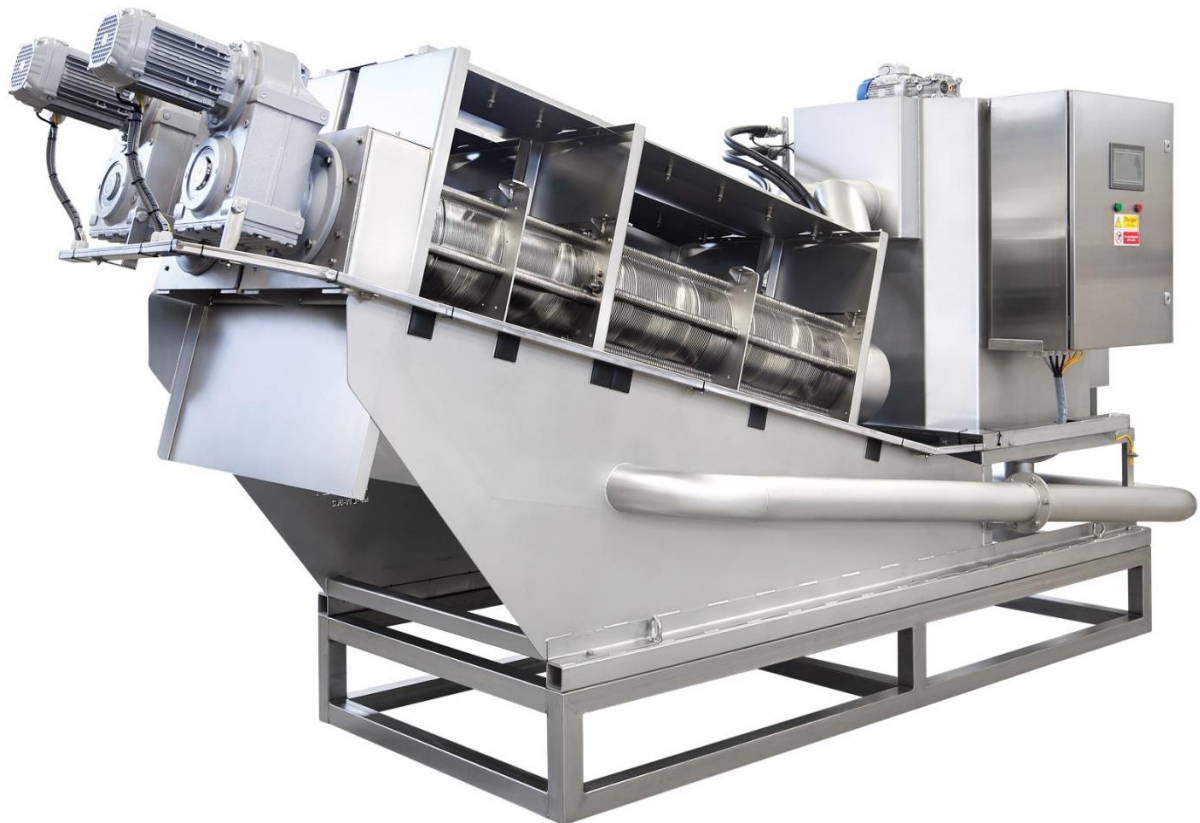


Sludge Dewatering Screw Press

Instructions for Use



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2. Safety precautions

Please respect the following safety instructions, breach of which could result in injury, death, damage to the press or other property damage. If the following instructions are not respected, the warranty for the press will be voided.

- 1) Commissioning, set-up and repairs may only be performed by a trained person.
- 2) Any interventions, connections and handling of the electrical box, electrical distribution system and the connection of drives or electromagnetic valves may only be conducted by an electrician holding a valid licence in compliance with Regulation No. 50/1978 Sb. (Collection of laws) or equivalent, according to the country of destination.
- 3) During manual operation of individual components of the dewatering equipment outside automatic mode, the instructions indicated in the relevant sections of this manual must be followed; otherwise, the components may be damaged.
- 4) Any tampering with individual components of the press (for instance, disassembling the gearbox of the screw, etc.) shall render the warranty for the press null and void.
- 5) Do not handle the machine while it is in operation. The machine must be turned off before any maintenance is carried out on it.
- 6) When coming into contact with sludge or polymer, use personal protective equipment (gloves) and respect local health and safety regulations.
- 7) The machine may not be used in explosive environments (Ex zones).
- 8) A forklift operated by a qualified and competent person must be used to handle the machine during transportation and installation.
- 9) The machine does not generate noise above sound pressure level of 70 dB(A). No special sound protection or precautions are needed.

3. Transportation and handling of the machine

Dewatering machines are long and relatively narrow equipment. Only a competent person (duly trained forklift operator) may handle the machine.

The weight of the equipment is always indicated on the manufacturer's plate. Please consider this weight when handling the machine. Please consider the distance between the centre of gravity and the height at which you will handle the machine with a view to the technical capabilities of the forklift being used.

It is important to remember that the centre of gravity of the machine is closer to the gearbox of the screw, the dewatering cylinder making up most of the weight of the equipment. The centre of gravity of the machine is hence not in its geometrical centre and as such it will tend to incline towards the screw gearbox during handling.

3.1 Handling the MP-DW 131, 201 types

As regards the MP-DW-131 and MP-DW-201 machines, which are transported on a pallet, only use a forklift truck to move the equipment during transportation and unloading.

As regards the final placement on the floor, use a forklift or a crane and nylon ropes or fastening slings, tying the ropes according to the picture – one rope behind the flange of the screw gearbox and the other rope behind the outlet pipe from the mixing chamber.

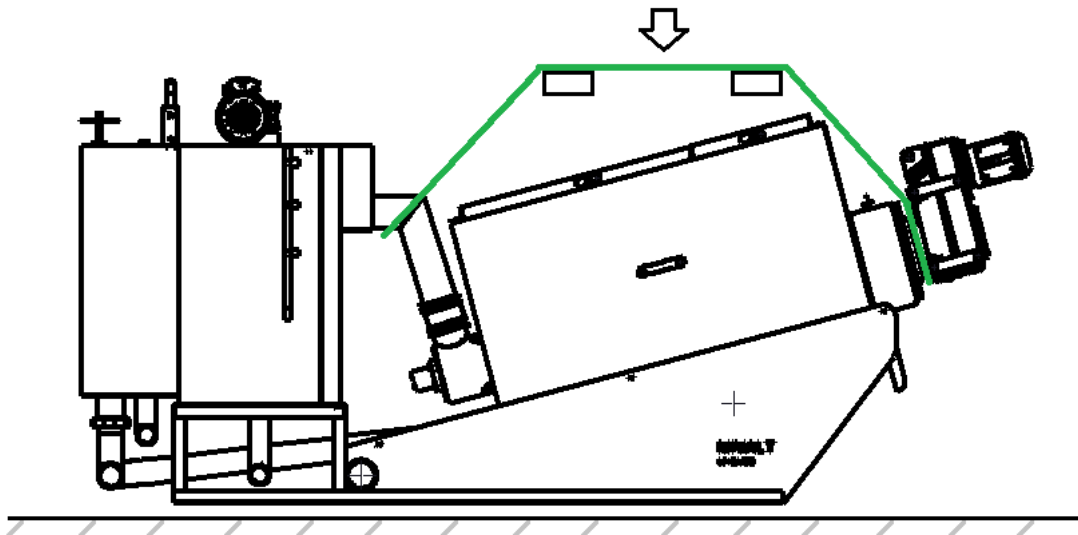


Fig. 1 – Placement of 131, 201

3.2 Handling the MP-DW 301 type

To relocate the MP-DW-301 machine, only use a forklift truck – for loading and unloading. Use a forklift truck or a crane and nylon ropes with a loading capacity of at least 1,000 kg or fastening slings attached to the handling eyes on the bottom frame of the machine for final placement. Separate the parts of the machine which may come into contact with a tense rope when lifting the machine using, for instance, cardboard or other protection.

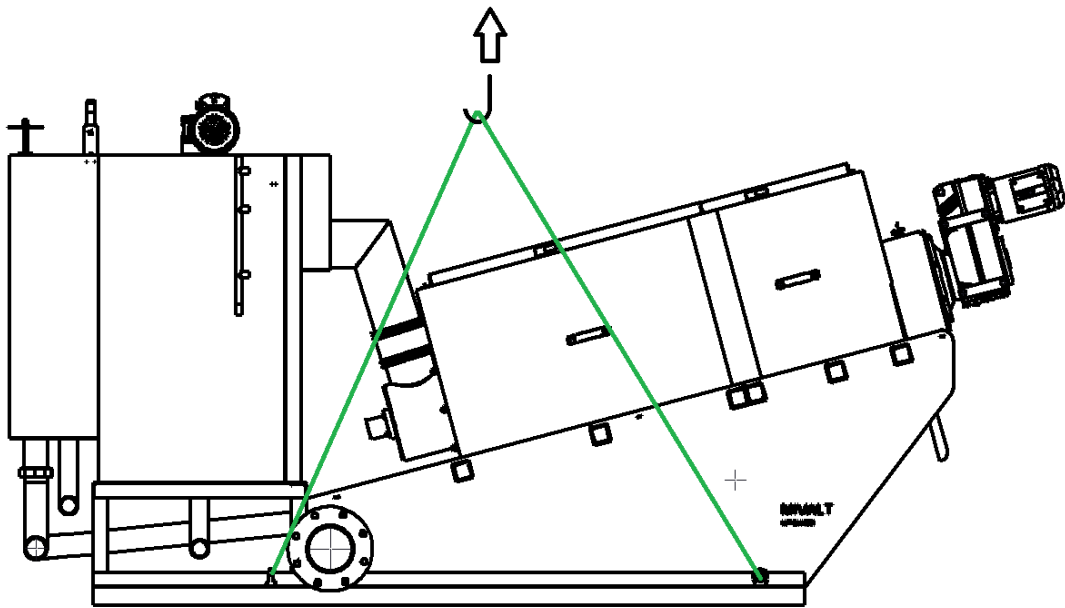


Fig. 2 – Placement of 301

3.3 Handling the MP-DW 302, 303, 401 types

To relocate the MP-DW-302, 303 and 401 machines and to place them on the floor, only use a forklift truck using the handling beams (rectangular profiles), which are part of the machine (internal dimensions of 192x92 mm). Using a forklift truck, the machine may be picked up from both the side and the face of the machine.

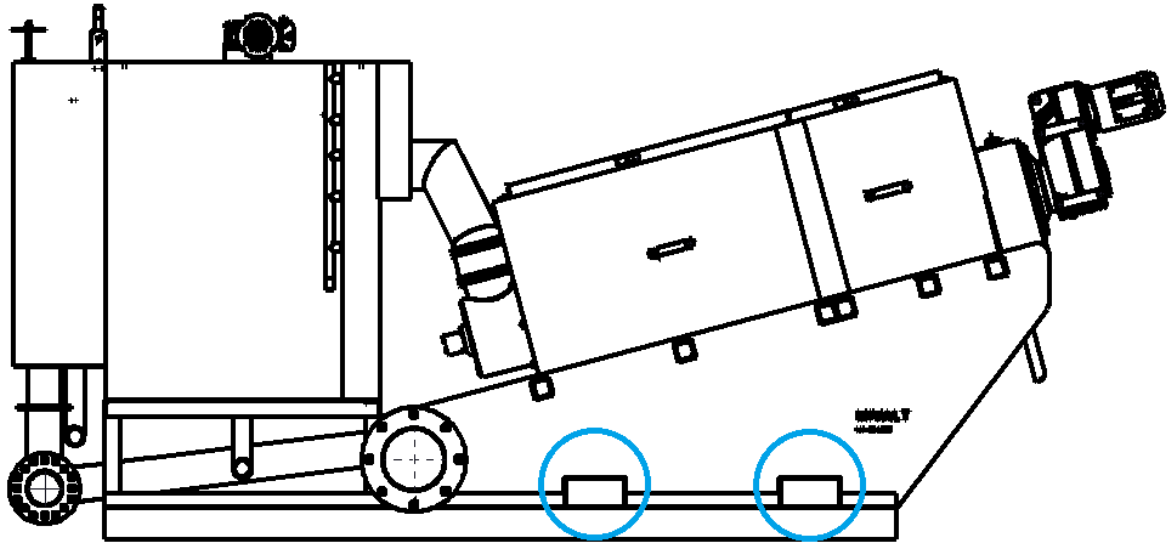


Fig. 3 – Placement of 302, 401

3.4 Handling the MP-DW 402, 403 types

The MP-DW-402 and MP-DW-403 machines are divided into two units for easier handling and transportation:

- A) The inlet, flocculation tank with the washing distribution system and the electrical box (approx. 25% of the total machine weight)
- B) Tank with dewatering drums (approx. 75% of the total machine weight)

Both the units are equipped with handling beams just as with the previous sizes. To handle both the units, only use these rectangular profiles.

After the final placement of both the units, screw both the parts of the machine together using paired eyes, welded to the frames of both the units, by means of the bolts which are supplied with the machine.

After connecting the units, it is also necessary to ensure continuity between both the parts of the machine (the prepared PE conductor of protective connection) and to connect the prepared conductors from the screw motors and pressure sensors to the electrical box as per the attached wiring diagram. In addition, it is necessary to fit a rubber connector between the neck of the dewatering

drums and the outlet-flocculation (mixing) chamber and to fix them using adjusting bolts at the connector ends.

IMPORTANT WARNING: It is forbidden to handle the machine when assembled (screwed together)!

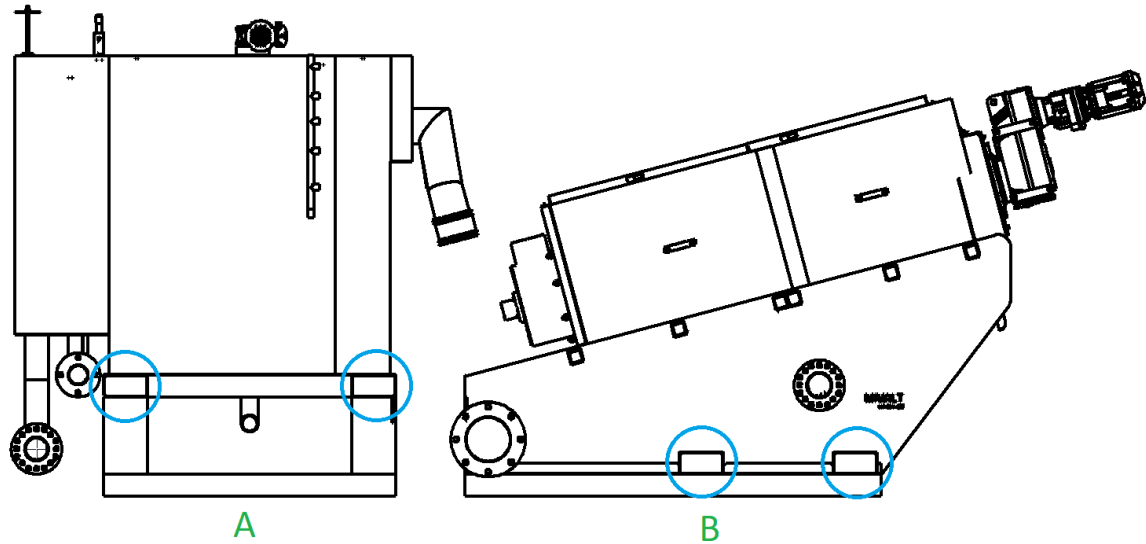


Fig. 4 – Placement of 402, 403

4. Process chart

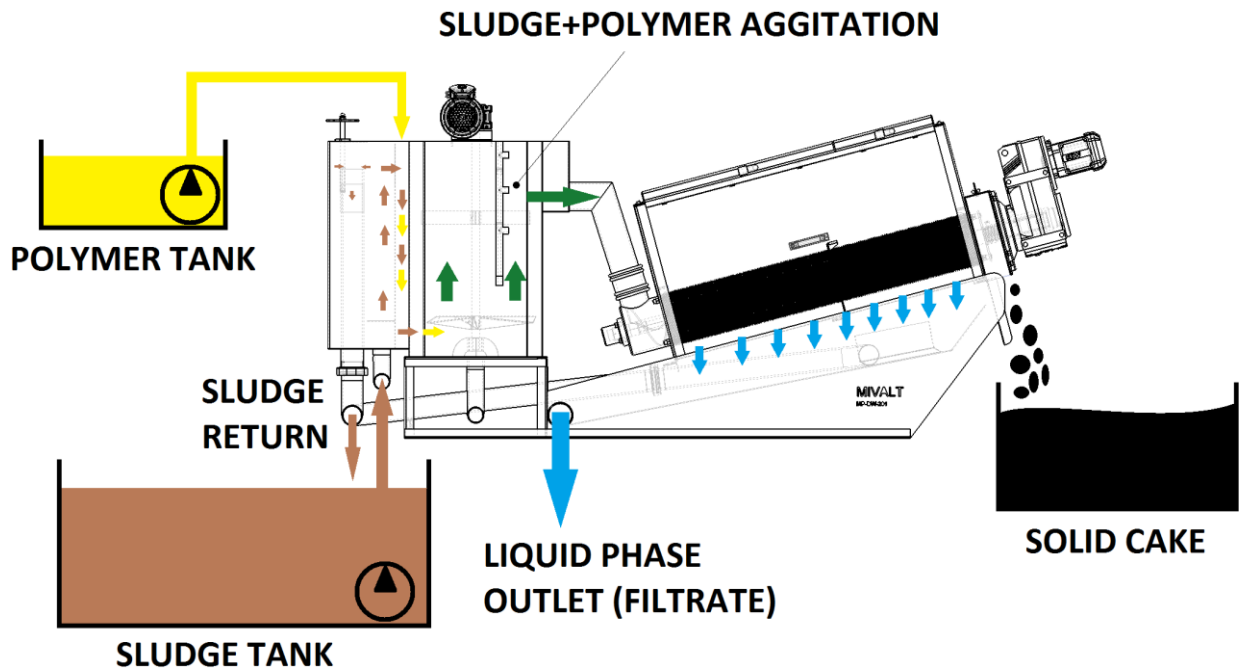


Fig. 5 – Functioning principle of the dewatering press

5. Mechanism of the dewatering drum

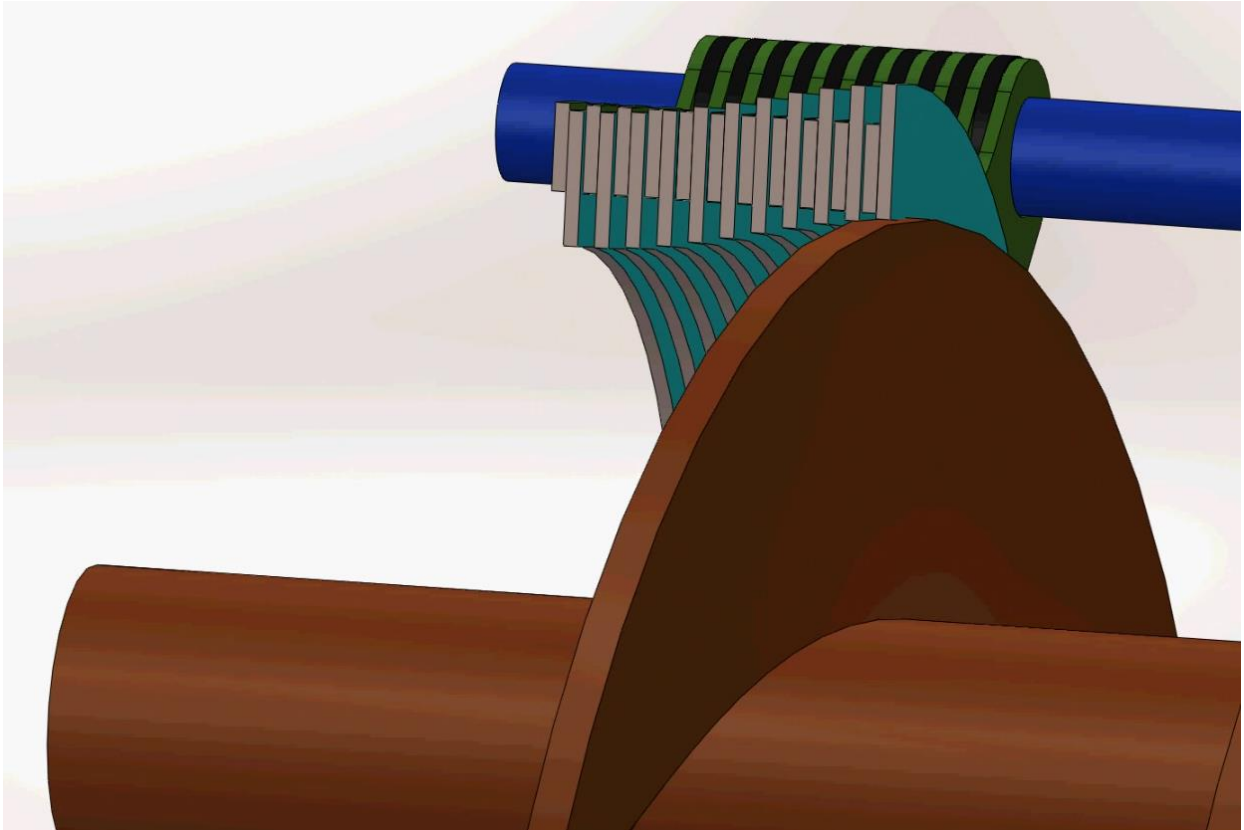


Fig. 6 – Section of the dewatering drum

The dewatering drum assembly is made of fixed plates/rings, which are firmly seated on threaded guiding bars. Behind each fixed plate (GREEN in the picture) there are spacers (BLACK) on the threaded bars which delimit the space for the free plates, thus also determining the clearance of the plate filter.

The free plates (BLUE) are narrower than the spacers. They are annular in shape and the inner diameter of these free plates is less than the outer diameter of the screw shaft. Free plates/rings are suspended on the screw and the rotation of the screw shaft causes the “planetary” movement of the free rings. Sludge moves along the screw shaft towards the outlet and water/filtrate flows away through the filter created via the gaps between the plates. The gaps are gradually reduced, just like the lead of the screw shaft is reduced.

6. Environmental and operational conditions

Trouble-free operation and maintaining the validity of the warranty for the dewatering machines require the following environmental conditions in which the MP-DW dewatering machine may be installed and operated.

6.1 Surrounding environment

- a. Ambient temperature during operation $+5$ to $+40$ °C, ambient storage temperature outside operation -20 to $+55$ °C
- b. Relative air humidity below 85%, without condensation
- c. Inside environment, or outside environment with protection against wind, rain and frost
- d. Environment without danger of explosion (no Ex zones)
- e. Without the presence of corrosive gases (H_2S , NH_3 ...) in the air, sufficient ventilation if the equipment is located inside at a wastewater treatment plant
- f. If the equipment is placed near ongoing construction works, it needs to be protected against contamination by mortar, concrete, sand or dust (e.g. by covering the equipment).
- g. When considering the future site of the machine's operation, please bear in mind the need for service interventions and regular maintenance of the equipment. Sufficient space needs to be reserved, primarily in front of the screw gearbox and at least from one side so that the whole screw assembly can be dismantled and removed from the machine if necessary. For this purpose, it is also advisable to fit out the room with lifting equipment or make arrangements allowing the use of a forklift truck or similar lifting equipment.

6.2 Electrical connections

- h. The TN-S or TT grid in the system according to the electrical box plate (typically 3/N/PE, 3/PE, 1/N/PE, 2/PE)
- i. Compliance with the protection requirements under the ČSN 33 2000-4-41 Ed. 2/3 standard
- j. If a residual-current device (RCD) is to be installed, the G type needs to be used, otherwise, the RCD could disconnect the circuit under the influence of EMC filter activity in frequency converters (ground leakage).
- k. The main lead protection needs to be coordinated with the main circuit breaker of the dewatering machine (according to the size of the machine and the electrical box plate).
- l. Installation of surge protection in the master electrical box: C type (class II) as a minimum * according to the ČSN EN 61643-11 Ed. 2 standard
- m. Voltage tolerance according to $U_N \pm 10$ %
- n. Grid AC frequency $f = 48 - 62$ Hz
- o. Phase imbalance tolerance 3%

6.3 Distribution of washing waters

- p. Maximum size of hard solid particles up to 0.2 mm
- q. Minimum operating pressure of washing waters $P_{MIN} = 2 \text{ Bar}$
- r. Maximum operating pressure of washing waters $P_{MAX} = 6 \text{ Bar}$

6.4 Length and dimension of piping

- s. For all the inlet/outlet connections of the machine's piping, the diameter of the piping should correspond to the respective part of the piping on the machine.
- t. The pump for transporting sludge water from the tank to the machine must be selected/dimensioned according to the actual needs – hydraulic flow / pressure necessary to overcome height differences, pressure losses in the piping and viscosity of the concentrated sludge water.
- u. For “sludge return” and “filtrate discharge” pipes, horizontal sections of the piping need to be eliminated and negative gradient must be avoided completely.
- v. For the suction part of the polymer piping (from the polymer tank to the dosing pump), the maximum length of the piping (hose) of 5 metres and the maximum elevation difference of 1 metre must be respected. In case of major differences between the position of the dewatering machine and the polymer tank, the dosing pump must be installed on the polymer tank (RECOMMENDATION: please specify this requirement already in the purchase order).

6.5 Sludge to be processed

- w. Do not use the machine to dewater sludge with a high content of chlorides (marine salt water, AlCl, etc.).
- x. The pH value of the sludge should range from 6 to 11.
- y. The sludge may not contain bigger solid particles, stones, leaves, fibres, straw, etc. Before dewatering, the sludge must be mechanically precleaned using a screen or similar.
- z. When entering the machine, sludge to be dewatered must contain 0.3% TSS (total content of suspended solids) as a minimum.

6.6 Pressured air connection (40X sizes)

- aa. Pressure of compressed air supply for pneumatic pressure plate should be within range of
 - i. $P_{MIN} = 5 \text{ Bar}$
 - ii. $P_{MAX} = 10 \text{ Bar}$
- bb. Compressed air particle class to be 5 or lower (ISO 8573-1:2010)
- cc. Compressed air water content class to be 7 or lower (ISO 8573-1:2010)
- dd. Compressed air oil content class to be 3 or lower (ISO 8573-1:2010)

7. Press installation

Once you have received the press, check that no mechanical damage has been incurred during transportation. Document, photograph and claim any damage with the carrier.

7.1 Installation procedure

- 1) As shown in the respective drawings or the chart above, connect the sludge inlet pipe (from the feeder pump), the sludge water return pipe (via overflow) and the filtered water/filtrate outlet pipe and then connect the shut-off valve to the discharge pipe of the mixing chamber (*for cleaning, closed while in operation*).
- 2) Connect the pipe/hose with clean (service) water (for washing) (fig. 16). Arrange for space to store the pressed dry matter (a container or a belt/screw conveyor).
- 3) Place the suction tube of the dosing pump in the tank / polymerization station with the prepared liquid flocculant solution. The pump head should be as small as possible (not more than 1 m) and the maximum length of the suction tube between the polymerization station and the dosing pump should not be more than 5 m. The distance between the dosing pump and the MPDW dewatering machine may be up to 50 metres based on the selected dosing pump.

If the source of polymer is placed further away from the dewatering machine, or with a greater drop, it is recommended to place the dosing pump on the polymer tank, thus minimizing the length of the suction tube while lengthening the outlet pipe. It is better when pressure losses at the outlet piping are greater than pressure losses at the pump suction side.

As shown in the attached chart of the electrical box and in the description of the terminals, connect the power supply of the electrical box and any external equipment – typically the following components:

- Sludge feeder pump (typically a screw pump – immersion or dry, peristaltic)
- Level-control switch (floater) in the sludge trap to get feedback (it prevents the sludge feeder pump from running dry)
- (*optional*) Level sensors – indication of polymer low level (for instance, from the MSP/ASP station)
- (*optional*) External signals to the master system (no-voltage contacts operation/failure)
- (*optional*) Data communication with the master system (UTP CAT5E/6 – MODBUS TCP protocol), see the external list of registers for the MP-DW machine

7.2 Checking the machine after installation

- Visually inspect that the machine has not been damaged (during transport or while being placed and installed).
- Check that the connected piping does not leak.
- Check that the dewatering cylinder is clean before powering up (check thoroughly that no dust, sand, metal splinters, mortar, concrete, etc. from construction works are stuck on the plates or between them; if necessary, clean them thoroughly using a vacuum cleaner and then water, all this before powering up).
- Check that the screw connections are tight.
- Check that the free plates in the dewatering cylinder can freely move – all plates must be able to be moved by hand.
- Check the voltage on the power supply terminals of the dewatering machine: it should correspond to the power supply of the machine indicated on the machine's plate; check the power supply to the electrical box by measuring the fault loop impedance and grid impedance.
- After powering up the machine, check the direction of rotation/direction of any peripherals, in particular the rotation of the dosing pump and the feeder pump (equipment connected only after installation of the machine or not connected via a frequency converter, hence dependent on the sequence of phases of the electrical box power supply).
- Check that both the dosing and feeder pumps correctly suck the respective liquids and supply their rated flow to the machine (the flow can be measured, for instance, by means of a metering tank while measuring the time with a stopwatch).

8. Determining the machine's capacity and hydraulic flow

The machine's capacity/performance is always indicated as the amount of suspended solids contained in the sludge which is required to be processed by the machine in an hour – in [kg/h]. The hydraulic (volume) flow rate of sludge in [m³/h] which the feeder pump should transport to the machine needs to be calculated based on the input dry sludge matter.

The machine must always be operated at approximately its rated capacity – amount of substance. If the machine is operated at a considerably lower capacity than that for which it is dimensioned, this results in an insufficient outflow of water between the plates. This will cause the machine to partially run dry, hence increasing wear and tear. By contrast, running the machine considerably above its rated capacity will cause the inner pressure of sludge in the dewatering drum to increase, and sludge will be pressed through the plates, again resulting in premature wear and tear.

Some types of sludge allow a marked increase in the process capacity. This always depends on the type and quality of the sludge, the type of polymer, and the method of chemical-biological treatment before the dewatering itself. In this respect, you should request assistance from a professional

consultant in the area of polymers and chemical management and after dewatering has been professionally tested for a sufficiently long time.

8.1 Calculating the hydraulic flow rate of sludge

The machine's capacity is indicated on the manufacturer's plate as well as in the catalogue.

Dry sludge matter is determined by means of a precise drying scale (a sample of approx. 5 grams of sludge is dried at a temperature of 120°C until a constant weight is achieved; the proportion before and after drying determines the amount of water evaporated, the rest being the content of solids).

The content of solids in the sample (TSS) can be measured by any laboratory which performs sludge analyses, or by your polymer supplier. If you do not know the exact dry matter content in your sludge, you can use the table below, which shows the typical values of the given types of sludge.

Type of sludge	Dry matter [mass %]
Sludge from an activation tank of a municipal wastewater treatment plant	0.3–1%
Excess sludge after gravitational thickening – aerobically stabilized	1.5–3%
Sludge after anaerobic stabilization (bigger wastewater treatment plant, biogas...)	5–6%
Sludge from flotation (DAF)	2–4%

The hydraulic flow rate of the machine is calculated as the quotient of the substance capacity of the machine and the dry matter percentage of the sample. Such calculation considers approximately a similar density for solids and water ($\rho=1,000 \text{ kg/m}^3$) (valid for biological sludge).

The indicative production of excess sludge for a municipal wastewater treatment plant is 0.050 g TSS/1EO/1 day.

$$Q_{\text{hydraulic}} \left[\frac{\text{m}^3}{\text{h}} \right] = \frac{Q_{\text{RATED}}}{\text{TSS}_{\%} \cdot 1000}$$

Example: A wastewater treatment plant with aerobic stabilization achieves a dry matter content in the thickened sludge of 2.4% (24 g = 0.024 kg of suspended solids per 1 kg = 1 litre of sludge) and the MP-DW-301 machine with a capacity of 60 kg DS/h is installed for dewatering.

$$Q_{\text{HYDRAULIC}} = \frac{60}{0.024 \cdot 1000} = 2.5 \left[\frac{\text{m}^3}{\text{h}} \right]$$

Result: This MP-DW-301 machine is able, with a dry matter concentration of 2.4%, to process 2.5 m³/h of sludge water and the feeder pump should be set approximately for this flow rate.

8.2 Calculating the polymer dose and flow rate

The polymer concentrate is supplied, as standard, in a liquid state in jerrycans in the form of emulsion or as powder. This polymer needs to be mixed with water in a certain ratio before use. The

recommended mixing ratios range from 0.1 to 0.5% of the polymer-in-water concentration. Your polymer supplier will recommend the specific concentration of the solution always after testing and detailed analysis of the sludge water.

General recommendations:

Polymer in the mixed state should have approximately the same viscosity as the sludge itself so that it can mix well with the sludge in the flocculation tank. The thicker the sludge is (contains more dry sludge matter), the higher the concentration of polymer that needs to be used.

The polymer dose is indicated as the weight of raw polymer necessary to flocculate the unit weight of sludge solids. For instance: 10 g of polymer per 1 kg of sludge solids. The polymer dose may differ based on the sludge type and polymer suitability for a particular sludge. The dose should be determined by the polymer supplier, or a process engineer. Do not underestimate the importance of determining these parameters – they can significantly influence the machine’s function, running costs and disproportionate contamination of water by polymers.

Indicative doses of polymer are shown in the following table:

Type of sludge	Polymer dose [g/1 kg TSS]
Aerobically stabilized sludge from wastewater treatment plant	4–10
Anaerobically stabilized sludge from wastewater treatment plant	5–9
Sludge stored over a long period without aeration	7–20
Sludge with a high content of fat	12–25
Industrial, mineral sludge	5–30

The hydraulic flow rate of the polymer solution based on the selected polymer concentration, polymer dose and amount of solids processed per hour can be expressed as follows:

$$Q_{HYD,POL} = \frac{Q_{RATED} \cdot DOSE \frac{g}{kg\ TSS}}{CONCENTRATION_{\%} \cdot 1000} \left[\frac{L}{h} \right]$$

Example: Let’s consider the wastewater treatment plant from the previous example (with the calculation of the hydraulic flow rate of sludge) with the MP-DW-301 dewatering machine (60 kg of dry solids/h) for which the polymer supplier has determined a suitable concentration of polymer solution of 0.3% (i.e., 0.3 litres of polymer concentrate per 100 litres of water) and a polymer dose of 7 g/kg TSS.

$$Q_{HYD,POL} = \frac{60 \cdot 7}{0.003 \cdot 1000} = 140 \left[\frac{L}{h} \right]$$

This value of the hydraulic flow rate needs to be set on the polymer dosing pump.

9. Operational principle and first start-up

9.1 Feeder pump and sludge pumping to the machine

Sludge water from the sludge tank/sludge trap (regulating reservoir, process...) is pumped by the feeder pump to the inlet (first) chamber of the dewatering machine.

Sludge in the sludge tank should be as homogeneous as possible so that the characteristics of the sludge (dry matter) brought to the machine are constant. This is desirable especially with a view to setting up a stable operating mode of the machine. If you set up the machine for a certain sludge density at the inlet side and it changes while the machine is being operated, the quality of dewatering, the filtrate cleanliness and the dry matter content of the sludge cake will vary as well.

If sludge becomes thicker during operation, the set polymer dose will very probably be insufficient, which will result in filtrate turbidity and a lower dry matter content of the final cake. While if the input dry matter content decreases, sludge will be overdosed by polymer, you will consume more polymer than necessary and the machine may not be sufficiently filled. Consequently, the necessary – optimal pressure on sludge will not be achieved, the final cake will not be sufficiently dry and you risk the machine running partially "dry".

To this effect, the most suitable solution is to have the sludge tank fitted with a mechanical agitator. Mixing by means of aeration elements is also possible, nevertheless, it is desirable that aeration not be in operation during dewatering. When using centrifugal feeder pumps, air bubbles may cause flow fluctuations or piping and pump aeration.

In addition, it is necessary to make sure that the volume of the tank from which the sludge is pumped to the dewatering press is sufficient. When processing sludge from flotation (DAF) and using a regulating reservoir, the volume of such reservoir should correspond to at least the hourly flow rate through the machine (for instance, when operating the machine with a hydraulic flow rate of 3 m³/h, the regulating reservoir should have a volume of at least 3 m³).

The feeder pump is operated via a frequency converter, hence its flow rate can be regulated by the pump's motor speed. Always respect the recommendations of the pump manufacturer regarding the regulation of speed (revolutions). With centrifugal pumps, if speed decreases, the efficiency may rapidly drop and the pump could overheat. With displacement (for instance, screw) pumps, flow can be easily regulated by selecting the frequency – the motor speed and the flow is not strongly dependent on the output pressure. The frequency–flow ratio dependency is almost linear, hence you can set up the required inlet to the machine by selecting the operating frequency. With centrifugal pumps, the situation is very different as a small change in operating frequency typically causes a considerable change in the flow rate. Besides that, the flow rate varies considerably with these pumps depending on sludge density as well as on changes in pressure due to changes of the level in the sludge tank, solids or air in the sludge such that the flow rate may fluctuate during operation.

For centrifugal pumps, it is recommended to set the operating frequency (flow rate) at a higher value than the flow rate required by the machine and to have the excessive flow discharged through the overflow in the inlet chamber back to the sludge tank (by unscrewing the inlet flow regulator to a certain level). In this way you will ensure that if the flow rate fluctuates, primarily the flow rate through the overflow will fluctuate while inlet to the machine will remain unchanged.

In the inlet chamber, sludge passes through a triangular overflow. The level of flooding of this overflow is proportional to the inlet to the machine. The flow scale is engraved on the metal surface of the inlet chamber next to the overflow itself. Behind the triangular overflow, sludge enters the intermediate space between the inlet and mixing chambers. Sludge which flows into the overflow pipe (height adjustable by means of the inlet flow regulator) returns to the sludge tank.



Fig. 7 – Setting the water level in the inlet chamber

The operating point of the pump, and hence the pump itself (the value corresponding to the displacement and flow rate) needs to be determined with regard to local conditions and the rated capacity of the machine according to chapter 8.

9.2 Flocculant dosing pump

Flocculant – polymer is added to the sludge between the inlet and mixing chambers by means of a nozzle (see point 8.2 of these instructions). Dosing is carried out using a displacement dosing pump – either a membrane or piston type – with the flow rate depending on the size of the dewatering machine.

With membrane pumps, the flow rate is regulated electronically on the pump's panel by setting the number of membrane pulses. With piston-type pumps, stroke height, i.e., the flow rate (consumption) of polymer, can be regulated manually.

Flocculation – sludge flocculation is the key part of the process. Polymer/flocculant works in sludge waters as a so-called magnet which temporarily collects the solids contained in sludge water, creating “flocks”. Flocculant causes a clustering of particles into bigger flocks, which then visibly separate from the residual water in the sludge. In certain specific applications (oil separators, foodstuff industry, chemicals industry) it may be crucial for successful dewatering to dose the sludge water with additional additives (coagulants, pH adjusting agents, etc.). In these cases, please contact your chemicals consultant, who will be able to propose the best solution for the specific application.

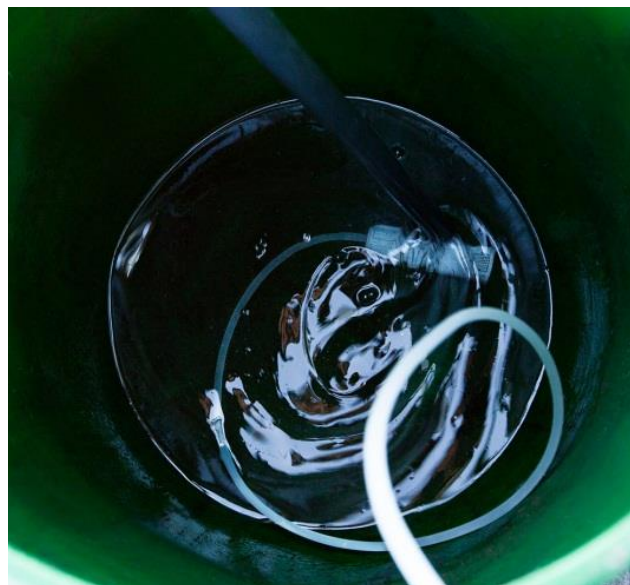


Fig. 8 and 9 Dosing pump with the MP-DW-131 machine type; polymer tank



Fig. 10 Automatic station for polymer preparation – ASP750/400-PP-C

9.3 Flocculant – type and selection

The selection of an appropriate polymer depends primarily on the type of sludge. We recommend contacting a suitable supplier of chemical products who will identify a suitable polymer for your specific sludge based on your sludge sample. Polymers are typically supplied either in powder or liquid (emulsion) form. Individual types of polymer differ by the type of charge (anionic/cationic) and their size, structure (linear, network), molar weight as well as viscosity.

It is impossible to state that a certain type of polymer is universal; in addition, even if a polymer is able to create flocks in the sludge, that does not automatically mean that it will result in good dewatering. The level of dewatering also depends on the strength and decay time of the flocks, etc. Therefore, it is always advisable to test several polymers on the sludge. Sludge can also be subject to changes over time. Its composition, age and density (content of solids – TSS) all matter. If all of a sudden a polymer no longer works or achieves considerably worse results, it is necessary to retest the polymer and, if necessary, select another / a new polymer.

The supplied polymer (powder, liquid concentrate) needs to be mixed with water.

In order to do this, you need a polymer preparation station, which we offer as one of the accessories for our dewatering machines. The current offer includes manual stations with an electric mixing system (the MSP series) with volumes of 300, 600, 1,000, 1 400 and 2 600 litres. For manual stations, the operator fills the tank with clean water, doses the appropriate amount of liquid concentrate or powder and manually starts the electric drive of the mixing system. We also offer automatic stations with their

own control system (the ASP series). Such a station consists of two tanks: the level in the lower (storage) tank, which serves as the source of polymer for the dewatering machine, is monitored. In this chamber, the level is measured and if it drops below a certain limit, a solution is automatically prepared in the upper tank, subsequently being drawn off to the lower one.

With liquid polymers, the most important thing while mixing is to evenly mix clean water with the polymer itself, thus mixing can be relatively quick (10–15 minutes). With powder polymers, it is usually necessary to wait until the polymer is activated, hence the mixing time is longer (30–90 minutes).

The concentration of the solution (polymer with water) is usually between 0.1 and 0.5% (1 to 5 litres of polymer per 1,000 litres of water).

Your supplier of polymers will provide the appropriate information about the concentration and the mixing time.

9.4 Mixing chamber

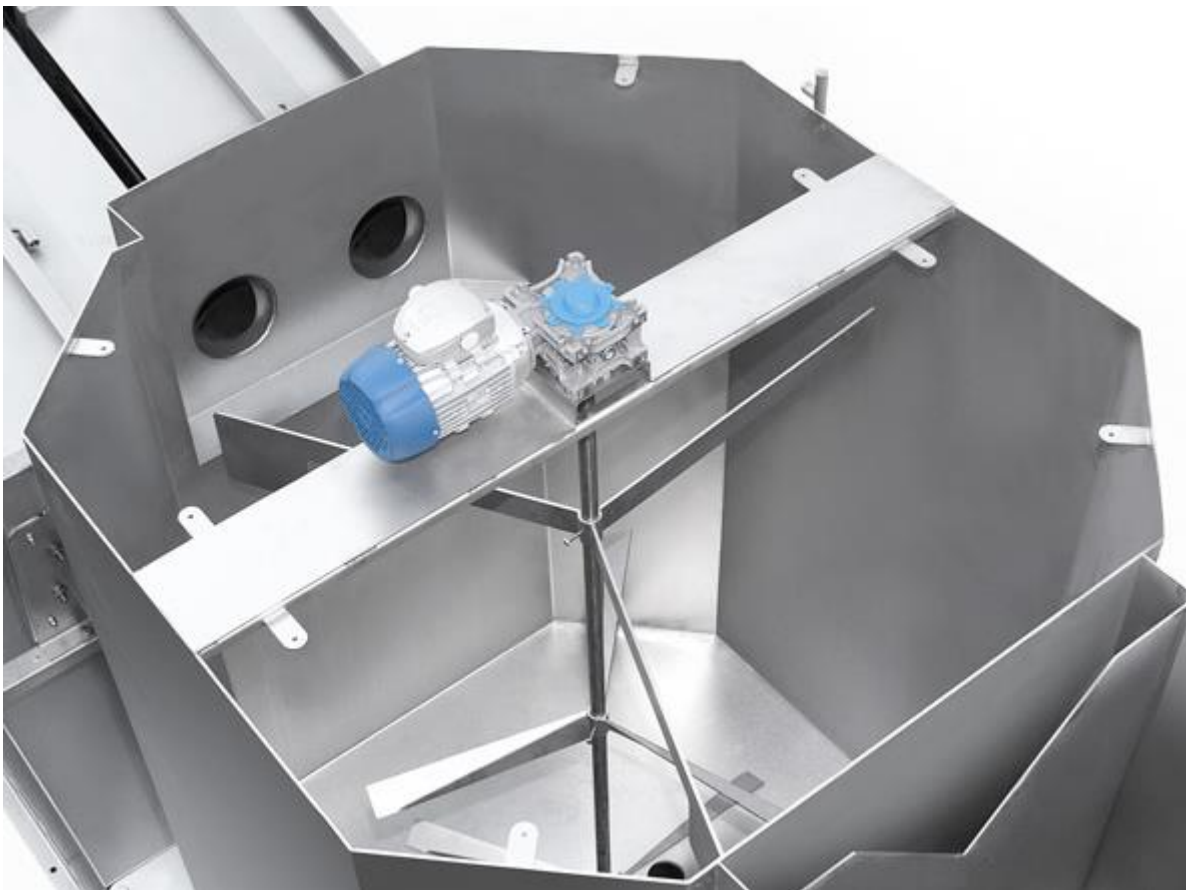


Fig. 11: Mixing chamber

The compounding chamber (intermediate space between the inlet and mixing chambers) and the mixing chamber are communicating vessels and hence have the same level. In the mixing chamber, the flocculant slowly mixes with the sludge water and flocks are formed. Mixing is ensured by a motor with a screw gearbox started via a frequency converter. The speed ranges between 10 and 35 min^{-1} . The speed should not be too low so the sludge does not sediment in the mixing chamber and is mixed

sufficiently; on the other hand, the speed cannot be too high, otherwise, the flocks will be broken up by the blades. By contrast, the formation of extremely large flocks (more than 50 mm) can be undesirable because of the poor outflow of water from the inner part of the flock; in such case, slightly increase the mixing speed. The ideal flock size is approximately 20 mm. If flocks are small (less than 3 mm), we recommend increasing the dose/concentration of the flocculant while reducing the speed of the mixing system. A phase difference between water and solids should be already seen upstream of the outlet pipe from the mixing chamber to the screw (visible clusters of solids in clear water).



Fig. 12: Polymer effect – raw sludge in the inlet chamber without flocculant (upper) and optimal flocks in the mixing chamber (lower)



Fig. 13: Polymer effect – optimal flocks

9.5 Screw

At the end of the mixing chamber, sludge water (flocculated) flows over the overflow tube to the screw press. During normal operation, this outlet tube should be flooded for approximately 2/3rds of its height.

The screw is driven by a motor whose power corresponds to the press size; the motor also includes a front gearbox. Screw speed range is 2–10 min⁻¹ **depending on the setting of the frequency converter.**

The higher the speed of the screw, the greater the equipment capacity, hence the machine is able to process more flow. At lower speeds the sludge processing takes longer, which results in better dewatering and hence in a typically better dry matter. However, it is always vital to run the machine at its capacity. To start with, we recommend setting the inlet sludge quantity and the polymer dosing following chapter 8. Then adjust the screw speed so that the mixing – flocculation tank is not flooded and the tube to the screw is filled to approximately 2/3rds of its height; however, at the same, the speed must be sufficiently slow so that the final dry matter is satisfactory.

With certain types of sludge, in particular foodstuff industry sludge with a high content of fat, a higher speed is desirable in order to avoid the screw being blocked.



Fig. 14: Screw and washing system

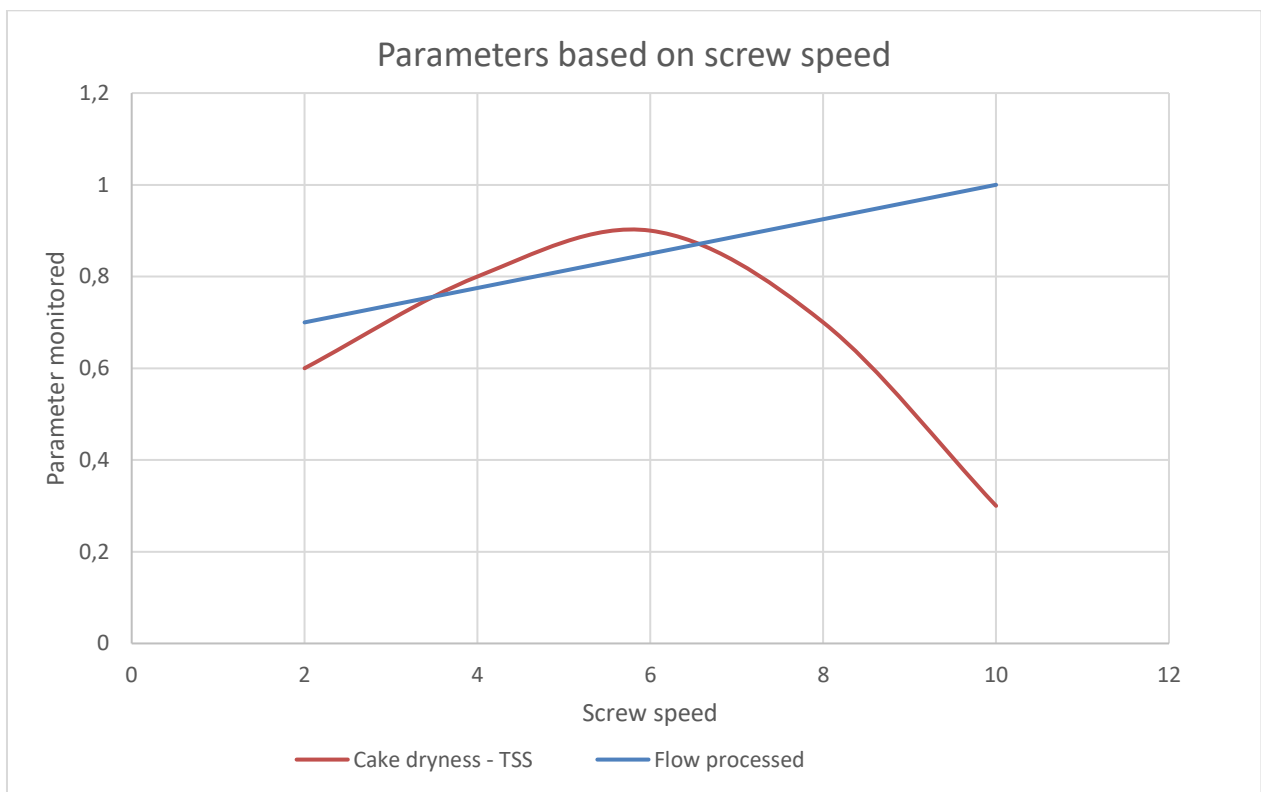


Fig. 15: Dependency of dewatering parameters on screw speed

Screw rotation forces the sludge to move along the helix “towards the gearbox”; de-sludged water flows through plates onto the lower cover and then to the raw water outlet (see the chart). The screw cover is made up of a plate filter. The filter consists of fixed plates which form a fixed part/stator and

moving rings which move up and down eccentrically following the screw movement. These moving rings have a self-cleaning filtering function.

The tank to which the dewatered liquid phase flows is divided as in the upper part of the screw some sludge is often pushed through the plates. This is due to the pressure increase of the sludge in the dewatering section where the sludge is pressed, with the aim of achieving sufficient outlet dry matter, and a part of this sludge is pushed between the plates. The amount of this sludge should correspond to a maximum of 10% of the sludge volume falling out of the machine. If this amount is considerably higher, the problem will probably be in the polymer – either in too low a dose, or its inability to create sufficiently strong flocks, or too high a pressure in the screw (low speed is set, there is a large amount of sludge at the inlet or the pressure plate is too prestressed).

Such sludge pushed through the plates is periodically washed by the washing system (the upper section) back to the overflow and then to the tank from which the sludge is pumped back to the dewatering equipment. Hence, this sludge does not influence the outlet water quality.

9.6 Pressure plate

At the end of the screw there is a pressure plate with a pressure spring and a locking ring. This plate regulates the sludge pressure in the dewatering section of the drum.

By setting the preloading of the spring by means of the locking ring's position on the shaft, you can control the pressure in the dewatering screw. The screw in the pressure plate itself must remain loose so that the spacer can move during operation. During operation, the spacer moves along the shaft and the spring is pressed due to the sludge moving towards the spacer.

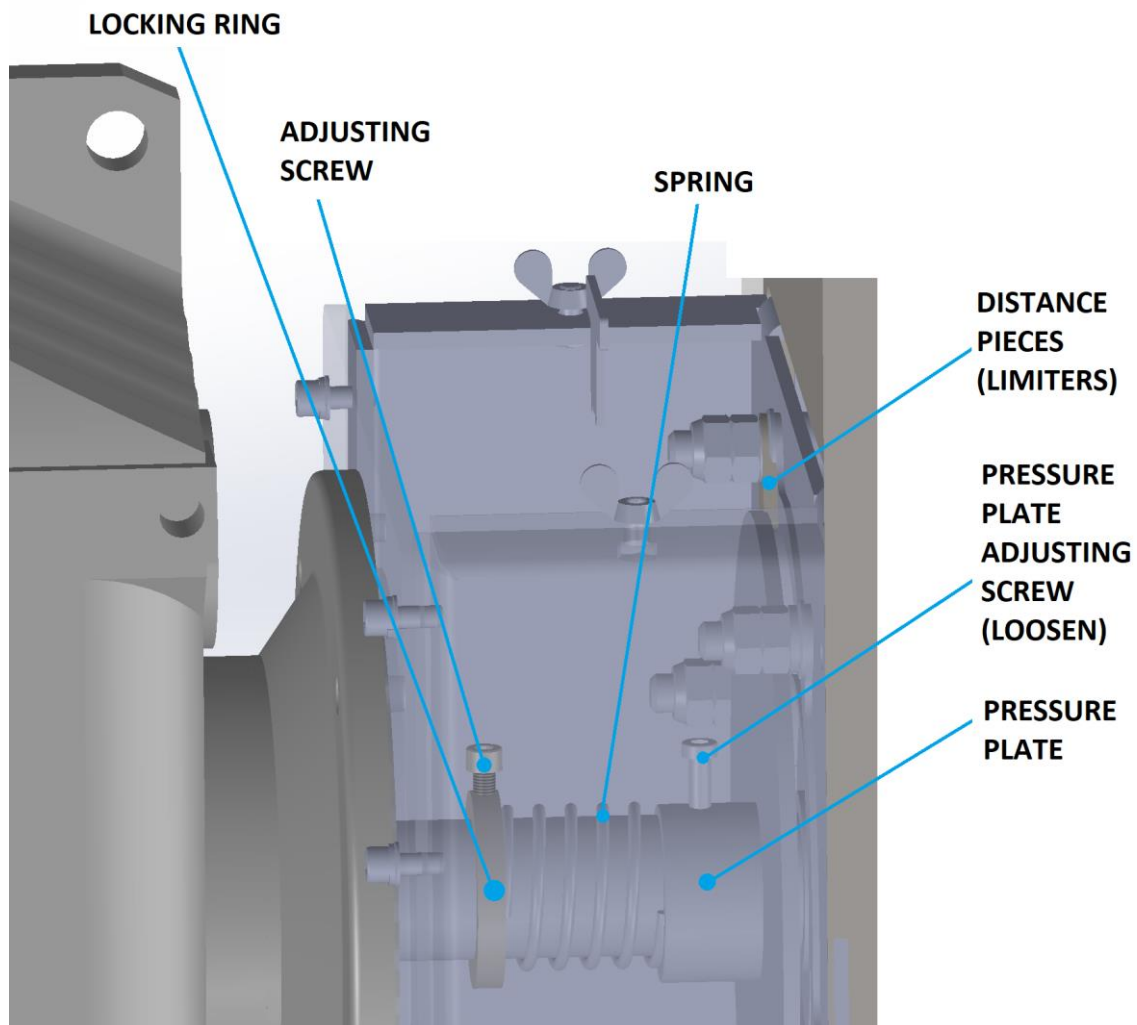


Fig. 16: Outlet from the machine

By moving the pressure plate, a gap is created through which the so-called cake falls out, which contains – depending on the type of sludge, polymer and set-up of the machine – approx. 14–25 % of dry matter.

After the initial set-up, we recommend resting the pressure plate against the last fixed ring (or distance pieces – limiters, placed on threaded bars behind the last ring) and fixing the adjusting screw in the locking ring of the spring on the shaft in an unloaded (not pressed) position of the spring. See fig. 16.

As standard, this set-up can be kept also for long-term operation and the spacer will not require any handling except for cleaning.

If the pressure needs to be increased, switch off the screw's drive, loosen the adjusting screw in the locking ring, move the pressure ring using a spanner by several millimetres towards the pressure plate and retighten the adjusting screw. In this way, you will slightly preload the spring, thus increasing the working pressure in the screw. However, a sufficient gap between the spacer and the last fixed ring should always be maintained during operation (corresponding to at least the thickness of the distance pieces). If the gap is small and more sludge is pushed through the plates during operation, the preloading needs to be reduced.

The dewatering press does not work on the principle of great mechanical forces or high working pressures. Common working pressures of sludge in the screw before it falls out are approximately in the hundreds of mbar (100–200 mbar = 1–2 metres of water). Overloading the machine by heavily preloading the spring is not advisable. If you need to increase the dry matter content of the cake, we recommend changing the polymer dose or type or the processed amount of sludge.

Another possibility for setting up the closure is to tighten the adjusting screw directly on the pressure plate. In this case, you will not use the function of the spring and the pressure ring but the spacer will be fixed in a single position with a fixed gap size. According to our experience we do not recommend this type of set-up.

Attention! A gap of a minimum of 5 mm or more must be set based on the size of the machine. If more sludge is pushed through the gaps between the plates, the set gap is insufficient and the pressure in the screw is too high; if the machine is operated in this mode for a longer time, the free rings and the screw shaft will be damaged. **Such damage caused by incorrect machine set-up will not be covered by the warranty.**

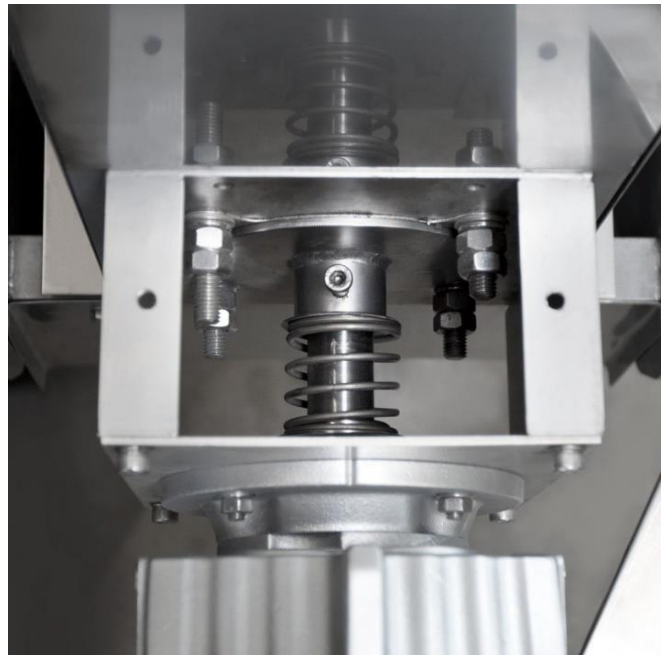


Fig. 17: Pressure plate, spring

9.7 Pneumatic pressure plate (40X series)

Procedures, regarding adjustment of pressure plate force, written in previous chapter are valid for standard type of pressure-plate with mechanical spring equipped. Optionally, machines can be equipped by pneumatically actuated pressure plate. Pneumatic pressure plates are standard solution for 40X series (401, 402 and 403).

Unlike on standard pressure plate, no regulation or adjusting of position to be done physically on the pressure plate. Adjusting the force, pressure plate pushes the outgoing material from the screw (cake) is happening through regulation of compressed air pressure, going to the actuating cylinder, by filter-pressure regulator. The filter regulator is typically mounted on the flocculation tank, below the electrical control box.

Compressed air flow diagram is below on Figure 18, main supply is connected to the inlet of filter-regulator, where pressure to the cylinder can be regulated. Output from pressure regulator is connected to the common port of solenoid control valve, which engages or disengages pressure plate. Pressure plate is engaged in automatic mode as long as screw is in FORWARD run direction and off-delay procedure is not active. Pressure plate is disengaged during start-up, during REVERSE direction operation of the screw, as well as during off-delay for screw clean-up.

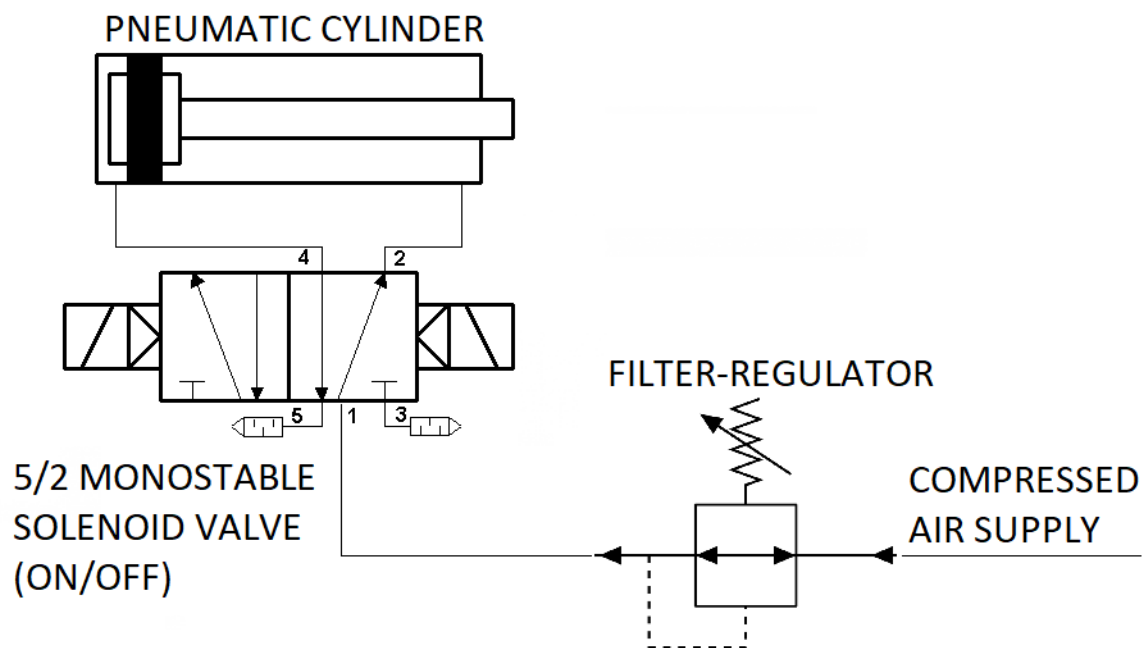


Fig. 18: Pneumatic pressure plate schematics

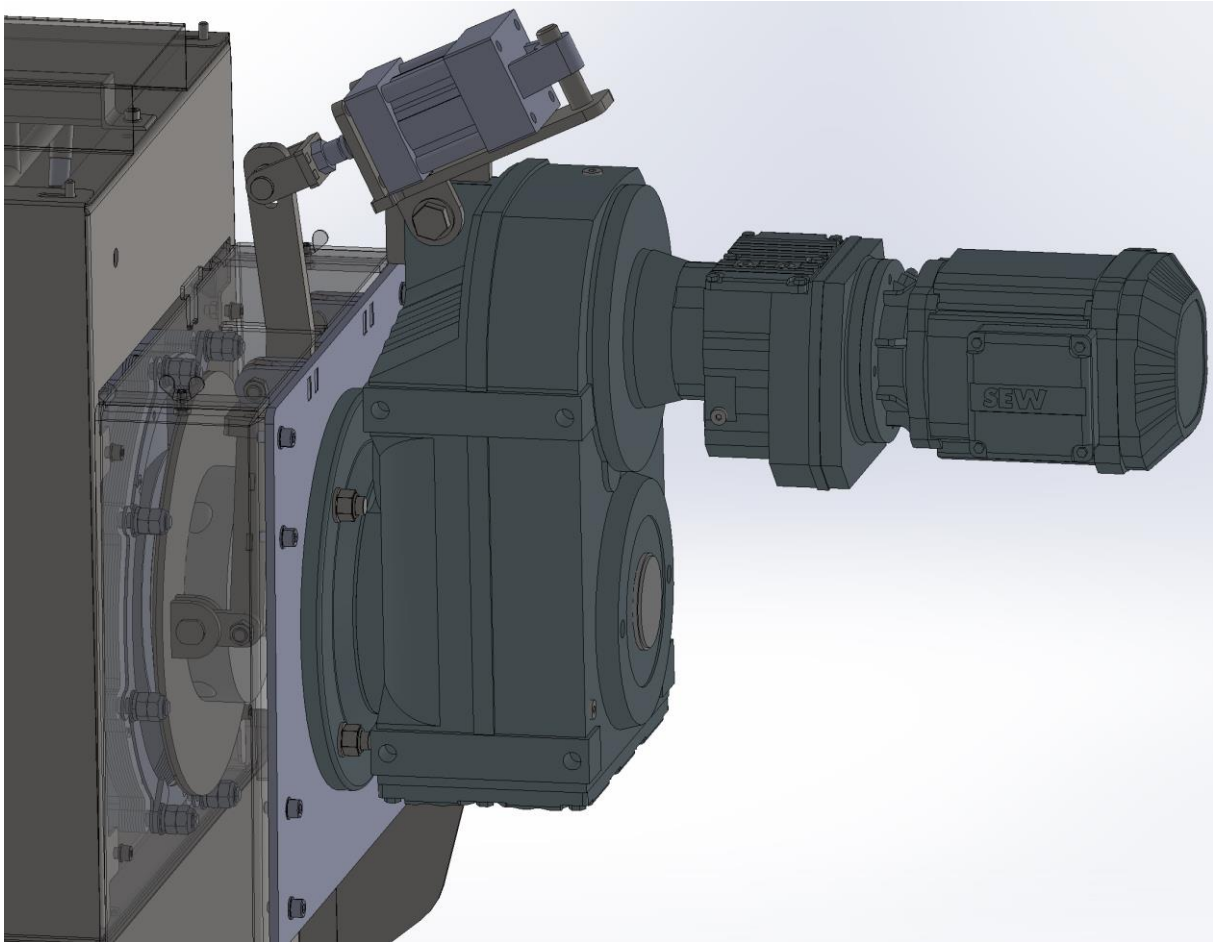


Fig. 19: Pneumatic pressure plate on MP-DW-401

Force from the rod of pneumatic double action cylinder is transmitted via lever mechanism onto pressure plate itself in its axis. Pressure plate contact surface with solid cake is not flat, but coned, to aid outgoing material and distribute counter-force more evenly.

Pressure plate is stationary, does not rotate with shaft. Between pressure plate and rotating shaft is polyamide (PA6) dry-bearing. All joints in the lever mechanism are done via stainless steel pins with axial secure by nut.

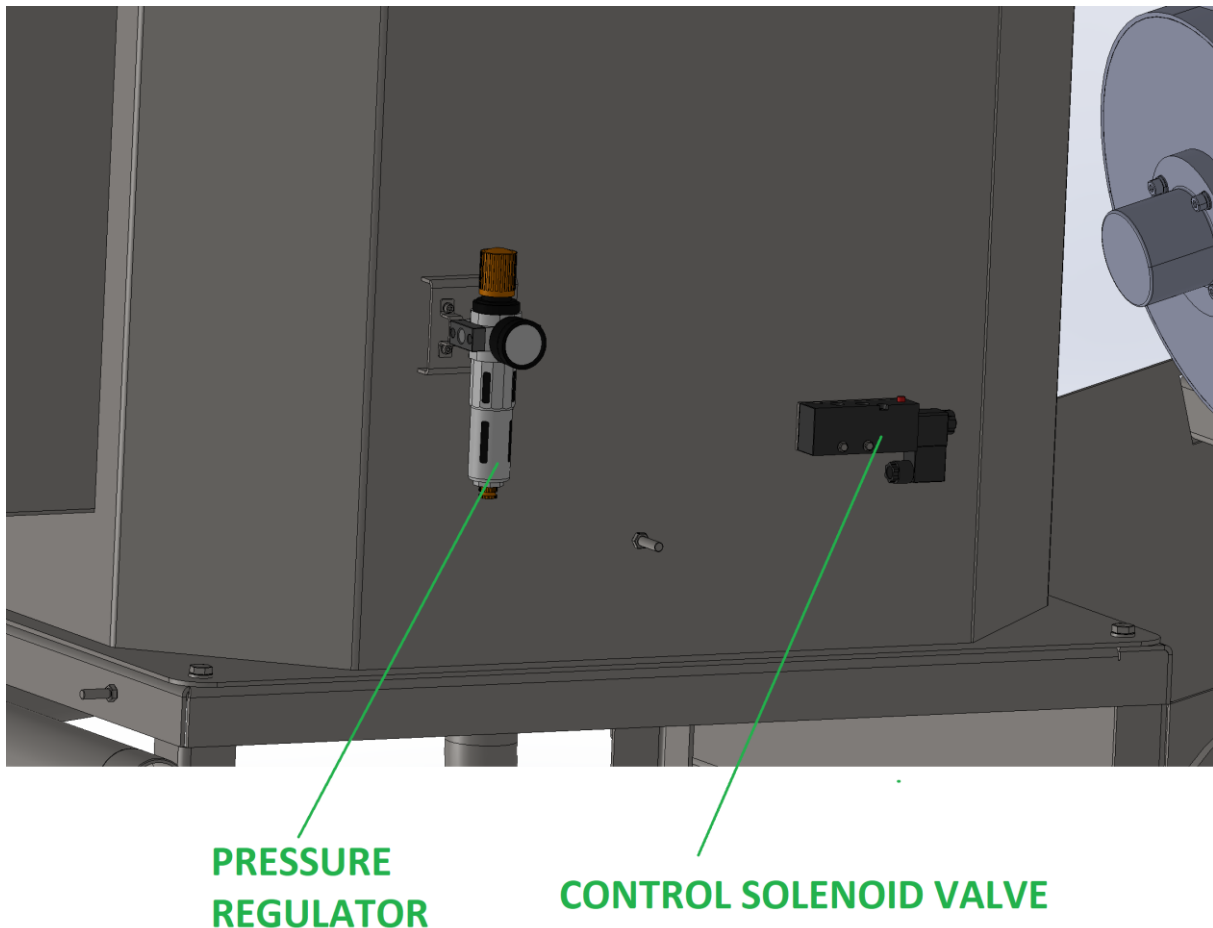


Fig. 19: Pneumatic pressure plate on MP-DW-401

To increase pressure plate force, turn the top side knob on the *PRESSURE REGULATOR* clockwise to increase compressed air pressure; it is possible to increase pressure up to the value of inline compressed air pressure. To decrease pressure plate force, turn the top knob opposite direction.

Increasing or decreasing the pressure to the pneumatic cylinder should be carried out per local operating conditions (flow, type of sludge, internal cake pressure), in accordance to procedures mentioned in previous chapter.

9.8 Outlet dry matter and machine set-up

The aim of dewatering is to naturally achieve the highest possible dry matter content of the cake leaving the machine, hence reducing the sludge volume as much as possible. The indicator of the outlet dry matter content is the TSS value – total suspended solids in the sludge cake. This value can be measured, just like with the input sludge, using a drying scale.

However, the actual dry matter at the outlet of the machine depends firstly on the sludge as such, and secondly on the selected chemicals and machine set-up.

One of the indicators of “sludge quality”, or its “preconditions for dewatering” is the **content of the organic component (volatile solids)** of the sludge, which is evaluated by a test determining annealing loss. The result of the test is information on how much of the total amount of solids is represented by organic components (bacteria, micro-organisms...). As the limit of any technology of mechanical dewatering consists in eliminating “free water” which is contained between organic states, we prefer the lowest possible organic content. Colloid-bound water from the cells themselves cannot be dewatered mechanically. Technologies such as drying, heating, ultrasound sonication, chemical processes – using an acid, etc. are used, or naturally by sludge stabilization.

The aim of sludge stabilization is to reduce the organic part of the sludge. For instance, when processing sludge from municipal wastewater treatment plants, when sludge is drawn directly from the active section of the wastewater treatment plant (activation, denitrification), the organic component may be approximately 70% or more. Such sludge can be dewatered mechanically to achieve 15–16% TSS. Consequently, sludge is often pumped into sludge tanks (lagoons) – aerated (aerobic stabilization) or non-aerated with controlled temperature conditions, dissolved oxygen ratio and mixing–homogenization of the sludge (anaerobic stabilization) where it is kept for a certain time (in the order of weeks). Its organic component content is reduced and then it can be dewatered to a higher percentage of dry matter. With aerobically stabilized sludge, approx. 18% dry matter after dewatering can be achieved, with anaerobically stabilized sludge around 23–28%. However, if the duration of stabilization is short, sludge behaves more like fresh/non-stabilized sludge and the dewatering limit will be around 15–16%.

With mineral types of sludge, the outlet dry matter content may be higher; this always depends on the density of mineral substances in the sludge. With sludge containing metals (zinc plating plants, manufacturing of printed circuits, etc.), the dry matter content is usually around 25–30%.

No matter how visually “low” the values of outlet dry matter may seem, one should realize that when dewatering 2% sludge to 15% dry matter content at the outlet, its volume reduces by 87%; when reaching an outlet dry matter content of 18%, it is 89%. However, the effort needed to increase the outlet dry matter by 3% TSS (a higher dose of polymer, lower screw speed (lower amount processed), premature wear and tear of the machine) in biological sludge containing a high percentage of organic component is disproportionate to the actual results.

The typical consistency of sludge with a dry matter content of 15% or more is a dewatered state when the sludge cake creates “mounds” without moving to the sides when transported to the container. If a cylinder is formed by hand from the sludge cake and is placed vertically on the floor, it keeps its shape.

As has already been stated, **the principle of the machine is not mechanical sludge pressing at high operating pressures and forces.** If the machine is set up and operated in this way, the plates and the screw will be subject to rapid wear and tear, which cannot be considered as damage covered by the warranty. If a higher dry matter content is required at the outlet, we recommend that you focus primarily on polymer selection and sludge storage conditions.

9.9 Washing system

Two washing system circuits are installed on the machine (per screw), a circuit for washing the lower part (thickening) of the dewatering drum and a circuit for the upper part (dewatering) of the dewatering drum.

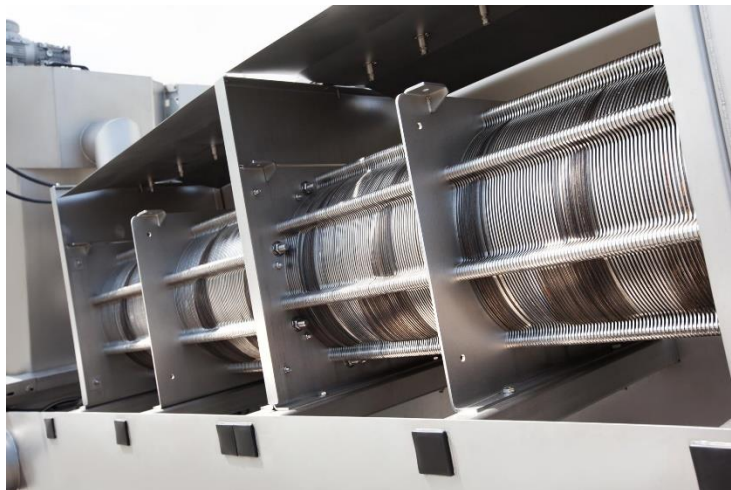


Fig. 20: Washing system – upper and lower sections

The lower circuit opens only when starting the machine. Its purpose is to wet the assembly in the lower part to prevent the machine from starting “dry”. The lower circuit opens also when ending the sequence of operation of the machine.

The upper circuit is opened periodically throughout operation of the machine. The aim of washing is to clean the space between the plates, which are clogged more due to higher working pressures than in the thickening part, and also to wash the sludge pushed through to the bypass piping and back to the sludge tank. It is necessary to set up washing times so that the quantity of water is sufficient to wash the sludge pushed through to the bypass piping and to actually clean the screw from the outside. Two values can be set on the display: the duration of valve opening and the pause between the individual openings. We recommend setting the duration of washing to 20 seconds and the frequency of washing to every 10 minutes as the initial values. In addition, we recommend watching the machine during operation and then adjusting the values so that the above objectives are met.

When the machine is stopped, the screw has a certain rundown during which the washing sequence is cyclically initiated in the following modes:

- lower section 30 seconds
- upper section 30 seconds
- pause of 30 seconds

The washing system distribution, where electromagnetic valves are connected for opening the individual sections of washing + the manual ball valve with a hose for manual machine washing, must be connected to the clean water distribution according to the parameters specified in chapter 6.3 .

9.10 Dry operation of the machine – without sufficient material flow

The machine may not be operated without sludge – it must not run dry. Water from dewatering, which flows away between the plates, also serves to reduce friction between the plates and to wash the space between the plates. **If the machine runs dry or with sludge with a very low content of solids, damage, if occurred, will not be covered by the warranty.**

The same applies if the machine is operated at a fraction of its capacity. For operating reasons, the actually processed amount may not be lower than 65% of the rated capacity of the machine. Appropriate operational conditions according to the machine size can be established following the instructions in chapter 8. Should you have any doubt about the suitability of the type of machine you have bought, or if the volume of the processed sludge changes over time, consult your supplier.

10. Cleaning, maintenance

10.1 Cleaning after ending the machine's operation

Any time dewatering is completed, the content of the mixing chamber must be discharged. This is due to the fact that the polymer efficiency is temporary (flocks lose strength in approx. ten minutes and the effect ceases completely in the order of hours) and if the machine is started again, the residual content of the mixing chamber would only flow through the plates without any dewatering and could clog them.

It is also necessary to keep in particular the dewatering drum clean. Using a manual hose, thoroughly wash the screw with plenty of water, concentrating on the space between the plates. When operation of the machine is completed, the set-up algorithm of the machine is the "screw rundown" mode, which also ensures that the screw is emptied/cleaned automatically (the duration of rundown is set in the order of minutes). If sludge that tends to spontaneously dry up is processed, we recommend loosening the adjusting screw of the locking ring of the spring if a shut-down longer than 2 days is planned (see chapter 9.6). Hence, the outlet is cleared. It is also advisable to switch on the screw manually at a higher speed and thoroughly wash the space between the plates while the screw is running.

It is also important to keep the level sensors in the inlet chamber and the mixing/flocculation tank (two pieces) clean.

If sludge containing an admixture of oils/fat, which tend to create coatings and stick on the surface of the plates, is processed, it is necessary to regularly perform *chemical cleaning* of the machine using degreasers, detergents, acids, etc. This will prevent a growing layer of fat from being formed on the surface of the plates which would otherwise reduce movement of the free plates and possibly cause them to jam, resulting in damage or premature wear and tear of the plates as well as the screw shaft.

10.2 Daily inspection – visual

During machine operation, it is recommended to visually inspect the movement of the plates on a daily basis.

The movement of the plates should be smooth and continuous. Check, looking at the dewatering drum from the side, that all the plates move smoothly and that none are jammed. If there is a problem, the plates must be washed and the space between the plates must be cleaned. In case of sludge with a higher content of fat, a degreaser needs to be used and the space between the plates must be regularly cleaned (see the previous chapter).

We also recommend continuously checking the dry matter content of the outlet sludge cake and its quantity as well as the filtrate cleanliness, and adjusting polymer dosing or screw/mixing system speed as necessary. The individual steps are described in chapter 9 of these instructions.

Check also the polymer inlet – whether the dosing pump is dosing the polymer correctly. If the polymer inlet is too low or non-existent, the dosing pump may be clogged or the suction part of the piping may need bleeding. We recommend firstly cleaning the pipes or flooding the suction pipes by a polymer solution. If the problems persist, the pump will break down. It is mostly necessary to inspect the check valves.

If the cleanliness of water from dewatering deteriorates or the content of water in the sludge cake at the outlet of the machine is higher, we recommend checking the concentration and quantity of the polymer used, or choosing a new polymer. The composition/quality of sludge may change over time and you might need to change the polymer even though the current one was suitable in the past.

10.3 Oil replacement

In the standard version, the machine is equipped with a gear motor for the screw, a gear motor for mixing and a dosing pump. Depending on the hours of operation and operating conditions, oil needs to be replaced in these components after some time. In the case of the sludge feeder pump, follow the instructions of the manufacturer indicated in its instructions.

Screw gear motor – SEW Eurodrive front gearbox

Type of oil: Mineral gear oil – **CLP 220**

Oil quantity: 1.3 l (MP-DW-131), 5.9 l (MP-DW-201/30X), 7.2 l (MP-DW-40X)

Recommended oil replacement interval: 15,000 hours of operation

Mixing gear motor – BOX screw gearbox

Type of oil: Synthetic gear oil – **ISO VG320**

Oil quantity: approx. 0.15 l (fill up to the oil gauge)

Recommended oil replacement interval: 10,000 hours of operation

Piston/membrane dosing pump – TAURUS series (models MP-DW-201 or higher)

Type of oil: Synthetic gear oil – **ISO VG 320**

Oil quantity: approx. 0.2 l (fill up to the oil gauge)

Recommended oil replacement interval: 4,000 hours of operation

10.4 Wear and tear mechanism of the plates and screw shaft

The most common sign of wear of the plates or the screw shaft is discontinuous movement: some of the plates may not move at all. A frequent sign at later stages of damage are pieces of metal in the form of wire or metal shavings which fall out from the machine together with the pressed sludge.

Such wear and tear may have more causes but the most frequent ones are as follows:

- Dry operation of the machine (without sufficient material flow through the machine)
- Machine overloading by disproportionately increasing the working pressure (for instance, by pushing the pressure plate all the way to the end), or due to the screw speed being too low with a high sludge inlet
- Insufficient washing
- Insufficient machine maintenance and failure to clean the machine at the end of operation
- Sludge of unsuitable composition. Not all sludge is suitable for dewatering by means of a screw press. In particular, sludge containing fibres, a higher amount of paper clusters or sludge with a high content of sand or other abrasive particles, which get stuck in the space between the plates)

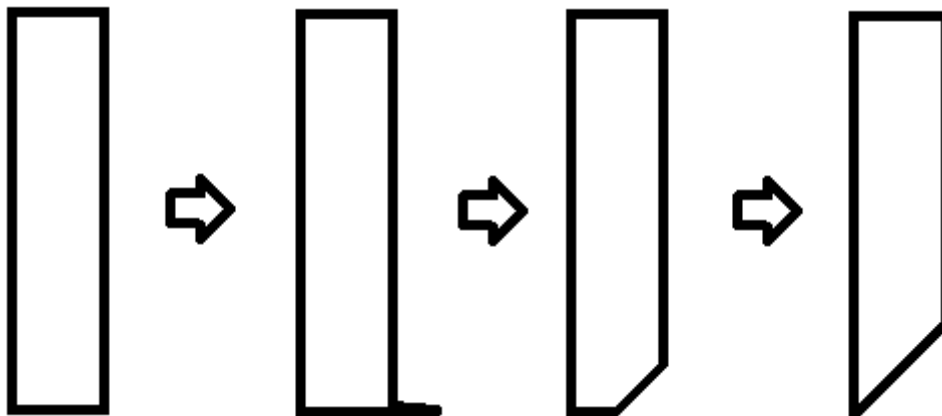


Fig. 21: Wear and tear mechanism of moving plates

The process of the plates' wear and tear is gradual. In the first stage, burrs appear on the internal diameter of the ring. Such burrs limit the movement of the ring, which accelerates wear and tear. If stainless steel fibres fall out from the machine but the capacity of the machine has not yet markedly changed, the machine can continue to run. However, at this moment it is absolutely necessary to change the conditions of operation according to the above information and instructions in chapter 9.

If discontinuous movement of the plates is visible with only some of the plates, it is recommended to replace them. At the same, we recommend partially dismantling the machine following the disassembly instructions for the screw and eliminating the burrs on the internal ring by grinding the plates smooth. In this way, tear and wear will be slowed.

The lifetime of the screw shaft and plates corresponds to tens of thousands of hours of operation if operated correctly. The correct functioning of the screw drum is tested, measured and recorded

repeatedly in the manufacturing process. If the plates are damaged by burrs, this is always due to external mechanical influences. Damage to the plates will not be covered by the warranty, not even during the warranty period.

11. Electrical box

The power supply and peripheral equipment, which are supplied separately, need to be connected to the electrical box. These typically include a feeder pump and a floater for the sludge tank, which prevents the pump running dry.

As an option, a state contact for the polymer level can be connected, which will ensure machine shut-down should the quantity of polymer be insufficient (this depends on the type of polymer preparation station). The electrical box also provides an interface: signals for external signalling to the master system (No. 2 no-voltage contacts running + failure, which can have various causes), or a MODBUS TCP communication line for monitoring the machine from an external control system.



Fig. 22: Electrical box

11.1 Power supply

The electrical box has been designed to be connected to the TN-S/TN-C-S three-phase network with phase-to-phase voltage according to the country of destination and the manufacturer's plate on the electrical box. The standard voltages are 3x380–480 V, or 3x200–240 VAC.

The standard version of the electrical box is intended for the 3/N/PE system. According to the country of destination, we also produce electrical boxes without the need for neutral. In this case, only 3/PE is required. An atypical solution is an electrical box with a single-phase power supply 1/N/PE or 2/PE.

The electrical box includes an undervoltage release on the main circuit breaker. If the power supply terminals of this release are not energized, it is impossible to reset the main circuit breaker. The purpose of the presence of the undervoltage release on the machine is firstly due to the emergency STOP button, which immediately de-energizes the machine by turning off the main circuit breaker, and secondly to prevent the machine from automatically starting up after a power failure. In case of power supply failure to the electrical box, which may be caused, for instance, during a thunderstorm by the intervention of overvoltage protection along the entire distribution line, the main circuit breaker must be turned on manually.

If you are sure that the power supply cable is correctly connected and the main circuit breaker cannot be reset, check the STOP button (turn to release it).

11.2 Feeder Pump

The next step is connecting the feeder pump to the respective terminals. Connect the pump using a four-core cable – three phase conductors and a PE protective conductor. Once the electrical box has been connected, check the direction of pump rotation; if it rotates in the opposite direction, swap the two power phases.

11.3 Floater

Once the pump has been connected, connect the level floater, which should optimally be attached near the pump (if a submersible pump is used) so that the distance between the point of attachment of the floater cable and the pump is approximately 25 cm and the floater has sufficient space to move. Another option is to attach the floater independently, directly in the sludge tank.

The floater indicates whether there is sludge in the tank and prevents the pump running dry. If you do not intend to use the floater, the pump will not start in automatic mode. If the technological concept of the sludge tank does not allow the tank to empty during normal operation, a jumper may be connected to the floater terminals. The floater should have the NO (normally open; closed when flooded) type of contact. Often floater switches are supplied which have both types of contact (NO and NC) – hence, you use only one of them.

11.4 External signalling

As an option, contacts can be connected providing for indication to the master system. In the electrical box there are 2 no-voltage contacts indicating the running of the machine and a failure which can have various causes, both contacts are of the NO (normally open) type.

11.5 Level sensors

The machine primarily uses 2 level sensors and optionally a third level sensor to control the level of polymer in the external tank. Level sensors work on the principle of conductivity measurement. Each level sensor (in the inlet and mixing chambers) is *de facto* only an electrode electrically isolated from the machine frame (PE potential). A relay of the HRH-5 type in the electrical box evaluates the electrical resistance and capacity between the electrode and the frame of the machine. The sensitivity of the sensors and the logic of the signal need to be set up.

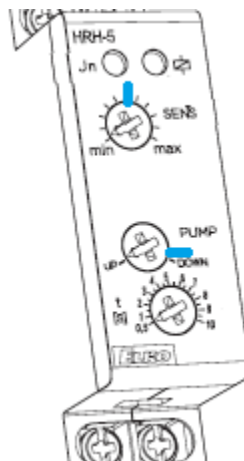


Fig. 23: HRH-5 level relay

The middle setting trimmer – the relay mode should always be in the “DOWN” position – it determines the logic of the output contact which is connected to the control system (flooded = contact made). The upper trimmer is used to set the evaluation sensitivity (limit electrical resistance for creating contact). We recommend setting the sensitivity at approx. half the scale and if the relay indicates a level even if there is none in the tank, you can increase the sensitivity by turning the trimmer towards “MAX”. The lower trimmer is used to set contact hysteresis, or switching delay. This value does not need to be changed and you can leave it at 0.

12. Control system

The machine is controlled by a “PLC” – a programmable logic controller installed inside the electrical box. The touch screen on the door of the electrical box serves to display states, to control and interact with the user (operator).

The default operating mode of all components of the dewatering equipment is set to **automatic**.

- If there is no active error in the machine and the sludge water level in the tank with the feeder pump is sufficient (the floater switch is on), the feeder pump is activated.
- Once a sufficient level in the inlet chamber (so-called “minimum inlet”) has been achieved and the sensor in the inlet chamber is flooded, the screw and the dosing pump are activated and the mixing process in the mixing chamber is initiated. The screw runs in “reverse” mode for the first 30 seconds of operation; in this way, the screw is freed from any sediments from previous operations. Then the screw stops and starts to run in the normal operating mode.
- Before the screw is activated, both the valves of the washing system are gradually set to on and ensure that the screw is wetted before starting.
- The machine runs in this mode until the end of operation. This may occur due to failure of any of the components, a lack of sludge in the sludge tank or a lack of polymer.
- During operation, the upper section of the washing system is cyclically switched on (the times are optional).
- When operation ends, the feeder pump, the mixing system and the polymer dosing pump are stopped immediately, and the screw runs down (the rundown duration can be set). During the screw rundown, both washing sections are switched cyclically (lower section 30 seconds, upper section 30 seconds, pause 30 seconds). The aim of this rundown is rough cleaning of the screw and its emptying.
- If a sludge conveyor is installed, this conveyor also runs down, which should be set for a longer time than the rundown of the dewatering screw (the time can be set).

Washing is done by means of 2 electromagnetic valves (per dewatering drum). The upper valve of the washing system is activated for a set time at set intervals and serves for regular sludge washing from the upper part of the screw to the bypass piping. The lower valve of the washing system is activated only upon first turning-on (start) of the screw.

The dewatering equipment delivery also includes a manual washing hose connected downstream of the manual ball valve. Its use has already been explained above (for instance, in point 10.2).

In case of a failure of any electrical part (feeder pump, dosing pump, screw motor, mixing system motor), all the other electrical parts shut down and an indicator light located on the electrical box’s door comes on.

An emergency STOP button is located on the electrical box's door, which when pressed will shut down all the powered parts of the electrical box (main circuit breaker). To switch it on again once the STOP button has been released, this safety element in the electrical box must be activated manually.

If the level in the tank where the feeder pump is installed (septic tank, sludge trap, activation, regulating tank) drops, the pump shuts down while the other parts of the machine keep running as long as there is a sufficient amount of sludge in the inlet chamber.

If the level drops in the inlet chamber of the dewatering machine, the whole machine stops.

If the flooding sensor in the mixing chamber detects flooding of the mixing chamber, it shuts down the feeder pump and dosing pump; when the level in the mixing chamber drops again, the pumps are reactivated after a certain delay.

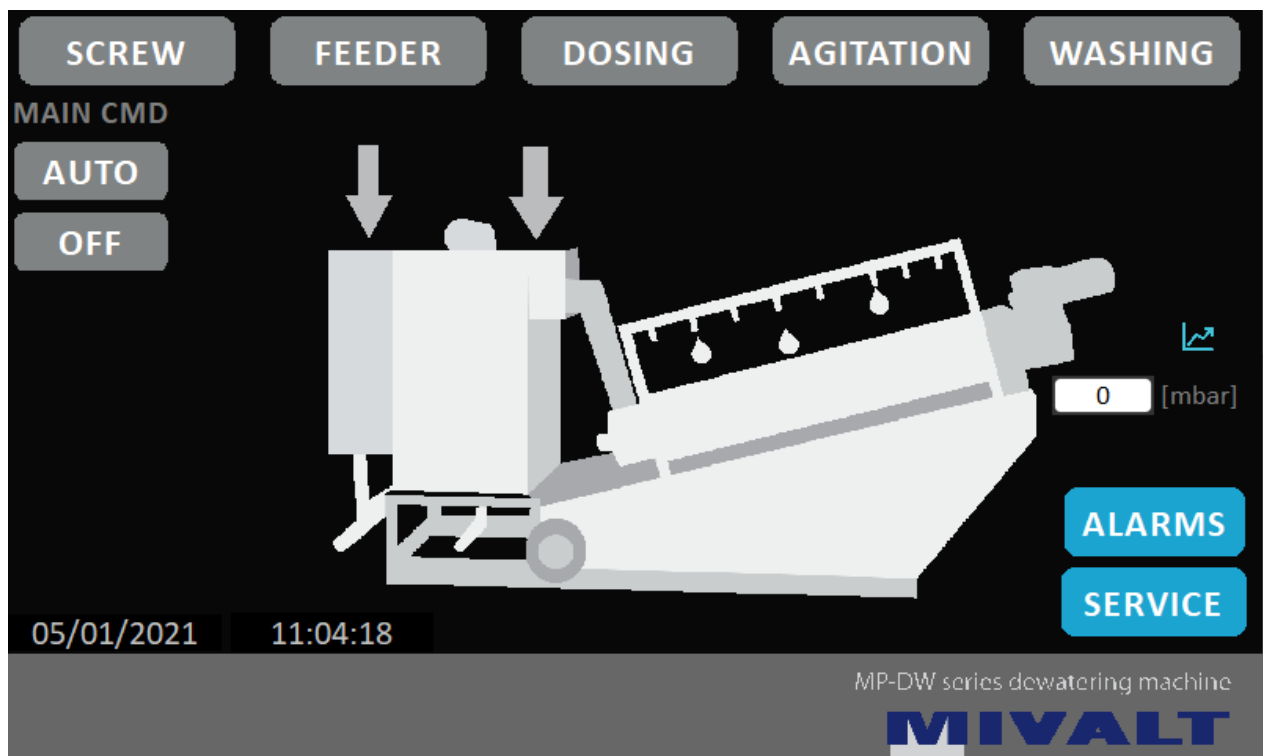
13. Control panel – HMI

The control panel with touchscreen allows the user to check the state of all the components of the dewatering machine and to manually turn them on/off. It is possible to control (speed up/slow down) components operated via a frequency converter, to set washing intervals, to obtain information about the reasons for machine shut-down and alarm messages. The service menu also allows you to read the actual values of the current and the frequency of components activated via the frequency converter.

All the settings are permanent and also remain saved once the equipment has been switched off.

If you wish to change the language of the panel, after switching it on press the SERVICE button (located above the MIVALT logo on the home screen) and you will enter the service menu, where you can select the required language by pressing the respective flag.

13.1 Main (Home) screen



The initial screen shows all the signals from the whole equipment. If a component is on, it is shown in blue; if off, it is white. The arrow above the inlet chamber indicates the feeder pump's state, while the arrow above the mixing chamber indicates the dosing pump's state. The figure below the screw gearbox indicates the sludge pressure measured in the screw.

In addition, using the AUTO/OFF buttons you can switch the whole machine (each component) to automatic mode or manually switch it off.

There is a menu on the upper bar by means of which the setting mode of individual machine components can be entered.

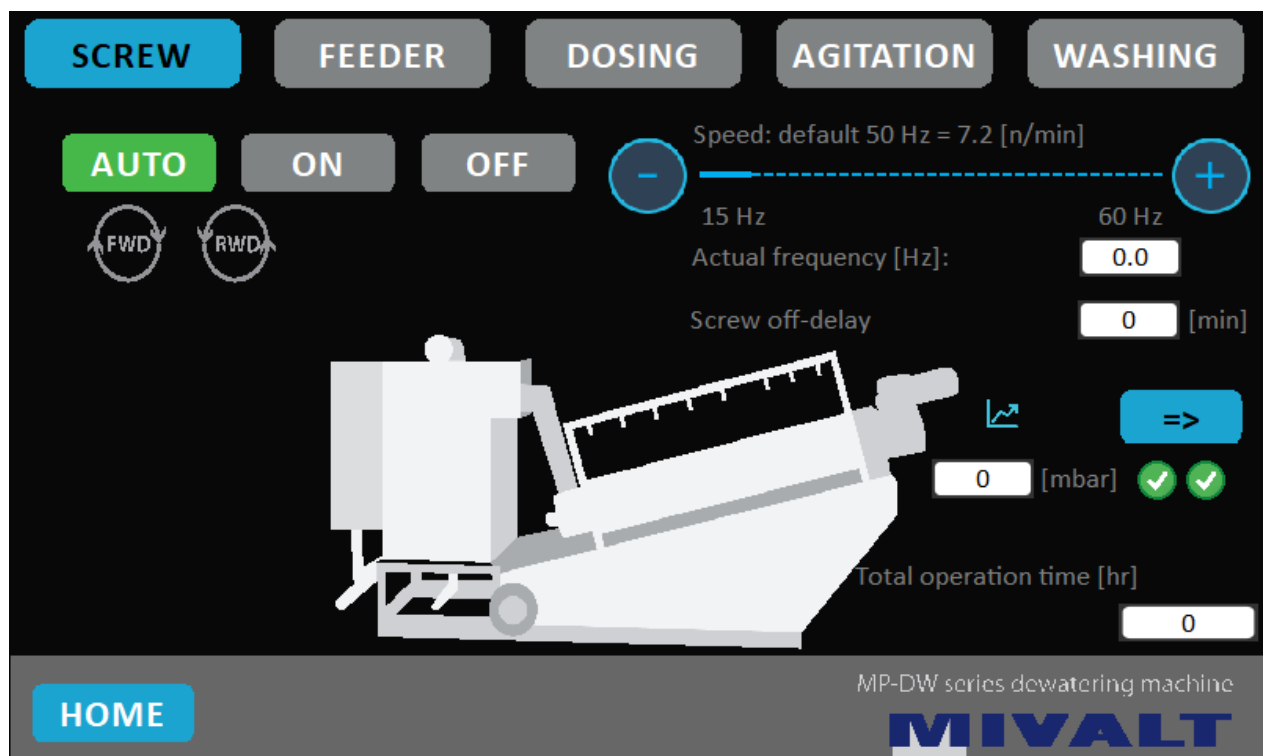
By pressing the ALARMS button, you will enter the history of alarm messages.

By pressing the SERVICE button, you will enter the administrator page which shows operating data of components, the state of sensors, software version, the history of components' load and the language selection for the display (in the standard version, you can select from Czech, English, Spanish, Hungarian or French).

If the electrical devices of the system are in automatic mode and any failure occurs (screw motor / mixing motor / feeder pump motor overload, problems with data communication with frequency converters, feeder pump starter failure, mixing chamber flooding, lack of polymer, ...), the machine will stop running and all the components will be switched off. Once the failure ceases to exist or has been eliminated, the equipment will restart. A record of the failure is saved in the history of alarm messages.

In case of a non-critical failure (for instance, flooding of the mixing chamber), the component may also be activated in manual mode **but this procedure is not recommended**.

13.2 Setting the screw



After entering the **screw component**, a menu opens where you can set the screw. It can be manually switched off, switched on or left in automatic mode. In manual mode, the direction of rotation of the

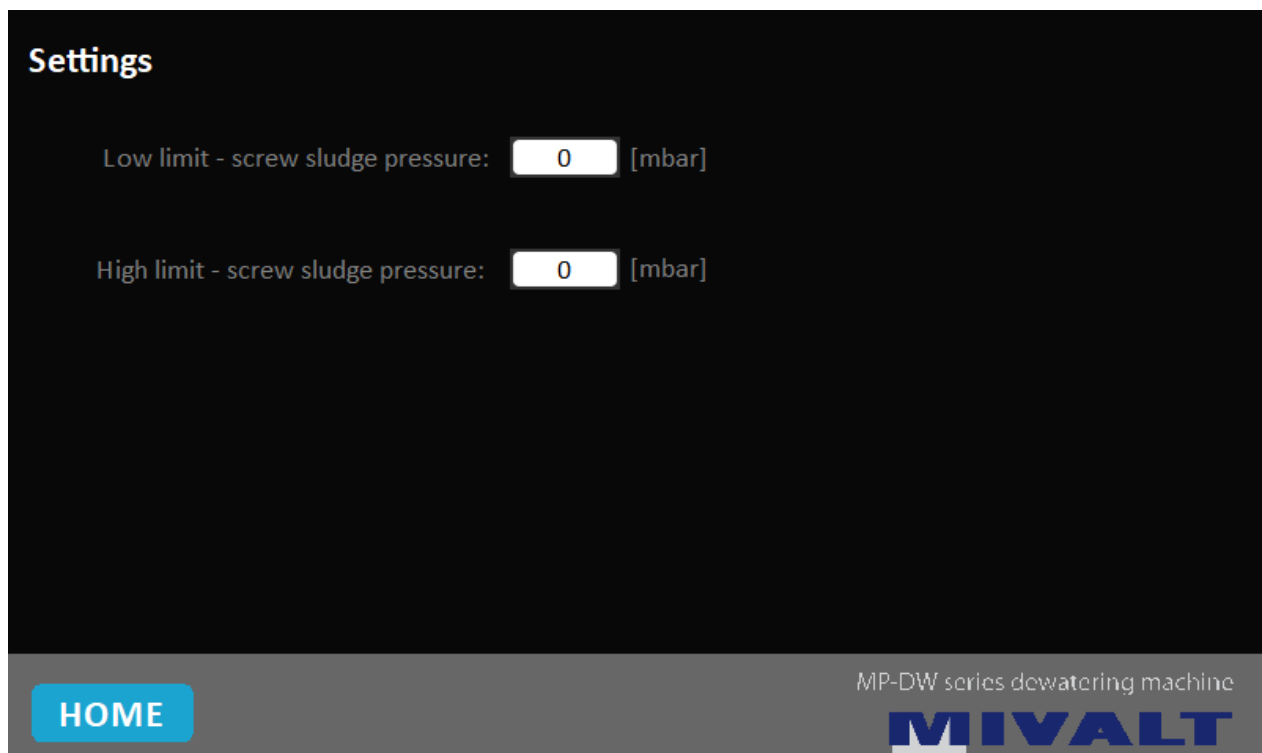
screw can be determined by using the FWD and RWD buttons; otherwise, these buttons indicate the current direction of rotation.

Speed, or the frequency of the screw's motor, can be set on the right-hand side of the screen. Using the + and – icons, you can speed up (or slow down) the screw and this value will be saved. The default setting is 50 Hz. The setting value ranges from 15 to 60 Hz. After pressing the number of the current frequency, you can also enter the required frequency in numbers.

Below the screw's speed setting, there is an indicator of the current frequency on which the component is running. If a negative value is displayed, this means that the screw is running in the opposite direction (active RWD).

Below the current frequency, the screw rundown after operation ends can be set in minutes. The setting ranges from 1 to 15 minutes; we recommend setting just a few minutes for rundown (for instance, 3 minutes).

Below the screw rundown is the value of the currently measured sludge pressure before the sludge falls out of the dewatering drum. You can set the monitoring of this value using “=>”.

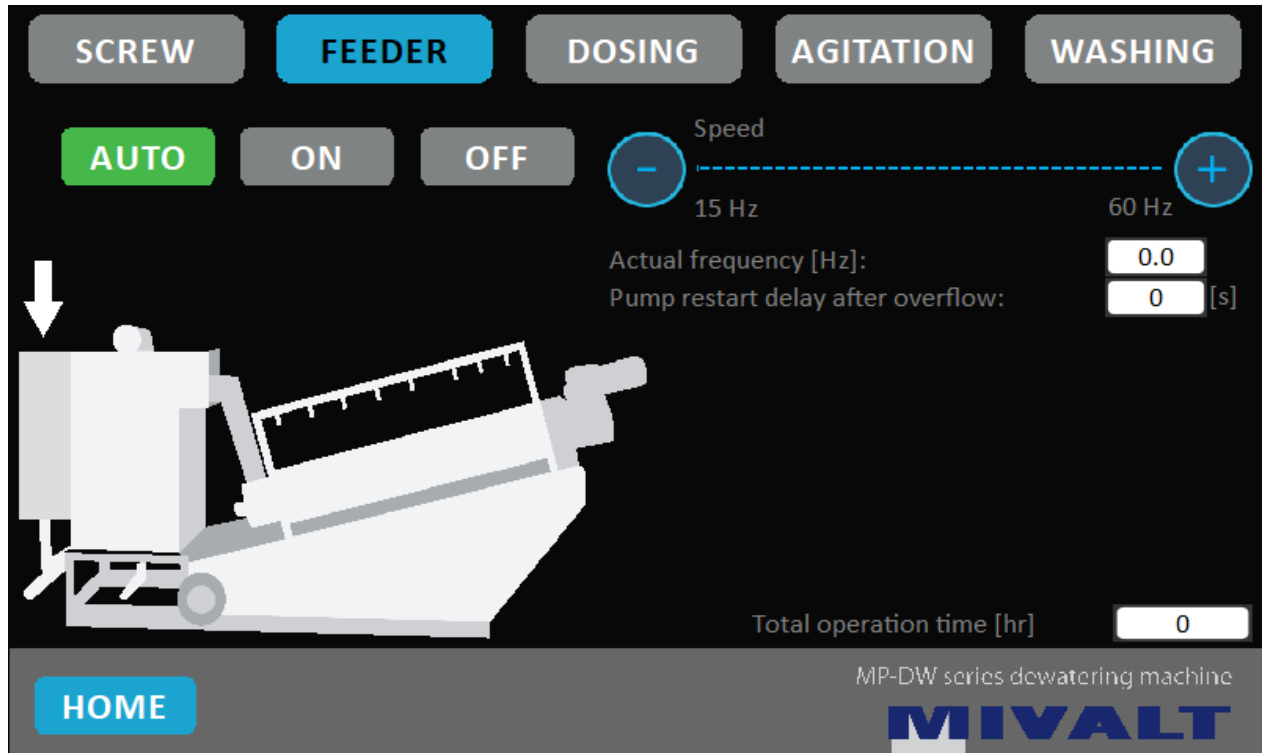


The required pressure range in the screw (both the upper and lower limits) can be set. If the limits are exceeded, an error is detected and the machine is shut down. By monitoring the lower pressure limit, you can prevent the machine from running dry; by monitoring the upper limit, you can avoid screw overloading. Both the values are specific according to the type of sludge; the ideal pressure value should be determined upon the initial machine set-up after a suitable polymer has been selected and sufficient dry matter content at the outlet achieved, respecting the capacity of the machine. Usually,

the value of the screw pressure in the machine is in the order of hundreds [mbar]. Note: 0.1 bar = 100 mBar = 1 metre of water = 10 kPa

Also displayed in this menu is an indicator of the component's state – if the screw is shown in blue, this means it is running. The bottom of the screen shows the counter of the screw's hours of operation.

13.3 Setting the feeder pump



The feeder pump can be set in the feeder pump menu. It can be manually switched off, switched on or left in automatic mode.

Speed, or the frequency of the feeder pump, can be set on the right-hand side of the screen. By pressing + or –, you can increase or decrease, respectively, the pump speed, changing its flow rate. The set value is saved. The default setting is 50 Hz. The setting value ranges from 15 to 60 Hz. After pressing the number of the current frequency, you can also enter the required frequency in numbers.

Below the pump's speed setting is an indicator of the current frequency on which the component is running.

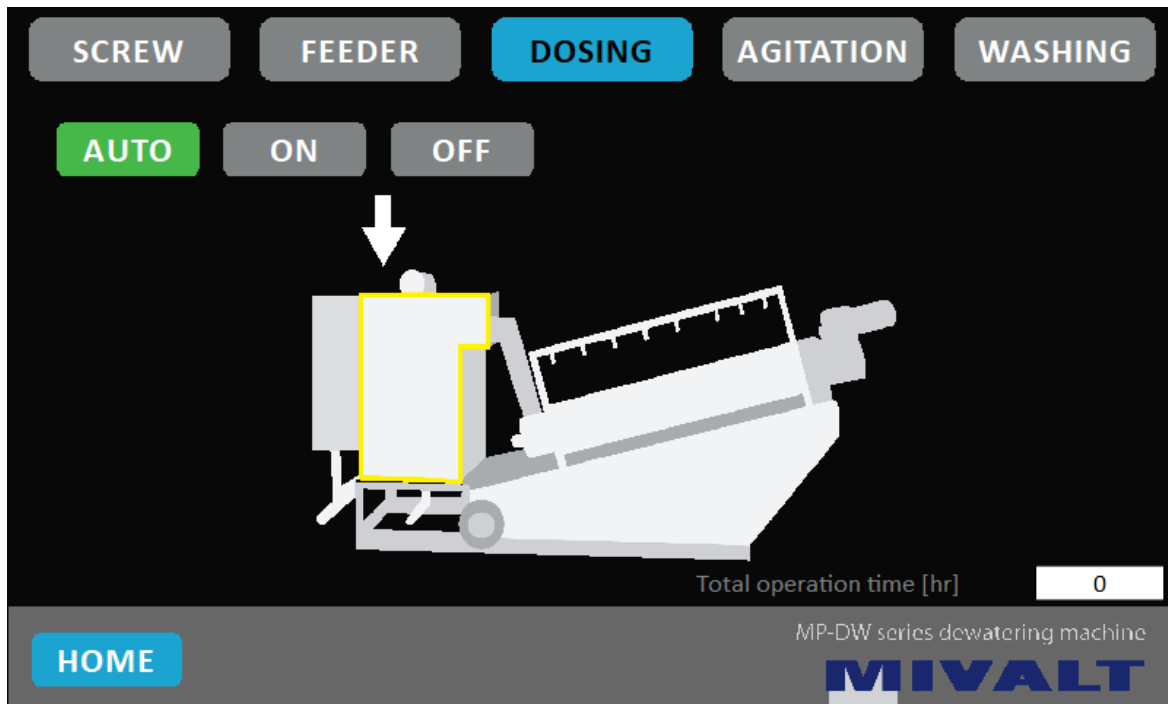
Also, the delay in the pump switching-on after flooding is displayed here. It is the time for which the pump remains off after flooding of the mixing chamber. It is a certain form of hysteresis to prevent the pump continuously switching on and off.

Also displayed in the menu is an indicator of the component's state – if the arrow is blue, this means the pump is running.

With the feeder pump in particular, **we strongly recommend not using** the manual ON function. If operation of the pump is not controlled by the floater, the pump may run dry, which would lead to its

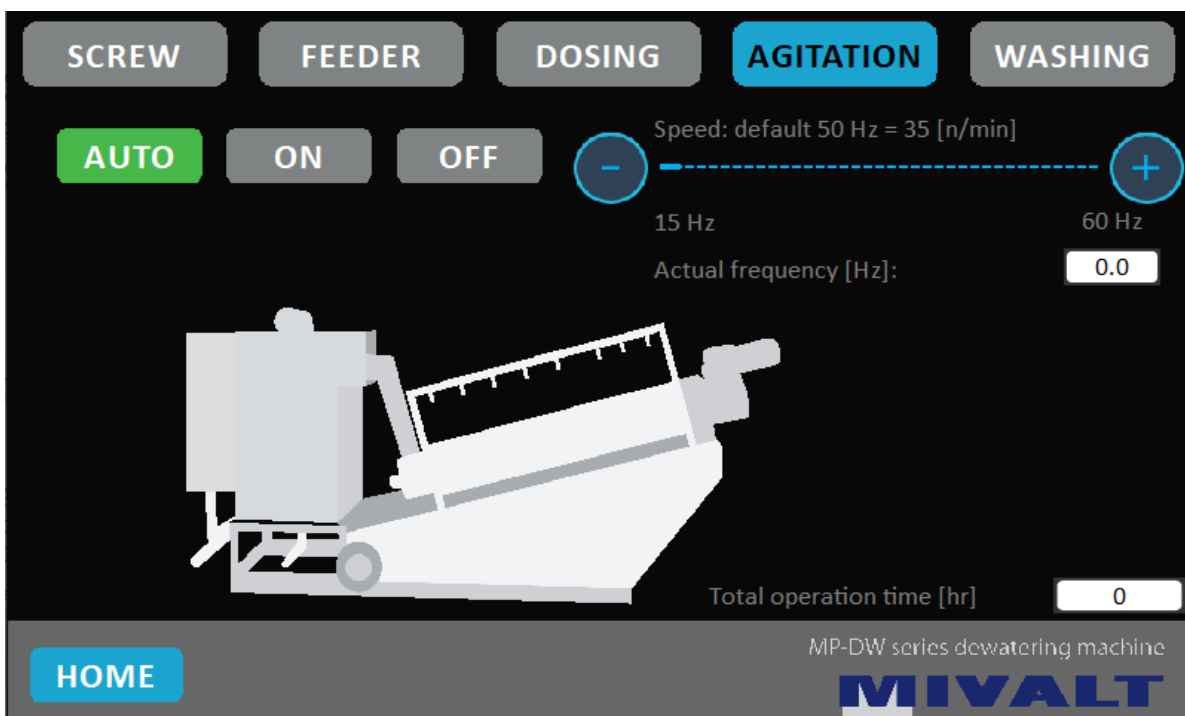
destruction. If you switch the pump to manual ON mode, always make sure an operator is present at the machine.

13.4 Setting the dosing pump



In the dosing pump menu, the AUTO/ON/OFF modes can be selected. The arrow above the mixing chamber shows that the dosing pump is running.

13.5 Setting the mixing system



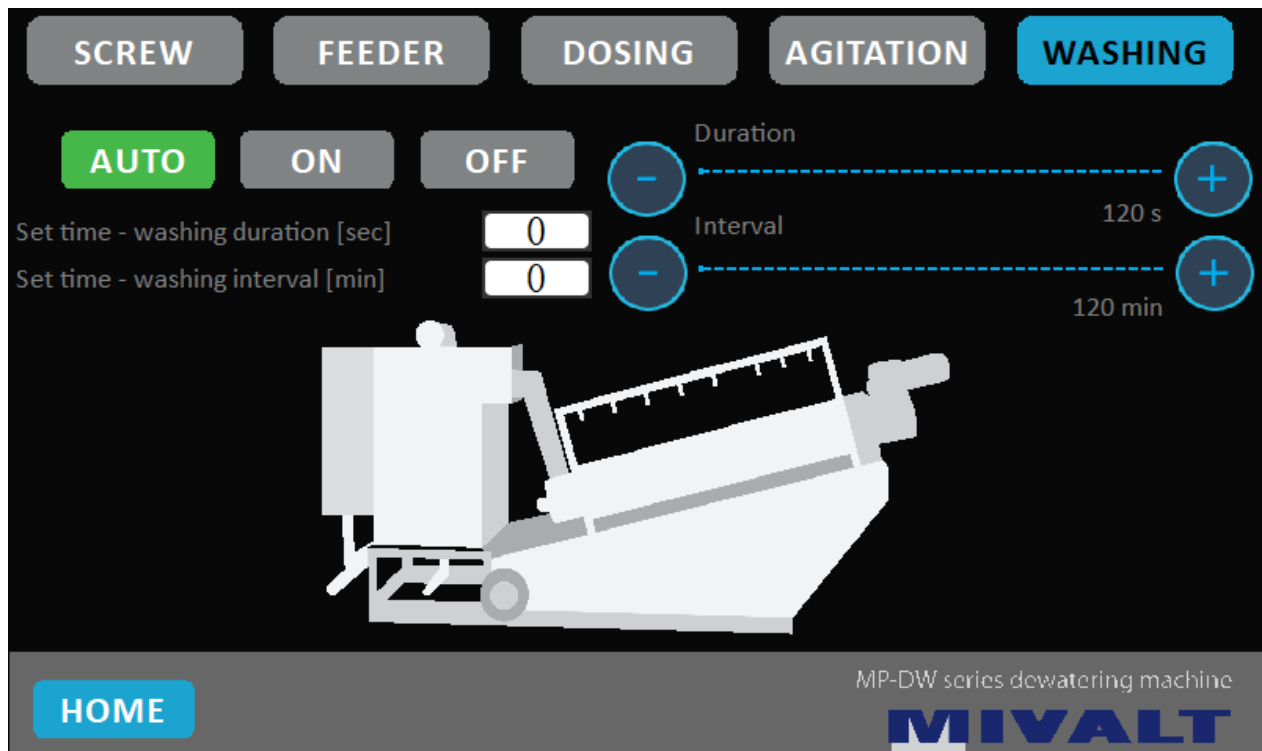
Mixing can be set in the mixing menu. It can be manually switched off (OFF), switched on (ON) or left in automatic mode (AUTO).

Speed, or the frequency of the mixing motor, can be set on the right-hand side of the screen. By pressing + or –, you can speed up or slow down mixing and this value will be saved. The default setting is 50 Hz. The setting value ranges from 15 to 60 Hz. After pressing the number of the current frequency, you can also enter the required frequency in numbers.

Below the mixing speed setting is an indicator of the current frequency on which the component is running.

Also displayed is an indicator of the component's state – if the motor in the mixing chamber is shown in blue, this means it is running.

13.6 Setting the washing



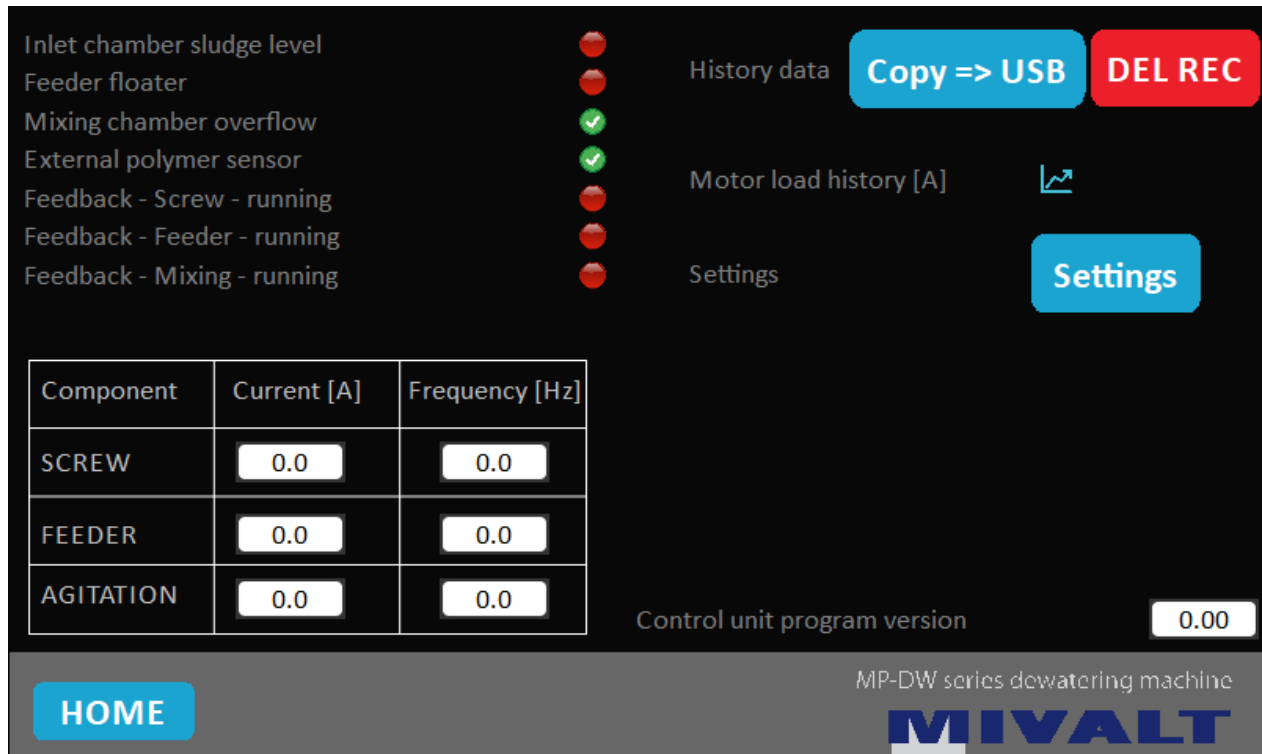
In the washing menu, only the upper electromagnetic valve is set. The duration of washing (i.e., the amount of water sprayed by nozzles onto the plates) and the interval between two washing cycles can be set. The default setting is washing for 10 seconds every 20 minutes.

In this menu you can also manually start washing. It should be noted that the valve will remain open until you close it manually or until you switch to AUTO mode. When washing is started manually, both valves (lower and upper washing) are activated while in automatic washing, only the upper part is washed.

13.7 Alarm screen

If a situation occurs resulting in an alarm message, the alarm indicator light on the electrical box’s door will notify you. By switching over to the alarm screen (using the icon on the HOME screen), the history of all alarm messages appears. If any of the alarm messages is still active and has not been closed, it is shown in red. If an alarm occurred but subsequently stopped, the text of the alarm will be in grey. The most recent alarms are listed at the top.

13.8 Service screen



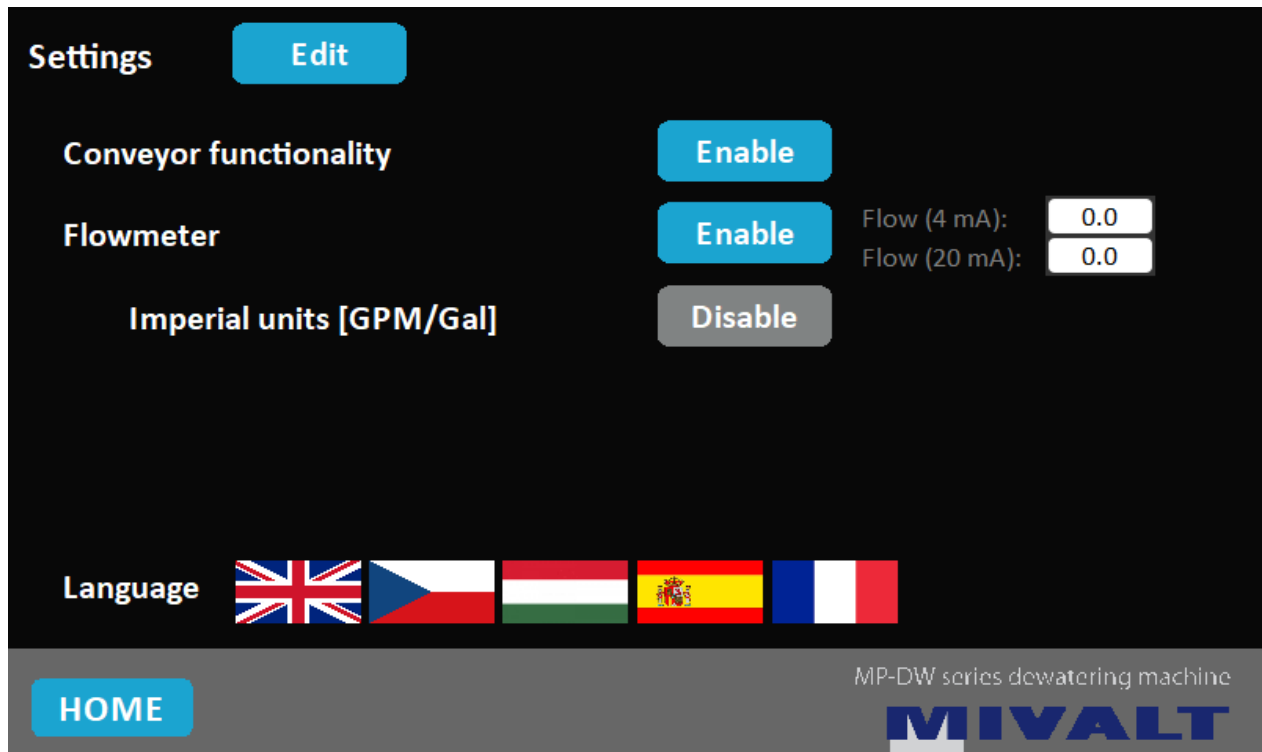
In the upper left part, this screen displays the status of all the inputs of the controller. If it is a state signal, its icon is either red or green. If the state is active (flooded sensor), the icon is green, otherwise, it is red. If it is an alarm state, either a green tick or a red exclamation mark are displayed (error – e.g. lack of polymer).

The right-hand side of the screen contains information read from frequency converters, hence the current values of the current (A) for individual motors and the frequency (Hz) on which the motor is running.

After pushing the “History of motors’ load” graph icon, a graph showing the history of currents is displayed as the current values are read every 2 minutes. By means of the blue square in the upper left-hand part of the graph, you can specify which stretch of time you require to be displayed – always enter the start time and the total time you want to be displayed.

This screen also contains a button to delete records related to currents. By using the “Copy to USB” button, you can download records concerning alarms, the values of currents of the motors and the history of sludge pressure to a connected USB drive (the slot is in the rear of the display)

After clicking the “Set-up” button, you will enter a screen, which enables you to switch on and off optional functions of the control system and to select the language.



You can also change the current language of the touch panel at the bottom of the “Set-up” screen.

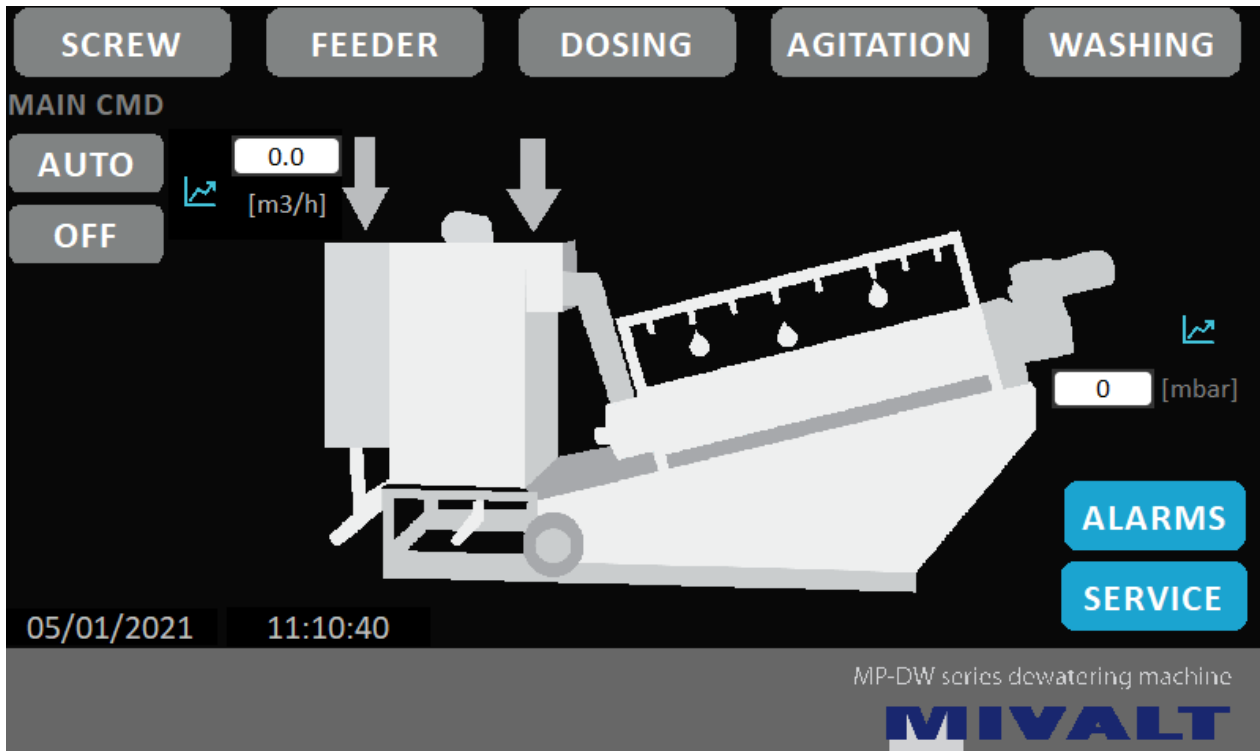
After clicking the “Edit” button, hence allowing the actual set-up on the “Set-up screen”, you can switch on/off add-on functions of the control system.

The add-on functions include:

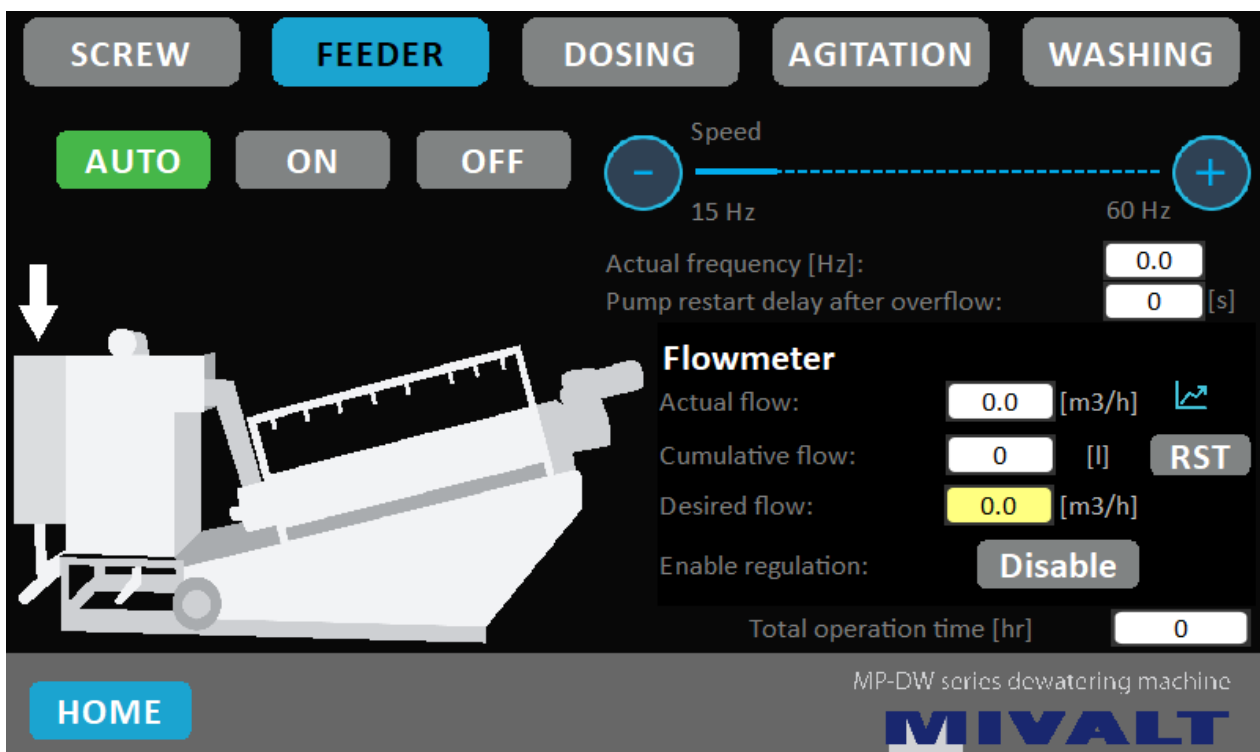
- conveyor control
- recording of data from the sludge inlet flowmeter and setting of the flow meter range or units.

These options are set by the manufacturer of the electrical box (both the flowmeter and the conveyor control require additional components to be installed in the electrical box).

When any of the add-ons is activated, additional windows appear on the home, screw and feeder pump screens.

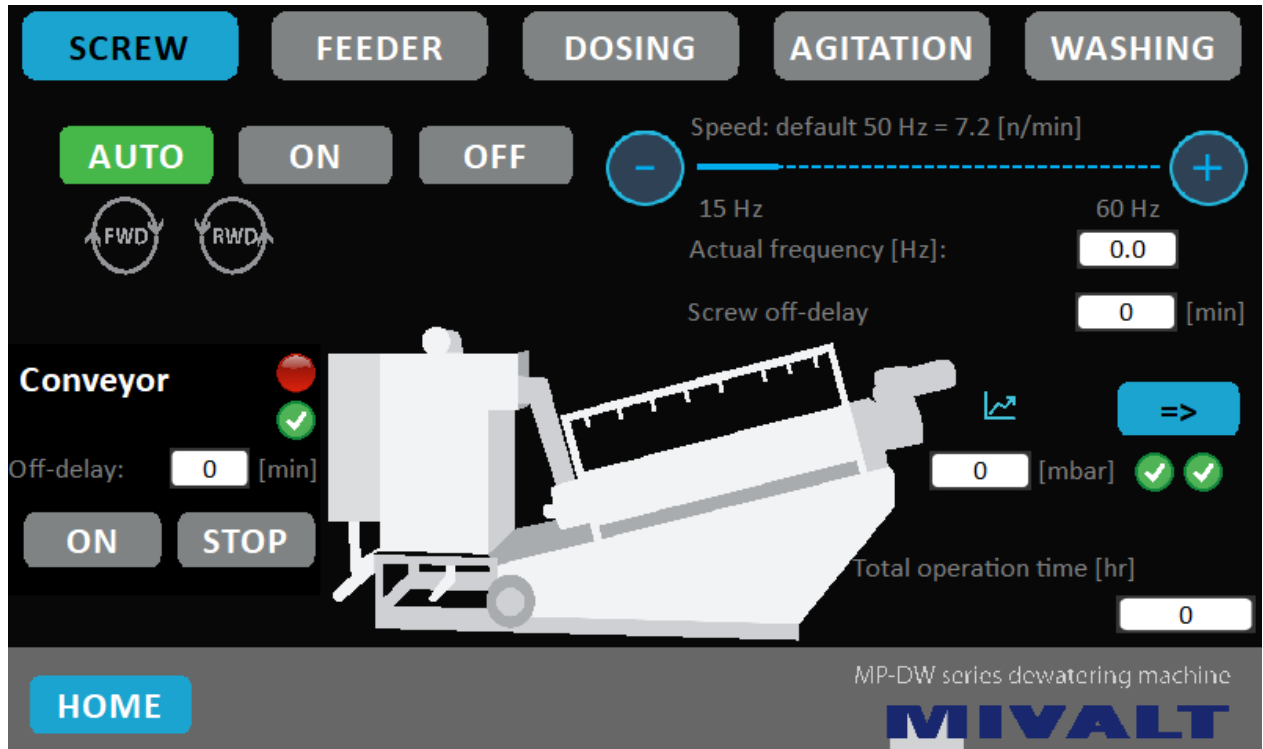


If the flowmeter add-on is activated, the home screen also indicates the hydraulic sludge inlet in the machine with history records (graph), which can be downloaded to a USB drive. This above-standard add-on will enable you to use, for setting the flow rate of the feeder pump, the integrated PI regulator



instead of the commonly performed frequency setting. The setting and release of this regulation is done on the "PUMP" screen. Concurrently, it is possible to monitor the amount of sludge processed (cumulative flow).

If the pressed sludge conveyor control is used, the screw screen includes an additional window, which displays the state of the conveyor as well as the possibility to set its rundown, to stop on-going rundown, or to manually start the conveyor. The conveyor is started in automatic mode when the dewatering screw is turned on in the forward (FWD) mode.



14. Troubleshooting

Error number	Error text	Cause	Solution
1	No sludge in the inlet chamber	Empty inlet chamber – zero sludge inlet	No need to resolve; it is status information on why the machine is not running.
2	Dosing pump failure	Motor starter of the dosing pump is electrically disconnected	Check the load of the dosing pump, is the polymer too thick or polymer piping too long?
3	Negative feedback regarding the screw operation	The screw has received a command to run, but it is not actually running	Check the power supply of the screw's frequency converter.
4	Negative feedback regarding the mixing operation	The mixing has received a command to run, but it is not actually running	Check the power supply of the mixing frequency converter.
5	Negative feedback regarding the feeder pump operation	The feeder pump has received a command to run, but it is not actually running	Check the power supply of the feeder pump's frequency converter.
6	The mixing chamber is overflowing	The screw is not able to process the quantity of sludge at the inlet and hence, the level in the mixing chamber is rising	Reduce the inflow – feeder pump frequency or increase the screw speed.
7	Time-out of communication RS485	Lack of communication between the controller and the frequency converter	Check the power supply of the frequency converters; check whether the communication cable is disconnected.
8	Screw – a general frequency converter error	Screw's frequency converter failure	Enter the screw menu, where you will find the specific error number

			and a description of the cause.
9	Mixing – a general frequency converter error	Mixing frequency converter failure	Enter the mixing menu, where you will find the specific error number and a description of the cause.
10	Pump – a general frequency converter error	Pump’s frequency converter failure	Enter the feeder pump menu, where you will find the specific error number and a description of the cause.
11	Screw – motor overload	The screw’s motor is overloaded	Try to start the screw in “reverse” mode, wash the plates and release the back closure. In case of failure, follow the instructions for a jammed screw.
12	Mixing – motor overload	The mixing motor is overloaded	Check the shaft of the mixing system to see whether it is physically blocked.
13	Pump – motor overload	Feeder pump overloaded	Check whether the pump or pipes are clogged. After starting, check the operating current of the pump to see whether it is sufficient.
14	Lack of polymer	Lack of polymer in the storage tank	Add polymer.

15. Warranty

The warranty period for latent manufacturing defects is 2 years from the date of sale (date of delivery).

The warranty does not cover wear and tear or defects caused by non-standard operation, incorrect installation or environmental impacts (see chapter 6) and neglected maintenance and service (see these instructions). If the safety precautions in chapter 2 are breached, the warranty shall also be void.

The warranty does not cover any operational wear and tear or damage to the plates or the screw shaft.

16. Manufacturer

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