

## **Description of the Sanieromat**

**Type SA 040**

**By**

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**PRESENTING A NEW CLEAN SOLUTION**

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## 1. Introduction

The SA 040 type Sanieromat has been developed specifically for removing sediment from sewage ponds, natural water bodies, sedimentation basins and trenches. In this system, the sludge conveyor pump and the backwash pump are installed on a so-called pump submersible. This pump submersible can be submerged or surfaced. In normal mode, the pump submersible is positioned directly on the sediment layer below the surface of the water. A cable assembly and pulley blocks can be used to move the pump submersible driven by electric winches directly on the sediment layer in X or Y direction. The lifting body can be used to set the penetration depth of the conveyor pump in the sediment.

Since the sludge conveyor pump is placed directly in the sediment layer, sediments can be conveyed with a relatively higher dry material concentration (DM value) without adding transport water.

Depending on sediment thickness, sludge is extracted layer-by-layer, so that the specified cable tension is maintained and turbulences are avoided as far as possible.

Due to the material selected and electrical drives, the Sanieromat does not cause any environmental hazards. The Sanieromat is therefore safe for use in drinking water reservoirs and other sensitive protected zones.

The geometry of the sediment surface that can be treated with the Sanieromat depends on the cable tension. The cable assembly can be used to handle a sediment area of a maximum of 10000 m<sup>2</sup>.

The sediment delivery rate depends on the flow speed, pipe length and drying agent concentration (DM value).

In the case of pure water, the delivery rate is 50 m<sup>3</sup>/h for a pipe length of 500 m.

When actually conveying sediment, a pump station must be inserted after a maximum pipe length of 100 m owing to the high DM value.

A control console can be used to control the pump submersible in the X and Y directions from land. The sludge conveyor pumps and backwash pumps installed on the pump submersible are also controlled from land. The valve positions on the compressed air distributor above the pump submersible must be changed manually only during the submerging and surfacing processes. Another small boat is required for this purpose.

The Sanieromat can normally be used at a water depth between 0.2 m and 12 m.

The Sanieromat can convey sewage and pond sludge with a dry material concentration of up to DM = 10%. Iron oxide hydrate can be conveyed up to a DM value of 8% and sintered sludge can be conveyed up to a DM value of 32%.

Depending on the selected sediment recycling method, the conveyed sludge is either pumped directly into the fields for fertilization or in polders for drying.

In the case of mechanical drainage, the sludge is conveyed either to a chamber filter press or a centrifuge or a band-pass filter press.

## 2. Description of the SA 040 type Sanieromat

Fig. 1 shows the complete structure of the SA 040 type Sanieromat. As shown in this figure, the SA 040 type Sanieromat comprises the following main function groups:

- 1 unit Pump submersible (1) with a built-in sludge conveyor pump (1.1) and a backwash pump (1.2)
  - 1 unit Winch boat (2) with four winches (2.2 – 2.5).  
Winches can be used to move the pump submersible in the X and Y directions. In addition to the winches, the complete electrical system control unit is installed on the winch boat.
  - 1 unit Auxiliary float (3) with a return pulley (5.1) that can be used to move the pump submersible in Y direction.
  - 1 unit Running cables (4.1 to 4.4) with a thickness of 5 mm or 6 mm that can be used in combination with four winches (5) to move the pump submersible (1) in X direction in a water body. The maximum length of a running cable is 200 m.
  - 7 unit Return pulleys (5 and 5.1, 5.2, 5.3) used to guide the running cable.
  - 2 unit Holding cables (6.1 and 6.2) with a thickness of 8 mm that can be used to position the running cables (4.1 and 4.2) and the auxiliary float (3). The maximum length of every holding cable is 100 m.
  - 4 unit Supporting pillars (7) on which the return pulleys (5) for running cables (4.1 and 4.2) and holding cables (6.1 and 6.2) are fixed.
- Please note:  
The support pillars are not included in the delivery scope of the Sanieromat. Supporting pillars must be fixed such that each pillar can absorb a force > 10000 N.
- 1 unit Tube package (8) comprising a sludge conveyor line (8.1) DN 100, a ½" compressed air line (8.2) and two electrical power supply cables (8.3) for the sludge conveyor pump and backwash pump
  - 1 unit Buoy (9) that is used to position the tube package above the pump submersible; the compressed air distributor (9.1) containing the compressed air valves used to submerge and surface the pump submersible is also positioned on this buoy (9).
  - 1 unit Compressor (10) to supply compressed air to the pump submersible and the float pipe
  - 1 unit The Sanieromat electrical power distributor (11) that supplies power to the conveyor pumps and winches through cables (8.1 and 8.2, 11.1).

Please note:  
The external electrical power supply must be connected to this electrical power distributor; 400 V, 50 Hz, 25 kW.

- 1 unit Control console (12) with the control cable (12.1)  
The operating elements on the control console are used to manually move the pump submersible in the X and Y directions in the water body. The sludge conveyor pump and backwash pump are controlled by the electrical power distributor (11).

### 3. Description of the pump submersible (1)

Fig. 2 shows a 3D illustration of the pump submersible (1), in which the front two floating bodies are omitted to present the complete assembly better.

The pump submersible has the following main components:

- 1 unit Sludge conveyor pump (1.1)
- 1 unit Backwash pump (1.2)
- 1 unit Pipe connection between the sludge conveyor pump and backwash pump including the non-return valve (see Fig. 3)
- 1 unit Suction box with altitude adjustment (1.3)
- 2 units Diving bodies, each with one 1" AG flood opening (1.5) and one dive opening 1" IG (1.6) to which the flexible ½" air pipe is connected
- 4 units Floating body (1.7)
- 1 unit Frame (1.8)
- 1 unit Running cable duct (1.9)

The sludge conveyor pump (1.1) and the backwash pump (1.2) have the same layout (see specifications). Both pumps are mounted on the suction box and connected with each other by a pipe. As shown in Fig. 3, the sludge pump sucks sediments from below the suction box and conveys them into the flexible pressure pipeline that is guided to the polder or intermediate station. In this conveying type, the tube flap presses against the wash pipe and closes it (see valve position I).

If sediments having a high DM value are conveyed, sludge consistency can be diluted using the backwash pump. Both pumps are then in operation. In this conveying type, the non-return valve is in flap position II.

If the sludge conveyor pump is clogged, the backwash pump continues to convey into the sludge pipe. The sludge conveyor pump is not in operation in this operating mode. In this conveying type, the non-return valve is in flap position III.

The running times of both pumps can be automatically set for a period of 24 hours using multi-function relays.

The multi-function relays are installed in the electrical power distributor (11).

The height of the suction box (1.3) can be adjusted using the four set screws. As a result, the sludge conveyor pump is immersed deeper or lifted up from the sediment layer.

The suction box is connected to both diving bodies (1.4) by a screw joint. Two floating bodies (1.7) are fixed on both diving bodies (1.4). A frame (1.8) additionally connects the upper sections of the

diving bodies (1.4) to stabilise them. The upper part of the frame serves as the running cable duct (1.9) that is used to move the pump submersible in Y direction.

#### 4. Description of the winch boat (2)

Winches for moving the pump submersible are mounted on the winch boat. The winch boat contains the following main assemblies (see Fig. 4):

- 1 unit Floating body (2.6)
- 2 units Winch with electric motor, gearbox, steel rope, frequency converter and rope drum to move the pump submersible in X direction (2.2 and 2.3)
- 2 units Winch with electric motor, gearbox, steel rope, frequency converter and rope drum and movement restrictor; comprising a spindle, a runner and two electrical end switches for moving the pump submersible in Y direction (2.4 and 2.5)
- 1 unit Electric switch cabinet (2.1) containing all essential motor protection switches, 4 frequency converters to control the winches and the control unit for the entire system
- 2 units Fender (2.7) for the running cable of the pump submersible
- 1 unit Steel frame for supporting the plastic cover (2.8)
- 1 unit Plastic cover (2.9).

The portable control console can be used to move the winch boat manually in X and Y direction from land by actuating the corresponding control keys. The movement of the pump submersible can also be varied using speed-controlled winches together with the frequency converter.

The winch speed and movement of the pump submersible can be adjusted depending on sediment consistency or the desired DM concentration in the sludge conveyed.

#### 5. Description of the installation of the SA 040 type Sanieromat in a water body

The following installation instructions should be observed if the SA 040 type Sanieromat is to be used for removing sediments from a water body.

The maximum area that can be cleaned using one running cable assembly is 10000 m<sup>2</sup>. If the water body or reservoir to be cleaned is larger than 10000 m<sup>2</sup>, the supporting pillars and all cables must be repositioned.

The maximum length in X and Y direction is 100 m.

The ideal size of a working area is approximately 5000 m<sup>2</sup>, where a maximum length of 100 m in X direction and of approximately 50 m in Y direction should be observed.

The complete structure of the SA 040 type Sanieromat is presented in Fig. 1.

The individual steps of system assembly are described below:

##### Step 1

Set up the infrastructure for the processing or storage of the conveyed sediments and install an electric power supply connection for the Sanieromat power distributor, 400 V, 50 Hz, 25 kW

**Step 2**

Set up the 4 supporting pillars (7) in the corners of the defined work area  
Ensure that each supporting pillar is fixed such that it can absorb a tensile force of at least 10000 N.

**Step 3**

Fasten the 8 mm thick holding cables (6.1 and 6.2) on the supporting pillars. Use a chain hoist to pre-tighten the holding cables with a tension of approximately 7500 N.

**Step 4**

Fix return pulleys (5) on each supporting pillar

**Step 5**

Fasten the auxiliary float (3) with return pulley (5.1) to the holding cable (6.1)

**Step 6**

Fasten both return pulleys (5.1 and 5.2) on the holding cable (6.2)

**Step 7**

Lay the running cable (4.1) between the winch (2.2) over return pulley (5.2) and both return pulleys (5) to the auxiliary float (3). Fasten the running cable (4.1) on the auxiliary float (3).

**Step 8**

Lay the running cable (4.2) between the winch (2.3) over return pulley (5.3) and both return pulleys (5) to the auxiliary float (3). Fasten the running cable (4.2) here.

**Step 9**

Lay the running cable (4.3) between the winch (2.4) and the pump submersible (1). Fasten the running cable (4.3) on the pump submersible.

**Step 10**

Lay the running cable (4.4) between the winch (2.5), the return pulley (5.1) and the pump submersible (1), and fasten the running cable (4.4) to the pump submersible (1).

**Please note:**

In doing so, running cable (4.4) must be fed through the running cable duct (1.9); see Fig. 2.

**Step 11**

Install the tube package with the sludge conveyor line (8.1), both electrical cables (8.3) for the sludge conveyor pump, backwash pump and compressed air supply line (8.2) and connect the sludge conveyor pipe (8.1) to the sludge conveyor pump (1.1) and the compressed air line to the dive openings (1.6); see Fig. 2.

**Step 12**

Connect the electrical power supply between the Sanieromat power distributor and the main power supply as well as between the winch boat and the power distributor, and install the electrical control cable

**Step 13**

Check the electric control unit for its correct functioning

**Step 14**

Lower the pump submersible, test the system and conduct a trial run

**Step 15**

Position the buoy (9), the compressed air distributor (9.1) and the tube package (8) above the pump submersible (1), and check buoyancy.

## 6. Description of the submerging and surfacing process of the pump submersible

### 6.1 Description of the submerging process

After assembling the Sanieromat system as described above, the pump submersible can be immersed in a water body. Each of the two diving bodies (1.4) is connected to the compressed air distributor (9.1) using a flexible compressed air pipe as described above; see Fig 5. Refer to Figs. 2 and 5 for the following work steps for immersing the pump submersible.

#### Step 1

Supply compressed air to the tube package

Compressed air valves VP 1 open

This will supply compressed air to the tube package and hence it will float on the water body.

Compressed air valve VD 1 closed

Compressed air valve VD 3 closed

Compressed air valve VD 2 open (open the three-way tap to atmosphere)

Compressed air valve VD 4 open

#### Step 2

Fill water in the flood opening (1.5) of both diving bodies (1.4)

When water is filled in both diving bodies, the pump submersible loses its buoyancy, immerses in water and sinks down to the sediment.

#### Step 3

Control the buoyancy of the tube package by actuating compressed air valves VP 1 and the 3-way valve VD 2

### 6.2 Description of work steps for surfacing the pump submersible

Observe the following work steps for surfacing the pump submersible; see Figs. 2 and 5.

#### Step 1

Ensure good compressed air supply. The system pressure in the compressed air tank of the compressor should be 6 bar.

#### Step 2

Compressed air valve VD 2 closed

Compressed air valve VD 4 closed

Compressed air valve VD 1 open

Compressed air valve VD 3 open

Compressed air flows from the compressor through the flexible compressed air supply line and is routed to both diving bodies (1.4) of the pump submersible.

Water in both the diving bodies is squeezed out through their flood openings (1.5).

As a result a buoyancy force acts on the pump submersible and it surfaces.

## 7. Technical data

### 7.1 Pump submersible (1)

Length: 3000 mm

Width: 1700 mm

Height: 1200 mm  
 Material: Polyethylene / steel (St 37) coated  
 Weight: 750 kg  
 Electrical connection: 2 x 8 kW; 400 V; 50 Hz  
 Sludge conveyor pump: PUMPEX SP 80, refer to the specifications  
 Delivery rate: 40 m<sup>3</sup>/h  
 Speed: 2850 rpm  
 Weight: 67 kg  
 Backwash pump: PUMPEX SP 80

## 7.2 Winch boat (2)

Length: 4000 mm  
 Width: 2000 mm  
 Height: 750 mm  
 Material: Steel (St 37) coated  
 Weight: 1500 kg  
 Electrical connection: 4 x 1.5 kW; 400 V; 50 Hz  
 Electrical power distribution and control unit: refer to the electrical circuit diagram  
 Number of winches: 4  
 Winch: Ø 180; L = 400 mm  
 Drive motor: KEB COMBIDRIVE ZG3  
 Cover: Awing made of polyvinylchloride

## 7.3 Running cable and holding cable

### Running cable (4.1)

Type: Round strand cable compliant with DIN 3060  
 Length: 100 m  
 Diameter: 6 mm

### Running cable (4.2)

Type: Round strand cable compliant with DIN 3060  
 Length: 100 m  
 Diameter: 6 mm

### Running cable (4.3)

Type: Round strand cable compliant with DIN 3060  
 Length: 200 m  
 Diameter: 5 mm

### Running cable (4.4)

Type: Round strand cable compliant with DIN 3060  
 Length: 200 m  
 Diameter: 5 mm

### Holding cable (6.1)

Type: Round strand cable compliant with DIN 3060  
 Length: 100 m  
 Diameter: 8 mm

### Holding cable (6.2)

Type: Round strand cable compliant with DIN 3060  
 Length: 100 m  
 Diameter: 8 mm

#### 7.4 Auxiliary float (3)

Length: 1000 mm  
Diameter: 250 mm  
Material: Steel (St 37) coated  
Weight: 25 kg

#### 7.5 Compressor (10)

Length: 520 mm  
Width: 270 mm  
Height: 450 mm  
Weight: 31 kg  
Motor output: 1.25 kW  
Pump volume: 250 l/min  
Filling volume: 180 l/min  
Pressure: 10 bar

#### 7.6 Electrical power distributor

Electrical connection power: 400 V; 50 Hz; 25 kW  
Length: 500 mm  
Width: 250 mm  
Height: 800 mm  
Material: Steel (St 37) coated  
Electrical power distribution: refer to the specifications

#### 7.7 Electric cable

##### Electric cable (8.3)

Length: 100 m  
Type: H07 RN-F 2.5 mm<sup>2</sup>  
Quantity: 2

##### Electric cable (11.1)

Length: 100 m  
Type: H07 RN-F 2.5 mm<sup>2</sup>  
Quantity: 1

##### Control cable (12.1)

Length: 100 m  
Type: H07 RN-F 1.5 mm<sup>2</sup>  
Quantity: 1