

Operating and use regulations

Microscreen drum filter

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1. Principle

Water containing solid particles flows through supply pipe (or channel) into inner space of filtration drum, the dirt is caught in the inside of the press-cloth and the clean water flows through the filtration press-cloth out. During this filtration process the whole filtration unit is switched off. The filtration press-cloth gradually silts with the flowing-in dirt, the press-cloth resistance to water flow increases and inside the drum the water level raises.

When the pre-set water-level difference between the inner and outer space of filter drum is attained, the water-level sensor at the front side of the filter automatically switches on the rotation drive of the drum as well as the backwash pump, which pumps the filtered water into the jet nozzles of backwash system. The dirt caught on the inner side of the press-cloth is flushed away by oriented stream of water from jet nozzles into waste trough which is placed inside the drum. The sludge flows into the sludge sump where it is pumped out by sludge pump which is also controlled by the water-level sensors placed on the wall of the sludge sump. Eventually, if the gravity irrigation is possible, the sludge pump is omitted. After finishing the backwash process the hydrostatic pressure falls.

Due to rotation of drum the already backwashed press-cloth gets to bottom side of the drum, the water-level difference decreases and the sensor switches off the rotation drum drive together with the pump. The drum drive and both pumps will not switch on until the next impulse. The given mode repeats in cycles. The down-time to running time ratio of the filter depends on the actual amount of dirt flowing into the drum, on their character and on the state of the filtration press-cloth.

Since in the backwash process the raw water inflow will not be interrupted and the backwashing water is taken right from the filtration unit, no other additional storage tanks for re-backwashing or for sludge water are required for such kind of drum, which results in considerable reduction of investment costs.

Due to automatic switch on/off of the filter the energy consumption is minimized, the average quality of filtered water raises, the density of out-flowing sludge increases and the service life of whole unit extends.

2. Technical parameters of filter

The main parameter from the viewpoint of the filtration capacity of the filter is the effective surface of the filtration press-cloth, which is determined by the selected size of filter. Next parameter is the size of holes in filtration press-cloth and the third one is its free function surface. All these parameters can be optional for the user according to required quality of filtered water. The filtration capacity can be also significantly affected by the character of filtered solid particles. The following parameters are considered here: their shape (flat particles silt the holes more easily than spherical ones), mechanical strengths (coherent particles are more easily filtered than the incoherent, slimy ones) and the ratio of large to small particles in total volume of influent water. When certain amount of coherent particles bigger than the holes in filtration press-cloth is present, the thin layer of sludge – secondary filtration layer is created that is capable of catching even much smaller particles than are the holes in the press-cloth. Hence it is essential to choose the filter with larger filtration surface in such order so that the down-period of the filter could be as long as possible and the

effective secondary filtration layer could be formed on the inner side of the filtration press-cloth. This layer is next, while backwashing flushed away into the waste trough.

All given viewpoints which usually do not have constant character, affect instantaneous filtration capacity of the filter.

The long experience showed, that when the microscreen filters were applied as the tertiary step of water treatment in municipal and industrial sewage treatment plants, the filtration press-cloth with the hole size of 0,04 mm performed the best. If the water contamination is higher or at special kind of usage it is necessary to determine the optimal filter size and the parameters of the filtration press-cloth on the basis of previous experience with filtration in similar conditions or by means of filtration test.

3. Filter operation

When settling the filtration unit it is necessary to consider the water flow into the filter. It must be realized in such way, that the smallest possible swirl and breakage of particle agglomerates be achieved. Therefore it is necessary to prefer hydrostatic inlet to pumped one. If this is not possible, it is recommended in order to get the maximum efficiency of filtration that the mitigating tank be placed in front of the filter, which will provide the calming period of about 10 minutes.

Influent water should not contain solid coarse particles bigger than 3 cm and sticky components including oils and grease.

The filter must be settled in horizontal position with maximum deviation of 3 mm.

The outlet for filtered water must be entirely clear !

Such case must never happen, that the water-level behind the filter raise so much, that in consequence of the insufficient water outlet from the filter the water-level inside the filter raise excessively.

The filter would stop filtering !

When exceeding the capacity of the filter or when interrupting the filtration course water flows through the filter untreated. Hence it is not necessary to build the by-pass channel with crest. In case the filter is equipped with sludge pump, after the overflow of the filter water raises to emergency sensor and the sludge pump will be automatically shut off. Water flowing through the emergency overflow goes to the pipeline for clear water. When the sludge pump is not installed, after the overflow water flows by gravity irrigation in sludge sump. In case the amount of water flowing by the emergency overflow is larger than can be embraced by outlet in the sludge sump, the water excess goes to the outlet for clear water.

The possibility to shut the water inlet to the filter will be very advantageous when changing the press-cloths. The filter designed for the concrete shaft can be pulled out and let down into the shaft even at full water flow rate in the channel.

4. Filter servicing and maintaining

The filter is constructed in such way so that it would require minimal servicing and maintaining. Due to automatic filter operation the servicing is reduced to only casual visual check-out of its functioning. Mainly it is necessary to check whether water comes out of all nozzles and whether the water jets have optimal shape. Correct functioning of backwash system is the basic requirement for the filtration ability of the filter. If the lower intensity of water jetting is discovered the filter must be turned off, the backwash pump must be taken out and the dirt from the filter basket around the perimeter of the pump must be removed. If only some of jets show insufficient functioning, the globe valve placed at the end of backwash piping should be switched over for several seconds while the backwash pump still running or it can be cleaned by 1 mm wire while the filter switched to the permanent run in the switch-board. Also the condition of waste-trough, sludge sump and consequent piping shall be checked from time to time. By no means can water gather in the waste trough. The silting dirt must be removed.

When launching the filter it is necessary to first of all fill the inner space of the filter with clean water up to the crest.

The visual check-out dates should be chosen according to the experience arising from particular filtration conditions.

The filter does not have any parts requiring pasting and its maintenance consists only in changing the filtration press-cloth. The service life of the press-cloth is very individual and depends on the character of filtered water and contained solid particles. The changing of filtration press-cloth is very easy and undemanding.

5. Description of filter operation control

The microscreen drum filter is controlled by level sensors. These sensors are placed in the front side of the filter at the water inlet to the filter. The sensors record the pre-set water levels and report to PLC in the filter switch-board. Based on the sensor signals the PLC controls the filter operation. The filter can be controlled by:

- contact sensors**
- one pressure sensor**

5.1 Description of filter operation control by contact sensors

The filter working is controlled via monitoring three water-levels by three sensors.

The longest sensor (No.1) indicates the minimal working level, when the filter drive and backwash pump drive switch off.

The middle sensor (No.2) indicates maximal working level, when the filter drive and backwash drive switch on.

The shortest sensor placed on the highest level (No. 3) signalizes the emergency level. After reaching this level the sludge pump will be blocked, the filter drive and backwash pump will be still running. Their switch off will come after falling to the switching level.

5.2 Description of filter operation control by pressure sensor

Only one water-levels pressure sensor is placed in the inlet tank. Based on monitoring the water levels it enables to control the functioning of one or even more filters. The sensor records the following water levels:

- switch off level
- higher switch off level (switch off after elapsed time)
- switch on level
- danger level

5.2.1 Operation control of one filter

Listed recorded water levels bring about the same filter functioning as the contact sensors. Moreover the „elevated water level“ is also monitored, which brings about automatic switch off after pre-set time period with no necessity to reach the switch off water level. By this the unnecessarily long period of working cycle caused by certain latency when reaching the switch off level can be avoided. The latency can appear when the filtration cloth has been used for longer time.

Should not the filter work for certain pre-set period, it is automatically set to minimal working period *„the minimal period of filter working“*.

The emergency level causes the start of drum drive together with backwashing and at the same time switching off the sludge pump. Such situation can happen in case of excessive amount of dirt or in case of silting-up of the press-cloth.

5.2.2 Operation control of more filters

If more filters (with connected inlet) are controlled by the only pressure sensor the PLC controls the set of filters as the whole unit. The work of particular filters is divided equally to avoid unnecessary overloading of one or more filtration units. Basically three situations can happen, which will be described and explained on the set of three microscreen filters. For different number of filters the principle of control is the same.

When the switch on level is reached the filter No. 1 will be switched on. After lowering the water level under the switch off level the filter No. 1 will be switched off. When the switch on level will be reached again the filter No. 2 will be switched on and after lowering to switch off level it will be switched off. At the next reaching of switch on level the same will proceed with filter No. 3. The further cycle will repeat with filter No. 1. Each filter will be switched on for at least the minimal working period which is pre-set in the PLC as the *„minimal period of filter working“*.

When the switch on level is reached the filter No. 1 will be switched on. If the water level does not fall under the switch off level within the pre-set period *„timer of adding of next filters“* the filter No. 2 will be switched on simultaneously. After lowering the water level under the switch off level both filters will be switched off (filter No. 2 is switched on for at least the pre-set minimal period). After reaching the switch on level again the filter No. 3 will be switched on. If the water level does not lower (within the period *„timer of adding of next filters“*) under the switch off level, simultaneously filter No. 1 will be switched on. This cycle repeats.

The situation from the previous point repeats but the switch on of two filters will not help to lower the water level down to switch off level. In such case next filters will be switched on one after another always after pre-set period „*timer of addition of next filters*“. All three filtration units can be working at one time.

If one of the filters is in the „0“ or „R“ mode (see below), it is disdained by the program and substituted by the following filter.

If some of the filters are not switched on for a certain period of time, they are automatically switched on for their minimal working period.

5.2.3 Operation control of sludge pump

The pumping of sludge from the sludge sump is controlled either by two contact sensors or by one pressure sensor. The sensor records two water levels:

- switch off level
- switch on level

If the sludge level in the sludge sump reaches the switch on level the sludge pump will start. When the sludge level falls to the switch off level in the sump, the sludge pump will automatically stop.

The reaching of emergency level at the inlet of the filter will automatically block running of sludge pumps.

6. Changing the filter cloth

The service life of the press-cloth is very individual and fully dependent on the character of filtered water and the solid particles contained.

The filtration cloth must be considered as the expendable supplies.

1. Remove the filter from service; if possible remove the rest of water through the drain valve (only models for stainless steel tank). When changing the press-cloth rotate the filter drum by switching to manual drive in the switch board.
2. Remove the used press-cloth by screwing off the pressure slips one after another and loosening the gasket which can be used again.
3. Fasten the new filtration cloth on one end by terminal screws under the pressure slip. Please pay attention to keep the press-cloth position perpendicular to the filter axis and loose cloth of approx. 4 - 5 cm at the edge along the slip.
4. Wind the press-cloth subsequently onto the drum. Press the gasket into the edge and then fasten the pressure slip carefully, not to turn the press-cloth under the slip. When fastening tear the press-cloth by treated screw end right while its screwing in.

5. After the press-cloth is fastened all around the drum, loosen the part already fastened at the very beginning, cover it with the end of press-cloth and fasten again into the drum.
6. Never remove the crimps between the drum slips.

The service life of the filtration cloth depends on the quality of water flowing into the microscreen drum filter. The quality of water varies significantly considering the applications. The service life of the press-cloth used at waste water treatment plants is approximately 6 – 12 months.

7. Reasons of defects and their remedy

A) Incorrect functioning of backwash system

The requirement for optimal functioning of the filter is the correct function of backwash nozzles. Therefore it is necessary at regular filter check-outs to pay attention to the state of nozzles and keep them unsilted from dirt and to keep the water jets in optimal shape.

If incorrect shape of water jet observed or disfunction of some of the nozzles noticed, they can be cleaned out using the 1 mm wire. If water does not come with sufficient intensity out of most of the nozzles the backwash pump must be taken away from the filter basket then the filter basket must be lifted out of the channel and the screen around the filter basket must be cleaned. If more severe silting of backwash system happens the pipes with nozzles must be disassembled and cleaned out with stream of clean water.

B) Continuous rotation of filter drum

The reason may be:

1. Momentary filter overloading by large amount of dirt in flowing-in water. The defect will pass after lowering the amount of dirt.
2. Incorrect functioning of backwash system (for fixing see previous text).
3. Silting of holes in filtration press-cloth either by fats and grease or by continuous encrustation when used for longer period. The defect can be remedied either by switching the filter to continuous run for 1/2 up to 1 hour or, if the defect is not fixed, by applying the degreasing agents for cleaning the press-cloth, eventually by changing the press-cloth.
4. The level sensor in front of the filter is silted with dirt. The sensor must be taken away from the collar and the dirt connecting particular electrodes must be removed.
5. The filter is switched on to continuous run.

C) Water flows permanently over the edge of sludge trough inside the drum and flows out to sludge sump

1. Incorrect functioning of backwash system
2. Filter overloaded with large amount of dirt in flowing-in water
3. Holes in filtration press-cloth silted

D) Water does not reach the sludge trough edges in the filter but overflows through the sludge sump edges

1. The level sensor in the sludge sump is silted with dirt
2. The sludge pump is silted with dirt

When checking-out the filter please pay attention to the automatic sludge sump drain functioning.

When the sludge sump is filled with sludge up to the level of upper sensor the sludge pump must start automatically and after pumping the sludge out down to the level of lower sensor it must stop automatically.

Should the sludge permanently flow out through the edges of sludge sump the danger arises that the filter basket screen of injection pump silt with the dirt, followed by whole filter working breakdown!

For any manipulation with level sensors (e.g. their cleaning) shut off the main power cutoff in the switch board!

8. Settling and launching the filter

1. The filter must be settled in horizontal position with maximum deviation of 3 mm
2. The minimum difference between the water levels in front of and behind the filter, behind the crest, inevitable for providing the maximum filtration capacity, must be 380 mm
3. When connecting the sensor to the switch board it is necessary to keep sufficient cable length so that the sensor could be easily taken away from the collar placed in the front side of the filter.
4. After connecting all cables into the switch board the check-out must be made regarding the drum rotation in accordance with the rotation arrows marked on both inner sides of the filter, the backwash pump rotation, and the pendant belt being wound all around the ring of the drum and correct determination of snub pulley.
5. Before launching the filter for the first time or after long period out of service it is necessary to fill the filter up to the crest with clean water.

9. Filter control

This chapter would be relevant, if the control panel is included.

Two switches are placed on the switch board for each filter. One for drum drive and backwash pump and one for sludge pump.

They can be set in the following modes:

- a) permanent (manual) service
- b) automatic service
- c) out of service

For the drum drive and backwash pump holds the following:

Turning the switch to the permanent service mode (marked „R“) starts up the filter drive and the flushing pump. The filter is in the continuous run.

Turning the switch to the automatic service mode (marked „A“). The filter is switched off at the beginning. Due to silting the filtration press-cloth with dirt the water level in the drum continuously raises till it reaches the pre-set switch on level. The filter is driven by the PLC.

C) The given elements can be switched out of service by switching to the „0“ mode.

When launching the filter for the first time (or if has been put out of service) it is necessary to open the water inlet gradually.

Table 1. Explanation of legend on the switch board

Filter No	Legend	Control
1	Engine M11, M12, M13 run	Drum and backwash drive
	Engine M14 run	Sludge pump
2	Engine M21, M22, M23 run	Drum and backwash drive
	Engine M24 run	Sludge pump
3	Engine M31, M32, M33 run	Drum and backwash drive
	Engine M34 run	Sludge pump

9.1 Setting and adjusting the program

All logic functions are provided by programmable automatic machine by Siemens – LOGO! integrated in the switch board. This unit enables easy changing of the parameters important for the microscreen filters run. The LOGO! unit is equipped with cursor push-buttons for editing the parameters, ESC button and OK button. For checking and monitoring of functions the LCD display is also present on the front panel (see Fig.1.)

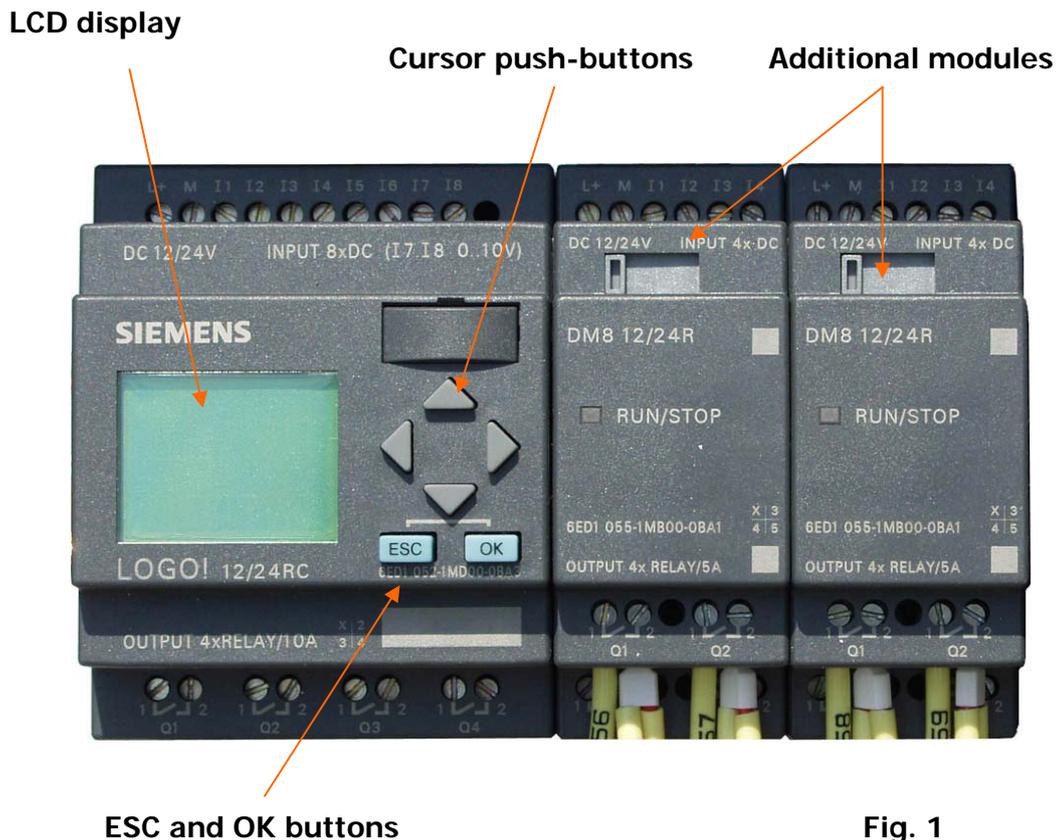


Fig. 1

After turning the main switch on the real time and date is displayed on the screen. Particular active and inactive inputs and outputs are displayed in following menu among which the switching is realized by cursor push-buttons (see Fig. 2). The input table is marked **I:** and the output table is marked **Q:**. Their active mode is highlighted by dark shade. The description of particular inputs and outputs is given in table 1.

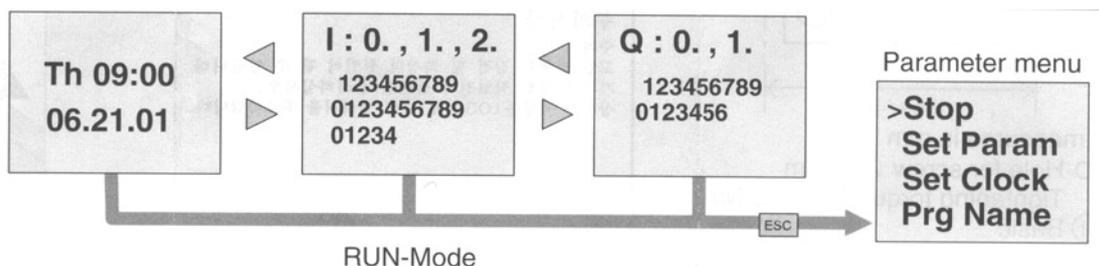


Fig. 2

Enter the Setting parameters menu by pushing the **ESC** button. Select the **Set parameter** option and with the cursor select required parameter to edit it. In the **Set parameter** menu you can change particular settings for the microscreen filter course.

Particular items are divided into blocks in the program, and they are marked with index **B** and number index (see Table 2).

Table 2. Meaning of particular blocks in Siemens LOGO!

block	description	parameters
B001	Main timer TL - working time TH - pause time	01:00m 01:00h
B002	Delay of higher switch off level probe (in the drum)	01:00m
B007	Switch off level in the silt tank	offset=0 on=100
B010	Danger level in the drum	offset=0 on=373 off=365
B013	Danger level in the silt tank	offset=0 on=690 off=680
B024	Switch off level in the drum	offset=0 on=232
B025	Higher switch off level in the drum (delayed by B002)	offset=0 on=253
B026	Switch on level in the drum (max. water level)	offset=0 on=344
B028	Switch on level in the silt tank (max. silt level)	offset=0 on=660

10. Safety

When using, manipulating and maintaining the unit please pay attention to the instructions contained in this document and follow the specifications and standards regarding the safety and health protection at work with waste treatment appliances. Also pay attention to common mandatory legislation regarding the requirements of work safety and health protection when working at risk of electrical accident.

CAUTION!

Before each manipulation or assembling on the microscreen filter the main power cutoff in the switch board must be shut off.

If the electric current in the switch board is not shut off it is not permitted to touch the microscreen filter with any part of the body.

Installation, service and maintenance of the unit can be performed only by determined staff, with corresponding qualification, instructed on the functioning conditions and principles of work safety.

11. Servicing

Entire servicing and other service regarding this product can be provided right by the producer:

IN-EKO Team, s.r.o.

Trnec 1734

666 03 Tišnov, Czech Republic

Tel.: +420 549 415 234

+420 549 415 589

Fax: +420 549 412 383

E-mail: secretary@in-eko.cz

12. Postscript

The guarantee period of 24 months is provided for this product. The guarantee is not valid if the defect is due to damage caused by incorrect storage, poor or unprofessional service or manipulation, unit overloading more than common service conditions or other accidental cause or neglecting the user guide.

The filtration cloth will be considered as an expendable supplies.