Operating and Safety Instructions Manual

BHS Pocket Leaf Filter (PLF)

Safety instructions for Pocket Leaf Filter (PLF)

Please read and comply with these safety instructions prior to the initial operation of your device.

Retain these safety instructions for future users.

The operation personnel must carefully read and fully understand the operating instructions and especially the following safety instructions.

In addition to the notes contained herein the general safety provisions and accident prevention laws must be observed.

Failure to comply with the safety information may result in danger not only to persons, but also to equipment and the environment. Failure to comply with the safety information may also lead to the loss of any damage compensation claims.

The device may only be used by qualified personnel who, by virtue of their training, experience and instructions have been explicitly authorized by the person responsible for the safety on- site of handling the device.

The operator must use the device properly. Depending on the operating conditions, particularly where dangerous media are involved, improper handling could lead to severe personal injury or damage to property.

The authorized personnel must consider the surrounding conditions and must pay attention to third parties when working with the device.

Appliances with working equipment, specifically valves and seals, must be checked to ensure that it is in proper working condition and is operating safely before use.

Never leave the device unattended while in operation and operating pressure is applied.

Always use appropriate gloves, protective glasses and protective clothing while working with the device.

Operation of the device may cause mechanical hazards of pinch points and malfunctions. Always make sure, that the filter device is only opened and maintained when the device is shut off and depressurized.

Operation of the device may cause thermal hazard arising from contact with hot filter parts or surfaces like housing and tubes when the temperature exceeds 50 °C.

Operation of the device may cause chemical hazards. Feeding of slurry and wash liquids may cause emissions of product vapor and has to be removed by gas exhaust systems.

Make absolutely sure that no pressure-generating reaction can occur within the test device.

If an external pressure generator is connected, a pressure regulator must be used. The maximum pressure can be found in the specification. If the specified operating pressure is exceeded, it may cause catastrophic failure of the device posing a risk of serious bodily harm.

Exceeding the specified process temperature also reduces the mechanical strength of the materials (e.g. synthetic materials) and increases the risk of bursting even in case of minor excess pressure.

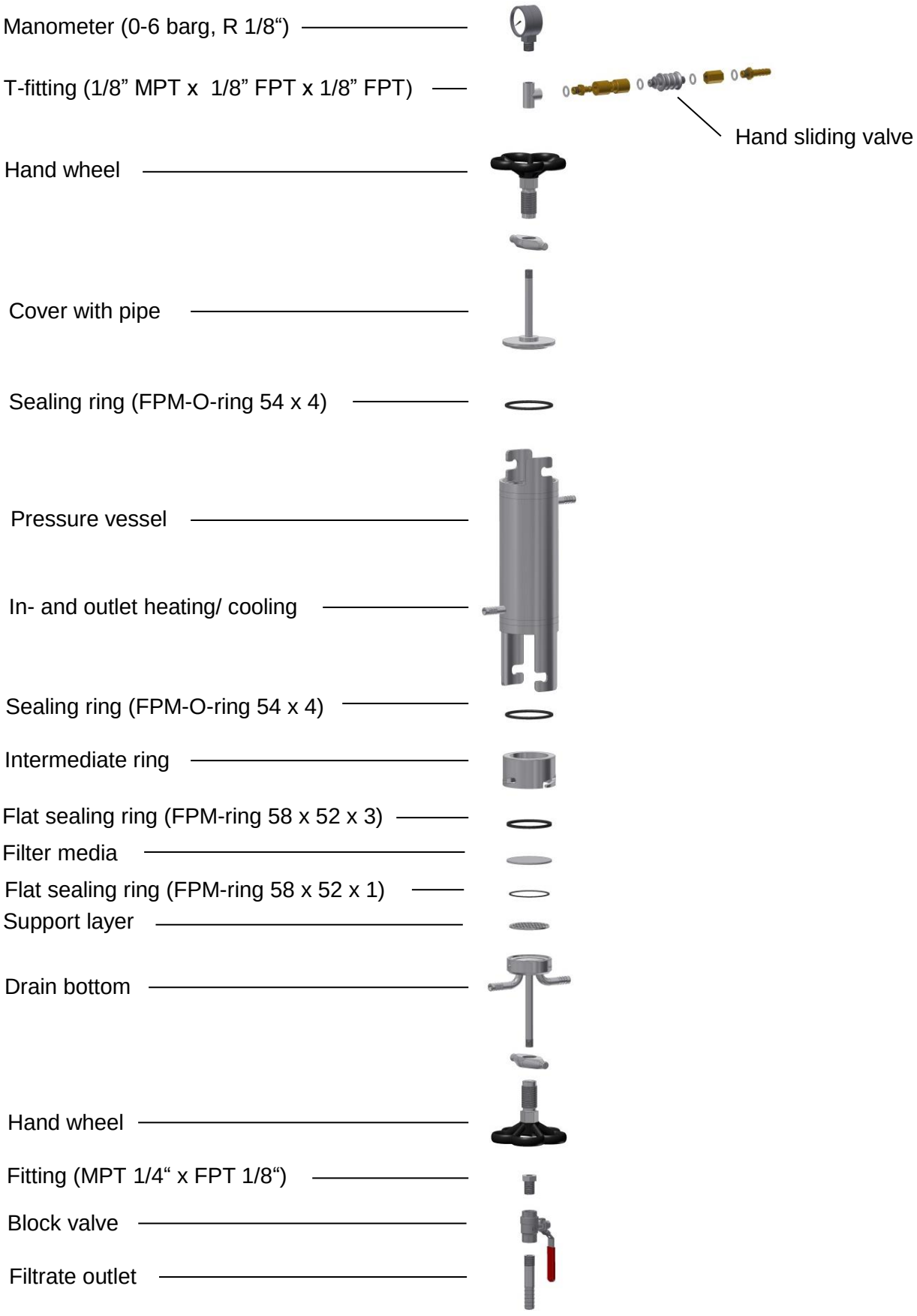
Some substances such as strong acids and alkalis may cause the device materials to corrode. Carefully check the chemical resistance of the seals to acid, alkalis and solvents.

Reliable and safe operation of the device is only guaranteed if the device is used as intended, in accordance with the operating instructions. The limit values specified on the data sheet must not be exceeded under any circumstances.

In case of modifications or changes to the filter, the operator will be responsible for the safety. In such a case, the warranty provided by BHS-Sonthofen GmbH will cease. Safety can only be ensured by using genuine spare parts and accessories recommended by the manufacturer.

Please read these operating instructions before starting and strictly observe the “Safety Instructions”.

1 Assembly drawing



2 Technical data

Filter area	20 cm²
Process volume	400 ml (1000 ml)
Jacket volume	200 ml (500 ml)
Maximum operating pressure	6 bar (g) to full vacuum
Maximum working pressure of the jacket	4 bar (g)
Maximum cake thickness	150 mm
Material of construction	AISI 316 stainless steel
Vessel design temperature	200 °C
Jacket design temperature	200 °C
Dimension	590 mm x 135 mm (780 mm x 135 mm)
Weight approx.	5.2 kg (8.0 kg)

Data refer to the BHS PLF 400 and PLF 1000 (indicated in parentheses).

3 BHS Pocket Leaf Filter (PLF)

In solid-liquid separation systems, a wide variety of parameters influence the performance of the filtration process. Evaluation and testing procedures can help plants determine the effectiveness of a particular system.

Parameters that can be evaluated include particle size and shape, particle type, density, concentration, viscosity, cake height, pressure or vacuum, filter media, batch or continuous operation mode, required production capacity and more.

Bench-top testing first must be used to narrow the gap between theory and practice and to begin the equipment selection process.

The BHS PLF bench-top filter system is currently the most effective approach to selecting and/or optimizing a pressure filtration system. It is a compact, portable filtration device that provides a fast, simple and validated analysis of the filtration performance of solid-liquid systems.

The BHS PLF is fully compliant to VDI Guideline 2762 "filterability of suspensions, determination of the filter cake resistance".

The filter is available in two different sizes: types PLF 400 and PLF 1000 with a process volume of 400 ml and 1000 ml respectively.

The unit includes a vessel, an inlet cover with a pressure gauge and a gas connection, and bottom outlet piece that holds the filter media. The vessel and bottom outlet piece of the stainless steel unit are jacketed and may be heated or cooled (see chapter 1 “Assembly drawing”).

With assistance and process support from BHS-Sonthofen and accurate data collection from the testing – combined with filtration theory and experience – proper selection of the appropriated filter type, scale-up, optimization and process guarantees can be realized.

The following operating instruction should help to ensure optimum equipment operation.

4 Testing preparation

Excellent testing preparation is the most important prerequisite for validated and reproducible test results. The following section should help to direct the selection of pressure and vacuum filtration equipment.

4.1 Required items

A number of items are required for accurate laboratory testing, including:

- **Material Safety Sheets** for all substances involved (MSDSs)
- **Personal protective equipment** (PPE)
- An amount of representative-quality **suspension** for each product to be tested
- **Temperature control unit** including heat-transfer medium (optional)
- A **beaker with stirrer** to use for the feed material before each run (optional)
- A sufficient amount of **washing liquid** (optional)
- Several **measuring cylinders** and **beakers** for the feed material, the filtrate, the wash media and the wash and dewatering filtrates.
- Small **container** for the filter cake
- A **gram scale**
- A **vacuum oven** or other technique to check the percent solids in the feed slurry, the wash and dewatering filtrates as well as the percent moisture in the filter cake by a **moisture analyzer** or other technique.
- **Spoon, spatula, ruler,** etc.
- Specific **test apparatus** to measure data such as **ph-value, conductivity** and **particle size distribution**, etc.
- **Stopwatch**

For pressure filtration tests the following items are additionally required:

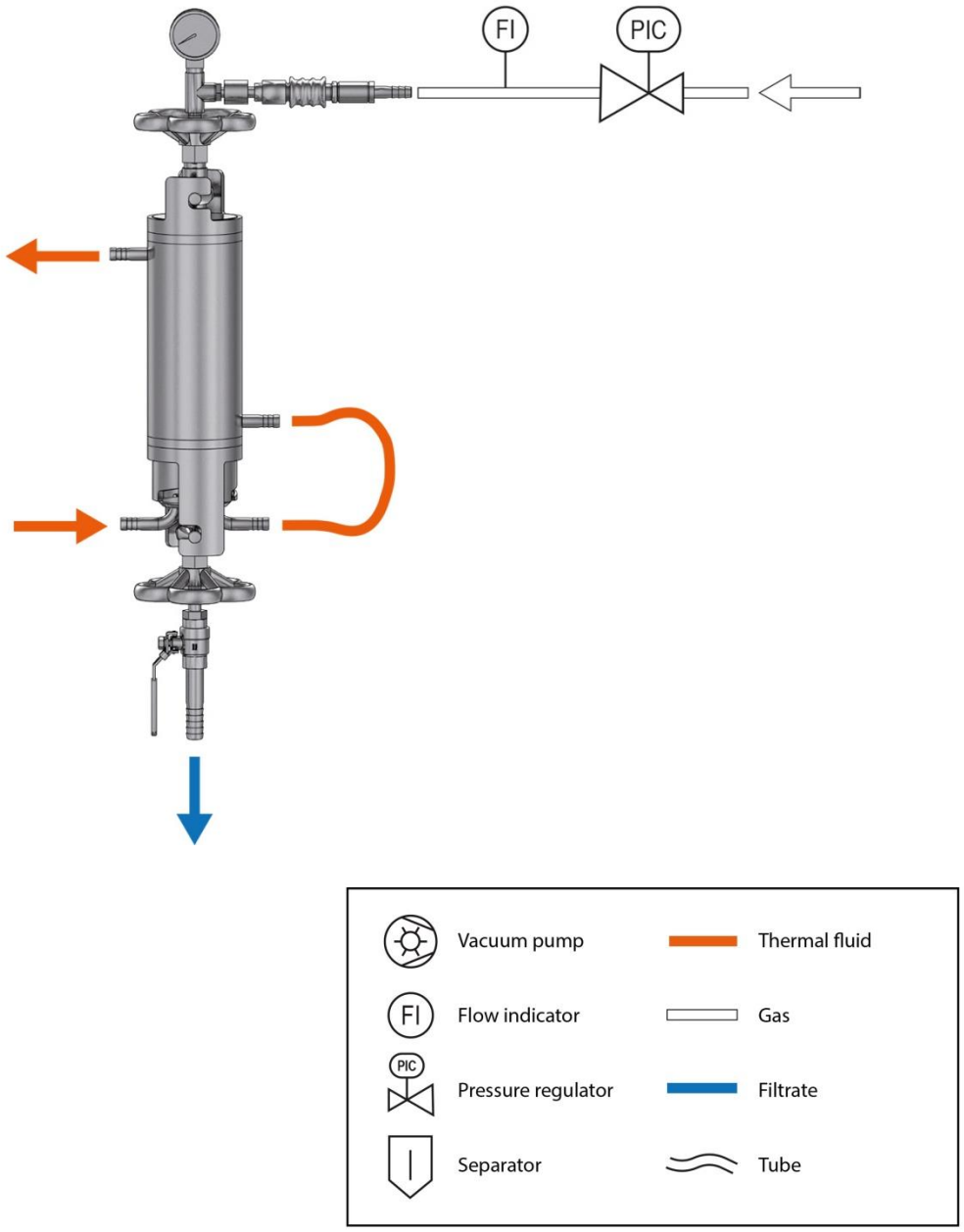
- A regulated **gas supply** that can be controlled at 6 bar g.
- A **flow meter** on the gas supply. The flow meter allows the gas flow rate to be measured during the drying step.

For vacuum filtration tests the following items are additionally required:

- **Vacuum source**
- A **vacuum flask** to separate the vacuum filtrate from the gas flow.
- A **flow meter** on the vacuum line section. The flow meter allows the air flow rate to be measured during the drying step.

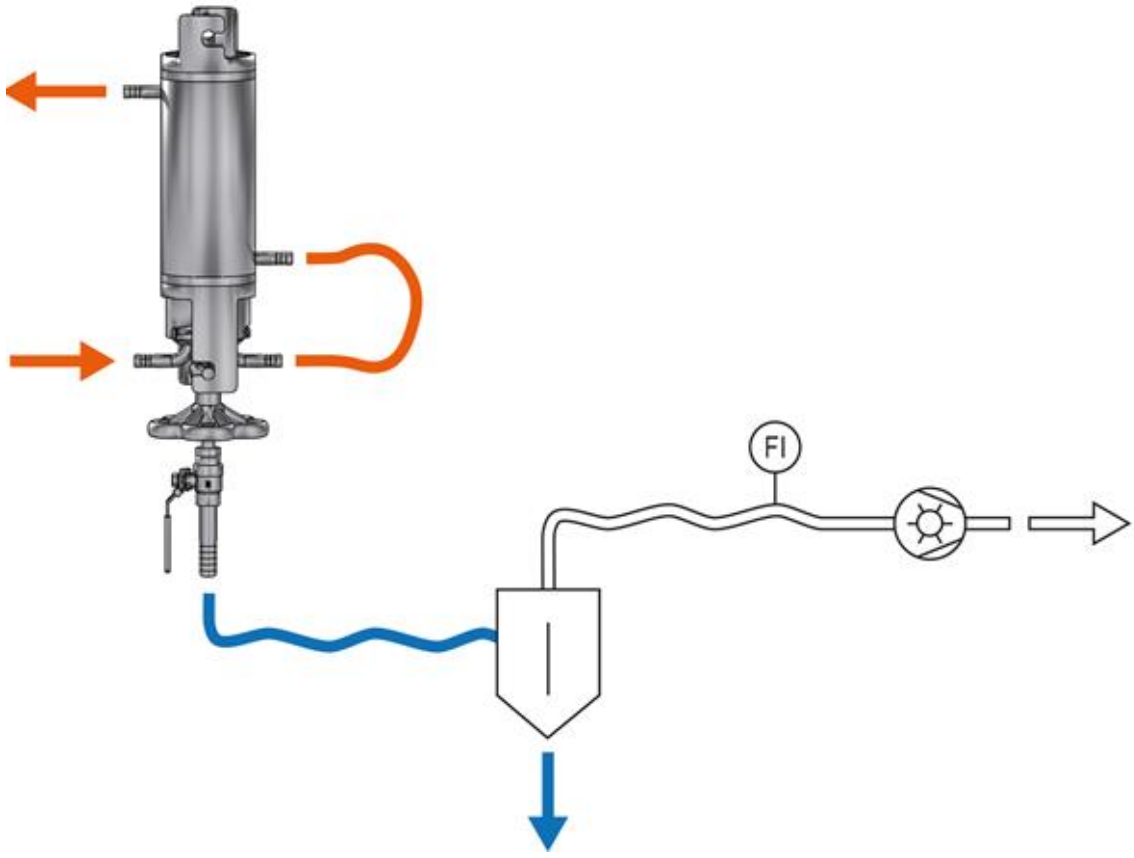
4.2 Test set up for pressure filtration

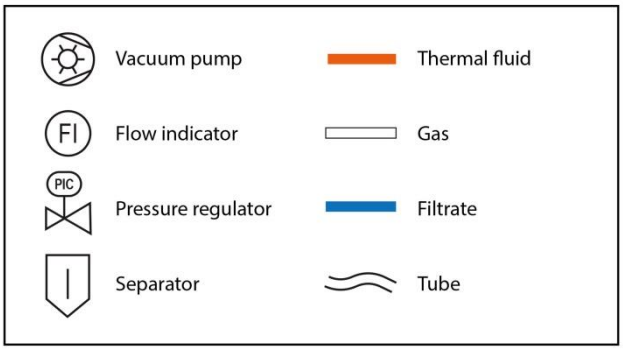
The following illustration shows a recommended test set up for pressure filtration tests.



4.3 Test set up for vacuum filtration

The following illustration shows a recommended test set up for vacuum filtration tests.





4.4 Choice of filter medium

The function of a filter medium is primarily to act as an impermeable barrier for particulate matter. At the beginning of a cake filtration process, the role of the filter medium is to act as a barrier. However, once the cake formation begins, the cake becomes the main particle-retaining barrier and the role of the filter medium is mainly a support for the cake.

Filter media used with the PLF can be synthetic (textile, felt, fleece), single-layer metal or multi-layer sintered metal.

The filter material has to be carefully selected according to the following criteria:

- Chemical resistance
- Mechanical stability
- Thermal resistance

Not only the fiber material but also the construction parameters of the filter media have an influence on the filtration area:

- Fiber type
- Yarn diameter
- Fabric construction
- Weave pattern
- Fabric finishing
- Making-up

The filter media should be selected in such a manner that:

- The filtrate is clear and free of solids after a short period of time (if required).
- No clogging of the filter media is detected after multiple test cycles.
- The cake discharge from the filter media is good.
- The filter media has a low resistance to the flow of filtrate.

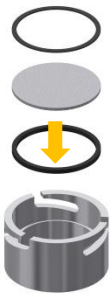
Please note, that the delivery includes a selection of filter media for test purposes.

4.5 Insertion of the filter medium

Insert the filter media according the following three steps:

1. 

Insert the support layer into the drain bottom.

2. 

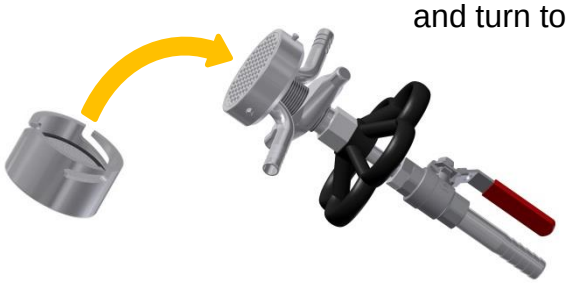
Insert in order the O-Ring sealing, the filter medium and the flat sealing ring into the reversed intermediate ring.

Please make sure that you use the suitable flat sealing ring:

- for sintered metal use FPM-ring of 2 mm height
- for synthetic use FPM-ring of 1 mm height.

Please make sure that the “filter cake side” of the filter medium is facing downward.

3. Assemble the drain bottom and the intermediate ring and turn to lock it with the bayonet catch.



4.6 Tempering of the test device

The pressure vessel and base are jacketed and can be heated or cooled with a heat-transfer medium. To do so, the heating/cooling in- and outlets have to be connected with flexible tubes that in turn are attached to a temperature control unit.
Usually, it is sufficient to temper only the vessel. The base has to be tempered if temperature sensitive suspensions are being investigated (e.g. viscous or crystalizing media).

4.7 Sample preparation

Special attention should be paid to the suspension preparation and sampling. The sample must be representative of what is to be found in the actual or future process. This includes particle size, particle distribution, particle shape, viscosity, temperature, solids content, chemical composition, etc..

Especially, organic suspensions tend to change their properties over time.
Mixing up the suspension over a longer period of time may change the filtration properties of the suspension significantly.

5 Testing procedure

Representative test results require a highly accurate and constant operation. The prudent course of action is always to repeat the important tests to ensure that the data which was first reported is accurate. If the data differ significantly, the test must be repeated.

Measurements and observations should be systematically documented in the test protocol.

The test procedure for the pressure and vacuum filtration is described in the following step by step.

5.1 Filtration

There are two different filtration modes of operation: constant-rate filtration and constant-pressure filtration. This operating manual addresses only to the most common method, constant pressure filtration.

Constant pressure filtration refers to a filtration process where the driving force (the pressure drop across the filter medium) is kept constant. Thereby the filtration rate decreases over time.

A premeasured amount of slurry is added to the top of the PLF. The filtration begins at an applied operating pressure difference and the amount of filtrate versus time is recorded.

The filtration step is completed when the filter cake is just saturated by the liquid phase.

The first optimization is the cake depth versus the filtration rate. Other parameters that are varied sequentially include:

- Cake depth
- Filtration pressure difference
- Filter media

In order to get a specific cake height it may be necessary to refill a measured amount of suspension into the unit by short-cutting the filtration process.

Please note, that the maximum filter cake height depends on the filter type being used:

- Rotary pressure filter ≤ 150 mm
- Belt filter ≤ 40 mm
- Plate filter ≤ 60 mm
- Candle filter ≤ 20 mm
- Autopress ≤ 15 mm

5.2 Displacement washing

Displacement washing (optional) is performed after the filtration step is completed. A measured amount of wash liquid is added carefully in a predetermined wash ratio so as not to disturb the cake. Once again time and pressure are measured. Additional washing steps can be conducted with the same or different washing liquids.
The washing step is completed when a gas blow off through the cake is detected.

5.3 Drying

Filter cake drying in the pocket-leaf-filter is tested by blowing/ sucking ambient-temperature or hot gas through the cake.
The pressure has to be kept constant and gas throughput has to be measured vs. time.

5.4 Cake discharge

After a preselected drying time, the cake has to be carefully removed from the filter media. Particular attention should be paid to the separating behavior of filter cake from the filter media.
The cake depth and weight has to be determined and if necessary analyzed (e.g. moisture content, leaching, etc.).

The filter media should be rinsed after each trial according to the process instructions.

6 Quick Start Guide testing procedure

Filtration

- Remove the cover from the unit.
- Place a vessel under the unit for collecting the filtrate.
- Measure out enough feed material to make the desired cake thickness.
- Slowly pour the measured suspension into the unit.
- Quickly connect the cover to the unit (only for pressure filtration).
- Apply the desired pressure difference to the unit.
- Open the block valve at the outlet.
- Simultaneously start the stop watch and measure the amount of time it takes until the cake is just saturated.
- Release the pressure/ vacuum from the unit.

Displacement washing (this step may be repeated as needed)

- Remove the cover from the unit (only for pressure filtration).
- Place a vessel under the unit for collecting the wash filtrate.
- Measure out the wash liquid.
- Slowly pour the measured wash liquid down the inner wall of the unit. Try not to disturb the cake when pouring the wash liquid into the unit.
- Quickly connect the cover to the unit (only for pressure filtration).
- Apply the desired pressure/ vacuum to the unit.
- Open the block valve at the outlet.
- Start the stop watch and measure the amount of time it takes until the cake is just saturated.
- Release the pressure/ vacuum from the unit.

Drying

- Apply the desired pressure difference to the unit.
- Start the stopwatch and measure the drying time and the flow rate of the gas.
- Release the pressure/ vacuum from the unit.

Cake discharge

- Remove the cover from the unit (only for pressure filtration).
- Remove the bottom outlet piece carefully.
- Measure the cake thickness.
- Inspect the separating behavior by removing the cake from the filter media.
- Weigh the cake and carry out any desired lab test (impurities, moisture, etc.).

7 Notes

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