400</td>
<td>5-10</td>
<td>4600 ~ 5100</td>
<td>3</td>
</tr>
<tr>
<td>KCS-20</td>
<td>2</td>
<td>1.5-2.0</td>
<td>15 ~ 20</td>
<td>1600</td>
<td>5-10</td>
<td>5000 ~ 5500</td>
<td>4</td>
</tr>
<tr>
<td>KCS-30</td>
<td>3</td>
<td>1.5-2.0</td>
<td>20 ~ 30</td>
<td>2000</td>
<td>5-10</td>
<td>5400 ~ 5900</td>
<td>6</td>
</tr>
<tr>
<td>KCS-40</td>
<td>4</td>
<td>1.5-2.0</td>
<td>30 ~ 40</td>
<td>2260</td>
<td>5-10</td>
<td>5800 ~ 6300</td>
<td>8</td>
</tr>
<tr>
<td>KCS-55</td>
<td>5.5</td>
<td>1.5-2.0</td>
<td>40 ~ 55</td>
<td>2650</td>
<td>5-10</td>
<td>6200 ~ 6700</td>
<td>10</td>
</tr>
<tr>
<td>KCS-60</td>
<td>6</td>
<td>1.5-2.0</td>
<td>55 ~ 60</td>
<td>2770</td>
<td>5-10</td>
<td>6500 ~ 7000</td>
<td>12</td>
</tr>
</tbody>
</table>

Note:

1. Applicable temperature 0℃~65℃, beyond 65℃ can be specially designed.

2. With the use of micro-flocculation device, the highest influent SS is less
than 120 mg/L, and the removal rate is more than 90% to achieve perfect filtration effect.

3. Water head loss < 0.1 MPa

4. The air consumption of lifting filter material is 0.15 m³~0.2 m³ per ton of water, and the air pressure is less than 0.35 MPa.

5. The particle size of the filter material is 0.7-1.2 mm and the filtration rate is 6-13 m/h. The cycle time of filter material is 4-8 hours.

6. Washing water consumption ranges from 5% to 10%.

IV. Operational Control Elements


The filter sand is usually transported in plastic bags of 0.83-0.85m³. In order to prevent the residue and thread head brought into the bag, screening screen under 10mm should be used in sand filling.

When the filter starts to operate, the filter bed will shrink and the height of sand filling will decrease a little.

4.2. Installation of Air Control System

The air control system should be placed in a convenient place and installed with a display panel.

Pressure regulator connects water separator drain pipe.

Compressed air over 4kg/cm² (usually 5-7kg/cm²) is connected to the air control system.

The air distributor of the air control system is connected to the filter as
needed.

4.3. Injection of Clear Water

Clean water should be used at the beginning of water injection. Wastewater from the beginning will block the screen hole of the filter bed because the sand washing device has not yet started.

4.4. Degradation rate measurement of filter bed and adjustment of sand rate

Measure the falling speed of the filter bed (sand pile) with a calibrated measuring rod. When the measuring rod is inserted into the depth of sand layer 100-200 mm, the measuring rod will drop with the filter bed. Based on the upper part of the side wall of the filter, the speed of the measuring rod falling within 2 minutes was recorded. Please check whether the sand layer is decreasing at an average rate of 3-6 mm/min.

Although the sizes of the filters are different and the datum points are different, 3-4 internal measuring points of 150-300 mm on the side wall of the filters or 3-4 external measuring points of 200-500 mm from the center of the filters are generally selected.

The decline rate of sand layer is generally faster near the center of the filter than around it.

If sand is found to stop falling in a certain place, we must refer to the "Trouble and Countermeasure" to deal with it.

If the filter area is 1 m² and the sand layer descending speed is 4 mm/min, the sand lifting capacity of the sand pump is 4 L x 1 = 4 L/min.
After the filter is filled with water, air is supplied to the sand pump. The amount of sand lifting is related to the supply of air. Firstly, the air volume should be adjusted so that the sand lift per m² reaches 3-6L/min.

The method for determining the sand lifting amount of the sand lifting pump is as follows: remove the front end of the sand lifting pipe from the air separator, and measure the sand lifting amount in unit time (seconds) with appropriate container. The amount of sand raised here refers to the increased sand and the sand in the water.

The average value is taken as the amount of sand lifting.

4.5. Washing Drainage

Standard washing drainage is about 1-3 times as much as sand increment (usually 2.0 times), but more washing water is needed in the case of high suspended solids concentration (serious pollution) in raw water. If the concentration of suspended solids in raw water is low (pollution is small), small washing water is needed.

Measurement of Washing Drainage: Close the pipe valve of the Washing Drainage Chief, open the pipe valve of measuring the Washing Drainage Pipe, connect the drainage to the appropriate container, and measure the amount of Washing Drainage within a unit time (seconds). If the drainage device is equipped with a drainage measuring device, the drainage quantity can be measured directly with the measuring device. (Normally no measurement is needed, and for convenience there is no measuring valve or measuring
4.6. Cleaning of filter sand

When new sand contains dirt such as mud, the filter should be operated with clean raw water or clean water to clean the sand. That is to supply enough clean water to the upper part of the filter bed so that the clean water overflows the washing tank and starts the filter.

According to the pollution degree of new sand, the washing time is different. Generally, 2-4 cycles of cleaning are needed to achieve the purpose of cleaning. A washing cycle takes about 6-10 hours or more.

4.7. Adjustment of raw water supply

Put the switch of the electric control panel into the open gear and run the water supply pump at the same time. Slowly open each filter's raw water into the pipe valve (originally OFF position), supply a small amount of water, gradually increase the water supply, and finally adjust to the appropriate supply.

4.8. Operation of Air Control Panel

1) Confirm that the pressure of compressed air to the control panel is at least 6 kg/cm² or more.

2) Check the installation of the internal parts of the control panel, and lock the adjustment button of the air flowmeter clockwise.

3) Adjust the pressure switch and adjust the pressure to 4kg/cm².

4) Open the manual valve, rotate the air regulator clockwise slowly, and
adjust the pressure to the same as the pressure gauge.

5) Put the selector switch on the control panel into the "manual" file.

6) Press the ON button of the solenoid valve and open the solenoid valve.

7) Rotate the adjusting knob of the air flowmeter counterclockwise to select the required air volume.

8) Supply air to the sand lifting pump and check whether there is sand moving in the sand lifting pipe.

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Printing and Dyeing Wastewater Treatment China  Waterworks Construction Site Yunnan China

Thanks

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