

FILTRATION_{LLC}

Horizontal Element D.E. filter **External Scavenge, General Manual**

The following rules are written broadly to apply to most types and sizes of horizontal element filters with external scavenge filters, and assure the optimal usage of the filters capabilities.

Filter capacities.

Theoretically, the maximum cake volume is obtained by filling the space between the elements totally with filter cake.

In practical terms such a limit would endanger the filter elements due to bridging of the cake between the elements, with the risk of damage to the filter elements due to the fast build up of high hydrostatic pressure.

For this reason the cake capacity is set to a safe limit that should under no conditions be exceed.

The d.e. slurry is prepared in the dosing tank in a 1:5 to 1:10 solution. The weight of d.e. for pre-coat, as well as for body feed and for total d.e. capacity is given below. The table for the different G - filters is based on an average volume 3.42 liters (0.9 gal) for 1 kg (2.2 lb.) d.e.

Always make sure there is enough water in the tank for the amount of D.E. to be mixed, always bring in the water first when replenishing the dosing tank.

An average D.E. Pre-coat is considered to be 1.2 kg/m² (0.25 lb./ft²) of filter surface.

<u>Filter</u>	<u>Pre-coat</u>	<u>Body feed</u>	<u>Total</u>
10 m ² =	12.0 kg	51.2 kg	63.2 kg
20 m ² =	24.0 kg.	109.0 kg	129.0 kg
30 m ² =	36.0 kg.	183.0 kg	231.0 kg
40 m ² =	48.0 kg	244.0 kg	292.0 kg
50 m ² =	60.0 kg	305.0 kg	365.0 kg
60 m ² =	72.0 kg	367.0 kg	439.0 kg

The use of Perlite and Cellulose in the pre-coat and body feed requires a recalculation of the amounts to be used, dependent on the specific density of the material.

Cellulose is naturally coarse and loose, and might make proper bridging by the D.E. difficult if used in larger amounts

The addition of Silica Gel or PVPP to the body feed have to be added to the D.E., and the total can newer exceed the maximum cake capacity for any given filter.

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Filtration flows

The filtration flow is somewhat dependent on the sharpness of filtration, and to a high degree on the product to be filtered, normally the pre-coat flow is twice that of the normal filtration speed.

The reason for the higher pre-coat flow is to achieve a bridging of the filter screen as fast as possible, and somewhat to compact the filter cake to make it more sturdy.

Beer filtration speed (average)

Normal filtration speed for pressure vessel filters is considered to be 5 hl/m²/h (0.4 bbl/ft²/h) (12 gal/ft²/h)

<u>Filter</u>	<u>Pre-coat</u>	<u>Filtration</u>
10 m ² =	100 hl/h	50 hl/h
20 m ² =	200 hl/h	100 hl/h
30 m ² =	300 hl/h	150 hl/h
40 m ² =	400 hl/h	200 hl/h
50 m ² =	500 hl/h	250 hl/h
60 m ² =	600 hl/h	300 hl/h

1. Filling the filters prior to Pre-Coat:

Before filling the filter make sure the vessel is securely closed and that all connections are tight. Close all valves, and then open the valves necessary to fill the vessel and dosing tank.

Pre-Coat with Product. If this alternative is selected, try to use clean pre-filtered product for pre-coating, also assure that the dosing pump is running during filling of the vessel with product.

This following description assumes that a clean liquid is used for filling, if not, follow the description for filling with product prior to filtering (Step 5).

Fill the filter, scavenge filter (and dosing tank) from the bottom, venting through the top vent. Make sure that the air is driven out of piping not used for filling, by opening them and allow them to be packed with water.

Close the dosing tank bottom inlet when the level is sufficient for pre-coat.

Close the bottom main filter vessel and scavenge filter fill valve when water starts running out the vent line on top.

Open the top feed, open the pipe loop for re-circulation between the feed pump and the vessel.

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2. Circulation:

Start the fed pump at full speed check the circulation loop.

Partly close the down on the **main filter outlet valve** until you have approximately 1.5 bar (20 psig.) to 2 bar (30 psig.) in the vessel. This valve **should now be left in this position**, control flow with flow control valve on feed pump discharge.

As soon as the circuit is stable, extend the circulation to go 50 % - 100 % through the dosing vessel, by partly opening the bottom in and outlet on the dosing vessel and partly closing the return valve in the by-pass.

Open the vent valve $\frac{1}{2}$ to assure a good venting of the vessel, water and air should be flowing back to the dosing tank.

Spin the filter stack up to low medium speed repeatedly (it must come to a full stop between each spin) until most of the air is out of the vessel.
(The circulation through the dosing tank and the open top vent will assure that the air is vented. It also assures that there is a sufficient supply of water to make up for the air removed.).

Close the bottom filter vessel inlet and run the filter only from the top. Check for air. Set to proper speed for pre-coat if necessary.

3. Pre-Coating

Pre coating can be performed with a clean product or with adjusted water, as a single pre-coat, or in 2 steps.

Pre-Coating with clean product:

This method is the simplest, but unless great care is taken, it will result in product with high amounts of O₂ and dissolved iron. If the pre-coat is performed with unfiltered product, it can contaminate the filter screens.

Pre-Coating with adjusted water:

This is a better method of pre-coating, the water is pushed out with CO₂ after pre-coating. There is no possibility of unfiltered product in contact with filter screens, an air - beer contact is avoided.

There are two different way to pre-coat the filter, one is by using the dosing pump only, the other one is by running the filter circulation loop partly of completely through the dosing tank.

Pre-Coating with dosing pump only:

This method is the least aggressive of the two methods, it represent the least possible wear on the feed pump and valves, on the other hand it takes longer that the alternative methods.

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Pre-Coating with re-circulation through dosing tank:

This method is the fastest way to bring the pre-coat into the filter, it will give a higher wear on all parts involved due to the much higher concentration of d.e. suspended in the water flow.

There are two ways of performing this pre-coat method:

Full circulation through the dosing tank, this is the fastest but also represents the highest wear on all parts involved

Partial circulation through the dosing tank, this is a variable speed method, pending on what amount of the total flow goes through the dosing tank. By adjusting the relationship between the flow through the normal re-circulation loop and the flow through the dosing tank, one can regulate the amount of d.e. suspended in the water flow.

This lets the user decide whether he wants to put emphasis on a fast pre-coat, longer pump life, or any combination of the two.

3 a. Pre-Coating with Dosing pump

Proceed from step 2 with closing the circulation through the dosing tank. A circulation should now be through the filter - feed pump loop, make sure that the back pressure in the vessel is maintained with the main filtrate outlet valve.

Flow speed should be at least double the normal filtration speed.

Always remember to leave a bleed valve open when the dosing pump is active, the dosing pump is capable of high pressures.

1st Pre-Coat:

Weigh up the amount of coarse d.e. (to assure fast bridging of the screens) and if used, cellulose to be used in the first pre-coat.

Start the agitator and CO₂ injection on the dosing tank.

Set the dosing pump for maximum dosage rate.

Fill the d.e. into the dosing vessel and continue to run the filter in circulation for pre-coat.

As soon as the flow in the return line start to clear up, decide whether to bleed of pressure through the vent valve or the sample valve on the flow meter

If the filter vent valve is used to bleed of pressure, this process will take longer, but there will be no need to refill the dosing vessel for the next pre-coat.

When the water in the dosing tank clears up, or the dosing vessel is almost empty, open the bottom filter feed for a few minutes to assure that all d.e. is on the filter elements.

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2nd Pre-Coat:

Same exact procedure as the first one, only this time with the same mix as the body feed.

Re-circulate until water in dosing tank clears up or dosing tank is almost empty and filter runs clear.

Open the bottom feed valve for a short period to bring all d.e. in the vessel on to the filter leaves.

Pre-Coat of External Scavenge filter:

Bring the scavenge filter into the circulation by first opening the feed valve and venting the scavenge vessel.

When water flow from the vent open the outlet valve. (The partly closed main filtrate valve will assure a flow through the scavenge filter).

Add the correct amount of **1st. pre-coat mix** (Full pre-coat amount.) to the dosing tank and pre-coat the scavenge filter.

When dosing tank clear up, or is almost empty, close the scavenge filter outlet and inlet valves. (In that sequence.)

3 b. Pre- Coating with Dosing Tank Circulation

Proceed from step 2 with adjustment of the circulation through the dosing tank to the desired ratio. Make sure that the back pressure in the vessel is maintained with the main filtrate outlet valve.

Flow speed should be at least double the normal filtration speed.

1st Pre-Coat:

Weigh up the amount of coarse d.e. and if used, Cellulose to be used in the first pre-coat. Start the agitator and CO₂ injection on the dosing tank.

Fill the d.e. into the dosing vessel and continue to run the filter in circulation for pre-coat.

Set the dosing pump to $\frac{1}{4}$ - $\frac{1}{2}$ dosage rate.

When the water in the dosing tank to clears up, open the bottom filter feed for a few minutes to assure all d.e. is on the filter elements.

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2nd Pre-Coat:

Same procedure as for the first pre-coat, only this time with the same mix as the body feed.

Re-circulate until water in dosing tank clears up and filter runs clear after opening and closing the bottom feed.

Pre-Coat of External Scavenge filter:

Bring the scavenge filter into the circulation by first opening the feed valve and venting the scavenge vessel.

When water flow from the vent open the outlet valve. (The partly closed main filtrate valve will assure a flow through the scavenge filter).

Add the correct amount of **1st. pre-coat mix** (Full pre-coat amount.) to the dosing tank and pre-coat the scavenge filter.

When dosing tank clear up, close the scavenge outlet and inlet valves. (In that sequence.)

Close the dosing tank in and outlet valve and open the re-circulation valve fully. (In that sequence.)

4. Pre-Coat water push out:

This step assumes that the filter has been pre-coated with water, if it was pre-coated with product, skip this step.

Stop the feed pump and pending on the conditions, stop or reduce to 0 the stroke on the dosing pump.

Close all valves.

Connect the CO₂ feed at low pressure and open the CO₂ feed to assure a slight positive pressure in the filter vessel.

Open the filter discharge valve partly, also open the flow meter sample valve.

(The amount of opening of the discharge valve should be such that it takes approximately 15 to 20 minutes to drain the filter. (Only CO₂ in the filtrate discharge.)

Close the main filtrate outlet and open the bottom filter fill/drain valve to drain out the liquid below the filter plates. Always make sure there is CO₂ pressure in the filter vessel.

When CO₂ flows through the bottom filter feed/drain valve, open the scavenge filter inlet valve and then the outlet valve slowly and in that sequence.

When CO₂ flows through the scavenge filter, close the scavenge filter valves.

Slowly open and close other valves in the system to drain out residual water in the filter piping.

Make sure all valves are closed.

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5. Filling Filter with Product

Prepare a full dosing tank with body-feed d.e. mix.

Set dosing-pump stroke to $\frac{1}{4}$ to $\frac{1}{2}$ prior to opening any product feed into the filter.

Open the filter vessel bottom feed/drain valve and set the flow regulating valve to less than $\frac{1}{4}$ opening.

Open all connection from feed tank to filter, make sure that the hoses and connection have been vented and primed with product. Make sure there are no heavy amount of solids present in the product.

Slowly open the main inlet valve, taking care not to shock the system and establish an even flow. (It should take 15 to 20 minutes to fill the filter with product.)

If the feed source does not have sufficient pressure to fill the filter, use a booster pump, or the filter feed pump.

Make sure that the CO₂ is vented of the top of the filter as the vessel fills.

When filter is $\frac{3}{4}$ full, slowly open the top filter feed valve.

After filter vessel is full, close the vent valve almost completely.

6. Circulation prior to Filtration

Set the main filtrate outlet valve back to its prior circulation position, open the flow control valve to almost full open.

(Leave the min inlet valve open to the product tank, this will assure pressure on the system and availability of product when the filter is vented.)

Open the circulation valve.

Start the feed pump.

Adjust the main filtrate outlet valve to maintain a 1.5 to 2 bar head pressure in the vessel. (This is above any pressure that might be introduced by the open connection to the product tank pressure.)

After a few minutes of circulation close the bottom filter feed/drain valve.

When the filtrate outlet sight glass clears up, slowly open the scavenge filter inlet, while venting the scavenge filter.

When the scavenge is filled with product, close the vent and slowly open the scavenge filter filtrate outlet.

When the filtrate sight glass indicates clear filtrate, close the scavenge filter outlet then the inlet. Slowly bring the filter flow down to filtration speed and stabilize.

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7. Filtration

Bring the dosing pump up to the setting needed for the product and filtration speed.
For unknown products make sure the setting is high enough to avoid blinding of the filter cake.

Slowly open the filter outlet valve while closing the circulation valve.

Make sure that filtrate stays clear and that flow and pressure are stable.

Close the vent valve, but check on it occasionally.

Make sure the dosage rate is appropriate for the product, adjust if necessary.
(Wait minimum 10 minutes between adjustment to evaluate the effect of prior adjustment)

Make sure there is sufficient d.e. solution in the dosing tank, but never exceed the total amount for the particular filter.

The filtration is finished when one of the following occurs:
When the total d.e. holding capacity of the filter is reached.
The vessel pressure becomes too high.
All product has been processed.

7. Circulation after Filtration

Open the circulation valve, while closing the main filter outlet valve.

Close the main filter inlet valve.

7a. Circulation for push out without scavenge filtration

Run the filter in circulation until product is clear in the inlet sight glass.

After product clears up, stop feed pump and close all valves.

7b. Circulation for scavenge filtration push out

Open the bottom vessel fill/drain valve

After a few minutes of circulation when the feed sight glass clears up, slowly open the scavenge filter inlet, while venting the scavenge filter.

When the scavenge is filled with product, close the vent and slowly open the scavenge filter filtrate outlet.

When the feed sight glass indicates clear filtrate, close the scavenge filter outlet then the inlet.

Stop the feed pump. and close all valves.

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8. Emptying Filter

8 a. Push out without scavenge filtration

Open the CO₂ supply and the bottom inlet/outlet, drain down the unfiltered product either to the feed tank, or to sewage.

8 b. Scavenge filtration I (Last filtration)

Filter is full, (no concerns for damage to filter cakes on main elements):

Open the CO₂ supply and the scavenge filter outlet, the full volume of the vessel is filtered over the scavenge elements. As soon as CO₂ bubbles are observed in the sight glass the scavenge filtration is at the end.
, The product remaining in the vessel must be pushed out through the bottom inlet/outlet

8 c. Scavenge filtration II (refill with other product)

Filter is full, (filter cakes on main elements maintained):

Follow the procedure for step 4 (pre-coat water push out).

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