keep it moving

CONCENTRATED SLUDGE RECOVERY

Tips for the optimum installation of MVA-FF

pumps, with or without sludge liming

Contents

1. Introduction

Recovering concentrated sludge at the end of the sludge treatment process is a delicate operation that is difficult to manage efficiently in view of a number of parameters that affect the operation.

The dryness of the sludge obtained depends on the concentration equipment used in the installation:

- The drainage table
- The belt filter press
- The decanter centrifuge
- The chamber filter press
- The screw press

The choice of one technique over another depends on the performance requirements, which are often imposed by the specifications and thus the end use of the sludge. It also depends on the size of the installation, how it is situated and how it is used.

Sludge recovery following the concentration stage can involve the use of a Moineau-type pump appropriate for the dehydration equipment and the installation, i.e. a pump specified as follows:

- Pump type depending on the application (thickening, dehydration with or without liming) and how sticky the sludge is
- Pump size depending on the flow rate, dryness, the isometrics of the sludge evacuation pipework and thus the discharge pressure loss
- Hopper size depending on the machine type (e.g. belt width)

Parameters more specific to the effluent and the treatment process also affect the specification of the pump, such as:

- Effluent type (urban, industrial etc.) and treatment type
- Nature and characteristics of the sludge

The regulations currently in force require a dryness of at least 30% for landfill disposal, making it necessary to artificially increase the performance of the sludge dehydration equipment by adding a greater or lesser quantity of lime.

Adding lime may also be necessary to stabilise the sludge before agricultural spreading or just to improve its quality as a soil amendment.

In any case, adding lime to sludge will necessitate the presence of a bridge-breaker on the pump hopper and impose a number of constraints in terms of the design and operation of the installation (depending on the situation). Taking all these elements into account when choosing the pump and its accessories will guarantee that the entire installation will operate correctly.

2. Pump selection guide

2.1. Presentation of the range

PCM EcoMoineau™ MVA-FF

- Based on Moineau™ technology, PCM EcoMoineau™ MVA-FF progressive cavity pumps are designed to facilitate the transfer or dosing of viscous, sticky fluids and pastes with a high dry matter content, containing solid matter with a tendency to form bridges. These materials are common in many applications and represent difficult conditions requiring specially adapted pumps.

Applications:

- Suitable for pumping dehydrated sludges, with or without liming
- Non-sticky pastes
- High dryness and viscosity
- Possibility of adding a bridge-breaker for sticky pastes, products with a high level of dryness and viscosity and limed sludges.

3. Guide to using feeder pumps

3.1. Installing the pump

3.1.1. Conditions for using the pump

The pump is specified according to the basic data supplied to us during the bidding process. The choices made take the operating parameters of the installation into account together with the constraints arising from the equipment's location.

If these parameters change, it is essential to contact PCM again to validate the decisions taken and make any changes necessary for the installation to function correctly. The relevant parameters are the flow rate, dryness, effluent type, sludge type, suction conditions, discharge circuit, maximum discharge pressure and quantity of lime injected.

3.1.2. Pump position

The pump is positioned so that its axis is beneath the sludge exit in the event of concentration via a drainage table, belt filter or filter press so that the product can be collected along the whole “line” of fall, avoiding the need for a hopper with sloping sides that could cause bank formation.

If the sludge exits to a centrifuge, this should preferably be offset to the rear in order to position an inspection hatch and facilitate access for maintenance operations.

If sludge is evacuated with a conveyor belt or transfer screw pump, the PCM EcoMoineau™ MVA-FF is positioned perpendicular to the sludge arrival direction with the feed offset to the rear.

3.1.3. Form of the extension

The extension between the exit from the concentration process and the upper part of the pump's bridge-breaker eliminates any areas with risks of retention or bank formation, consisting of vertical surfaces.

This connecting hopper can be equipped with inlets for accessories such as:

- A lime injector placed behind the hopper
- A vent for capturing vapours
- A flange for evacuating washing water from upstream equipment
- A level sensor for flow control

3.1.4. Max. load in the hopper – adjusting the pump in operation

The pump's operating flow rate is such that the sludge level in the hopper is no higher than the axis of the bridge-breaker. The drop height depends on the nature of the sludge, but for safety it should not exceed 1.5 m in standard applications.

For optimum operation in the presence of lime, the sludge level should not rise above the half-frames, while without liming it is preferable for the rear of the screw to be partially uncovered during operation.

3.1.5. Collection from several dehydration systems in parallel

Regardless of the type of concentration equipment installed, using a system to transfer sludge to the pump hopper makes it possible to use a single pump with a higher capacity to evacuate all the output together. The sludge can be collected with a transfer screw pump or a conveyor belt suited to the quantities to be evacuated and located according to the concentration equipment used. The sludge falling from the conveyors into the MVA-FF hopper should be limited to the rear area and no further than the middle.

3.1.6. Use of two pumps at the same time

In a configuration with two pumps positioned in parallel for simultaneous operation, it is essential to install two independent pipe networks rather than grouping the flows via a Y connector on the same circuit. This arrangement can cause major malfunctions in one pump relative to the other, with difficulties in controlling the flow and the discharge pressure, resulting in premature wear of the equipment.

3.1.7. Discharge pipework

The layout of the discharge pipework is important, as it determines the pressure loss imposed on the pump. It thus contributes directly to the selection of the pump. PCM can help guide you towards several appropriate solutions.

The basic rules are as follows:

- The nominal diameter of the pipework is at least equal to the nominal diameter of the pump outlet flange
- Limit the number of singularities in the discharge pipework
- Bends must have a radius of at least 5D
- Valves must be of full-bore knife gate type
- Butterfly valves and check valves must be avoided
- Sudden changes of direction must be avoided

The nature of the pipework is chosen in order to limit the coefficients of friction, which means that stainless steel or, failing that, steel are preferable. PVC lies between stainless steel and steel, but as it is less able to withstand pressure in use this solution should only be chosen if the discharge pressure is low. Cast iron pipework generally has a high level of internal roughness, and consequently it should be avoided for this application.

Flexible pipes may also be used, but with caution due to the difficulty in achieving robust connections, particularly under pressure. However, flexible pipes can be a useful solution at the end of the system to direct the sludge discharge to different places.

3.1.8. Bridge-breaker rotation direction

The rotation direction of the bridge-breaker is such that the half-frames rotate in opposite directions to each other, always towards the exterior of the pump, scraping the hopper surface and pushing the product towards the screw.

3.2. Precautions when stopping the pump

3.2.1. Draining the network

In the event of a prolonged shutdown, it is advisable to rinse the installation with mains water if the discharge pressure is low, or to purge the system with air to avoid difficulties when restarting. The latter solution is preferable to avoid re-diluting the sludge.

In the event of liming, **the pipework must be purged**. This operation will prevent the limed sludge solidifying in the pipework and forming an obstruction. These obstructions lead to a major increase in pressure loss beyond the maximum capacity of the pump.

3.2.2. Washing phases

If the operating cycle of the concentration system involves start and stop phases leading to the presence of large quantities of water, it is important to provide a means of evacuating the water upstream from the pump with a by-pass system on the extension hopper between the two devices. An overflow in the extension hopper will enable this water to be evacuated, though without draining the pump completely.

3.2.3. Isolating the pipework

For the best operation of the installation, it is advisable to place an isolation valve on the discharge pipework with a downstream tap enabling the discharge circuit to be purged with compressed air.

Similarly, if the presence of water or low-concentration sludge cannot be avoided upstream from the pump, it is important to include a larger-diameter tap between this isolation valve and the pump outlet to enable the water to be evacuated to a drain and avoid re-diluting the sludge.

3.2.4. Washing water – total pump drainage

A drain tap built into the pump will make it easier to maintain the equipment. It is important for this drainage to take place, particularly for installations with significant pressure loss, because in this case the pump installed for sludge will not be able to evacuate the flow of washing water.

3.2.5. Applications with long pipework

If the discharge pipework is of considerable length, it is advisable to include taps enabling air to be injected and allowing the pipework to be drained section by section. This precaution will make operation more flexible and enable much simpler, less costly interventions when necessary.

3.3. Sludge flow management

3.3.1. Sludge level control

Controlling the sludge level in the hopper of the PCM EcoMoineau™ MVA-FF enables more flexible operation with variable flow rates, making optimum use of the pump's capacity and incorporating the upper and lower safety devices.

This operating mode is particularly recommended in the following situations:

- Variable flow rate
- Pump starting with a small buffer volume
- Presence of a sludge liming installation

3.4. Sludge liming

3.4.1. Role of lime

Adding lime increases the dryness of the sludge to achieve the values required by standards or the specifications while also stabilising the sludge if necessary.

If the injection takes place in the pump hopper, the pump will have to ensure a homogeneous mix, even with large quantities of lime added.

3.4.2. Reaction between the lime and the sludge

Adding lime to the sludge causes an exothermic reaction, releasing fumes in sometimes significant quantities. It is essential to include a vent in the extension hopper between the pump and the concentration system if the assembly is completely covered, as in the case when a centrifuge is used, for example. For maximum effectiveness, the vent should be placed between the lime injection point and the sensor position.

3.4.3. Special case of quicklime

This phenomenon is even more pronounced with quicklime, in which case the vent must be installed and it is advisable to connect the extension or the hopper to the exterior or to an air extraction network. In this case, it is also advisable to install a system for stopping fines and dust entering the circuit, such as a filter sleeve or filter.

3.4.4. Injecting large quantities of lime

If the quantity of lime added to the sludge is significant, it may be necessary to install a mixer upstream of the pump to obtain a more homogeneous mixture and facilitate agricultural use, for example. In this case, the pump, with or without a bridge-breaker depending on the sludge consistency, is positioned at the outlet from the mixer and solely fulfils the transfer function.

3.4.5. Lime injection system

The use of an injector-type system optimises the introduction of the lime into the hopper, but a deflector should be added to prevent the risk of sludge accumulating on the injector tube.

The specification of the injector must be sufficient to ensure that it does not become saturated in normal operation, minimising malfunctions due to the presence of humidity.

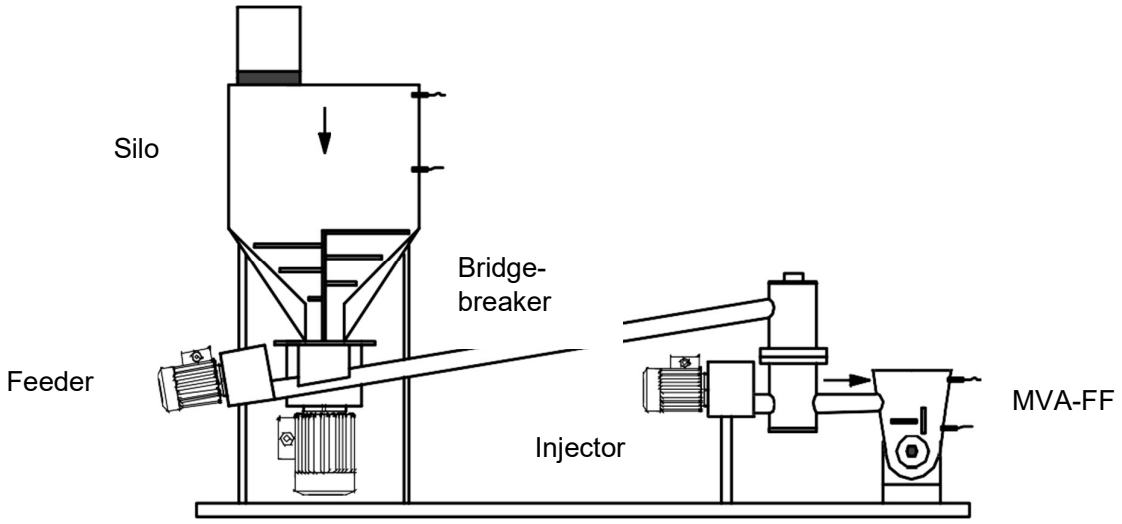


Figure 4 – Diagram showing a typical sludge liming installation

3.4.6. Lime injection point

The lime is injected above the pump hopper on the motor side, preferably perpendicular to the pump's main axis. The point where the lime leaves the injector is in the area where the sludge falls in order to facilitate and accelerate the mixing of the lime with the sludge. This also limits powdery emissions, particularly if quicklime is used.

3.4.7. Lime injection with sludge present

The lime injection should begin several minutes (at least five) after the sludge begins to arrive in the hopper (not as soon as the centrifuge is started, for example), when the sludge has reached its normal level of dryness.

Similarly, at the end of the cycle, the lime should be stopped 10 to 15 minutes, or more depending on the installation, before the machine is stopped, especially if the cycle includes a washing phase. This step enables the pump to be cleaned by the sludge, evacuating any lime that may remain in the circuit.

Failing to respect these recommendations can lead to lime arriving when the aqueous phase is significant or when the pump is empty, causing clumping and damage to the equipment.

3.4.8. Operation of the PCM EcoMoineau™ MVA-FF in the presence of lime

For optimum operation of the system and the most homogeneous mixture, it is essential to use flow regulation, controlling the distribution of lime based on the sludge level in the hopper. This means equipping the pump and the lime feeder with variable speed drives.

Regardless of the situation, this requires a level detector to be installed to check the presence of sludge in the pump hopper.

3.4.9. Liming management

Including a management module in the system makes it possible to incorporate operational safety features for the pump depending on the level of sludge in the hopper.

This module is available in a variety of configurations to suit the different levels of integration possible.

3.5. Operation – maintenance

Given the nature of the product being transferred and the installation conditions, rigorous operation involving regular maintenance is essential to ensure the correct operation of the whole system in the long term. This precaution includes regular cleaning of the pump and its accessories, especially if lime is added to the sludge.

To make these operations easier, inspection hatches must be installed in the pump's connecting extension as shown below. This access will make it possible to check what is happening in the hopper and make any adjustments necessary.

3.6. Polymer lubrication

3.6.1. Operating principle

In order to reduce pressure losses in the discharge pipework, PCM offers its customers complete polymer lubrication kits suited to discharge pressures of 12 to 24 bar.

PCM offers two systems in the form of complete kits for integration into all types of installations during construction or modifications to the process:

- Polymer lubrication on the PCM EcoMoineau™ MVA-FF integrated directly into the pump design, guaranteeing optimum yield at low cost. The lubrication pipe is interchangeable with the standard part (meaning that lubrication can be integrated at any time): **the installation is thus scalable**. Polymer lubrication of the feeder pump is integrated between the discharge pipe and the pipework flange.

- Polymer lubrication with a lubricating ring means the process can be adapted to any type of installation (existing systems) through deployment on the sludge discharge pipework. This assembly can be combined with lubrication on the PCM EcoMoineau™MVA-FF to improve the installation's performance.

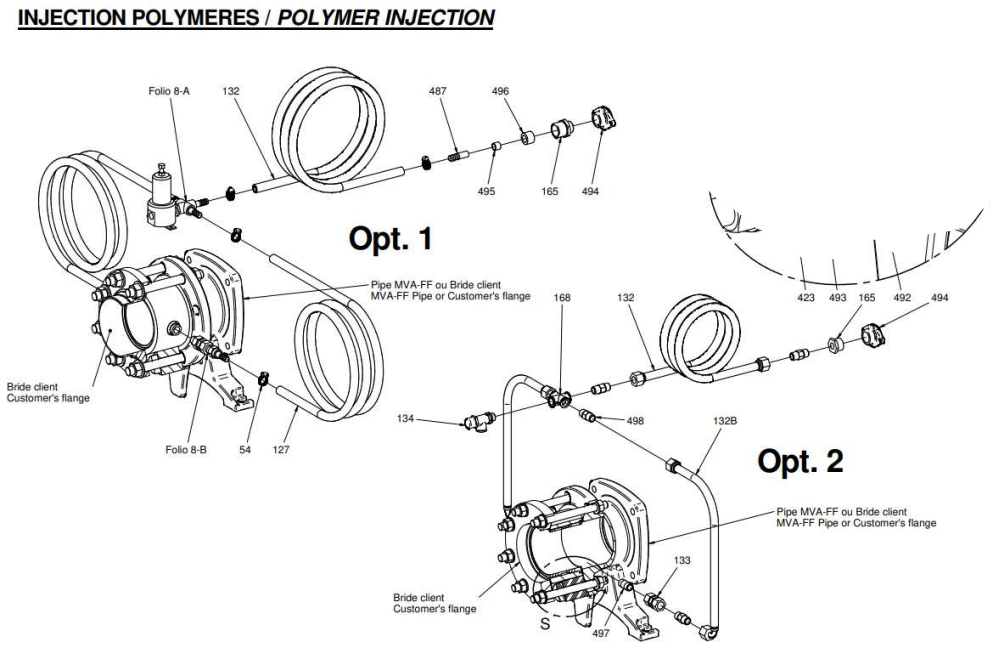
3.6.2. Installation

The polymer injection system must enable the product to be spread evenly over the internal surface of the pipe to obtain the best lubrication results for the lowest consumption and thus limit the impact on the ultimate dryness of the sludge.

The polymer used for this application is the same as the one injected upstream from dehydration, so the feeder pump can simply be connected to the existing preparation system.

3.6.3. Contents of the lubrication kit

The polymer injection kit includes a Moineau polymer feed pump or a lubricating ring depending on the installation configuration, a safety pressure switch, check valves and flexible pipes to connect these elements together.



3.6.4. Performance

Polymer lubrication reduces pressure loss in the discharge pipework and thus extends the limits on the pump's use. This can make it possible to continue working with the same pump if the conditions of service change.

With polymer lubrication, the pump is subject to less stress, reducing maintenance costs (intervention time and spare parts) and thus improving the LCC (Life Cycle Cost).

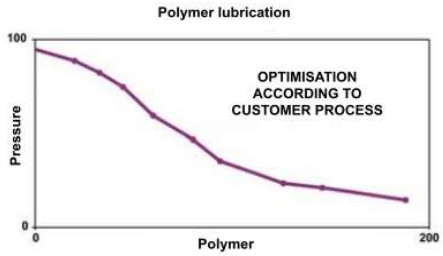


Figure 7 – Performance of polymer lubrication

Polymer consumption is linked directly to the discharge pressure in the installation, the nature and behaviour of the sludge and the final operating pressure required by the operator.

The settings must thus be defined when the equipment is commissioned. It is then up to the operator to refine the system's operation to optimise costs and achieve the best operating ratios.

3.6.5. Example installations

Polymer lubrication can be used with all types of urban and industrial effluent if the system has long discharge pipework as shown below.

Enabling greater flexibility in operation, polymer lubrication kits can be added to PCM EcoMoineau™ MVA-FF models at any time thanks to the scalable design of these products.

3.7. Safety and regulation of the feeder or hopper pump

The electronics ensuring of the safety and regulation of the PCM EcoMoineau™ MVA-FF must respond to the following conditions:

- Presence of sludge in the hopper
- Increased pressure at the pump discharge
- Start of polymer injection
- Operation of the pump with no product
- Quantity of lime deposited in the hopper

The regulation and control functions are the following:

- Starting/stopping the pump's bridge-breaker
- Regulating the level of sludge in the hopper
- Checking for dry running or overpressure
- Checking the discharge pressure and injecting polymer

Operation of the process:

Lime feed

The lime feed is controlled based on the presence of sludge. If the minimum or maximum levels are reached in the hopper, the lime is stopped.

Safety features

Fitting a pressure switch at the pump discharge provides the safety required for operation under overpressure (with a valve closed for example).

In addition, the use of a dry-running protection system will protect the stator. In certain configurations, the level controller in the pump hopper can play the role of a low level controller.

Presence of sludge

A device to check for the presence of sludge is always added to the hopper to control the injection of lime into the hopper, potentially with a time delay or more advanced control.

Several types of equipment can be used for this function:

- Laser probe measurement
- Infra-red cell measurement
- Spring scale sludge weight measurement

Pump speed regulation

The level of sludge in the hopper is compared with the reference level and the pump speed is adjusted accordingly. If the sludge height rises in the hopper, the pump speed increases and vice versa. If the maximum level is reached, lime injection is stopped, and an alarm contact is activated. If the alarm lasts longer than a time T0, the whole system is shut down. The same occurs if the minimum level is reached Operation of the bridge-breaker

For applications using the PCM EcoMoineau™ MVA-FF, the bridge-breaker operates continuously as soon as the installation is powered up. The pump only starts when the product to be pumped arrives.

Dry running

If the dry-running protection sensor is triggered, an alarm contact is activated causing the pump to shut down.

Overpressure

If the discharge pressure exceeds the maximum pressure threshold for the equipment, the entire system is shut down (feeder or hopper pump, lime distribution, sludge supply pump and polymer feeder pump).

4. Accessories associated with the pump

The options available to our customers are:

- Polymer lubricating ring
- Control unit for managing the feeder pump
- Safety pressure switch
- Dry-running protection sensor
- Level measurement

The lubricating rings and pipes are supplied for a nominal diameter of 150.

PCM can deliver a complete solution to its customers consisting of:

- Main pump
- Polymer lubrication system
- Polymer injection pump
- Accessory for polymer feeding and system safety

When customers purchase this equipment, PCM can commission the system, deliver training and provide a maintenance contract. **The entire system consists of the items of equipment listed above together with the connectors and hoses necessary for all the connections.**

5. Final note

This booklet presents the basic rules for the proper use of the Moineau pump following sludge concentration. Naturally it cannot answer all your questions, so we invite you to contact our specialists, who can give you the benefit of all their expertise and experience.