

Grit Chamber Screenings Piston Pump System of Separate Sewer Systems “PisPo_mini”[†]

1. Introduction

The screenings removed at pumping stations and sewage treatment plants are a collection of various types of miscellaneous debris. In transporting screenings out of these facilities, a belt conveyor or skip hoist is generally used. However, this equipment was prone to trouble due to its complex structure and large number of component parts, and because complete sealing is difficult, poor sanitation and leakage of foul odors were problems.

This report introduces a product called “Grit Chamber Screenings Piston Pump System: ‘PisPo_mini’,” which realizes sanitary, space-saving, and energy-saving transportation of grit chamber screenings from separate sewer systems.

2. Features

2.1 Sanitation and Ease of Maintenance Control

Because transportation of screenings is performed by a closed piping route, splashing of wastewater and leakage of foul odors are not concerns, and a sanitary working environment is realized. Furthermore, because the moving equipment is limited to the grit screenings piston pump, the structure is simple and maintenance control is easy.

2.2 Compact Design and Easy Retrofitting in Existing Facilities

Conveyor systems include a drive mechanism, the supporting structure for the equipment, etc., and require a large amount of space. In contrast, because construction of the “PisPo_mini” screenings piston pump system comprises mainly laying of the piping route, the system achieves a large space saving. The system can be laid out freely in any direction, including horizontal and vertical, which enables easy retrofitting in existing facilities. In particular, when a “PisPo_mini” system is installed as part of the renovation of an existing facility, the space available for maintenance is increased and maintenance control is improved.

2.3 Energy Savings and Other Cost Advantages

The “PisPo_mini” system is energy saving in comparison with conventional transportation systems because the pump is operated automatically, corresponding to the actual amount of screenings generated.

Construction costs are also greatly reduced, particularly in plants with a long transportation distance, because the “PisPo_mini” system requires only construction of piping (in addition to the pump).

3. Outline of Screenings Piston Pump System

3.1 Outline of Transportation System

In conventional systems, the transportation system of the screenings which are raked up by the trash removal device in the grit chamber of the sewage treatment plant is made up by connecting various types of transportation equipment such as conveyors, skip hoists, and the like. In contrast to this, the composition of the “PisPo_mini” system is extremely simple, comprising only the screenings piston pump and the piping route (**Fig. 1**).

Where equipment power requirements are concerned, as shown in **Table 1**, the results of a trial calculation for a plant with a maximum hourly wastewater flow of 200 000 m³/day show that the power required by the “PisPo_mini” system is approximately 50% that of the conventional system.

3.2 Outline of Piston Pump

As shown in **Fig. 2**, the screenings piston pump has a structure in which the screenings are pumped by a piston driven by an oil hydraulic unit. The device has a modular structure, in which upper part of the screenings piston pump is equipped with a hopper and bridge breaker for receiving the screenings, and also includes a control board for controlling the outlet gate valve and the operation of the device as a whole.

Opening and closing of the gate valve are interlocked with the pump so as to prevent backflow from the piping route.

The head of the piston which pumps the screenings into the piping route is equipped with a cutting edge that breaks up large pieces of foreign matter. If foreign

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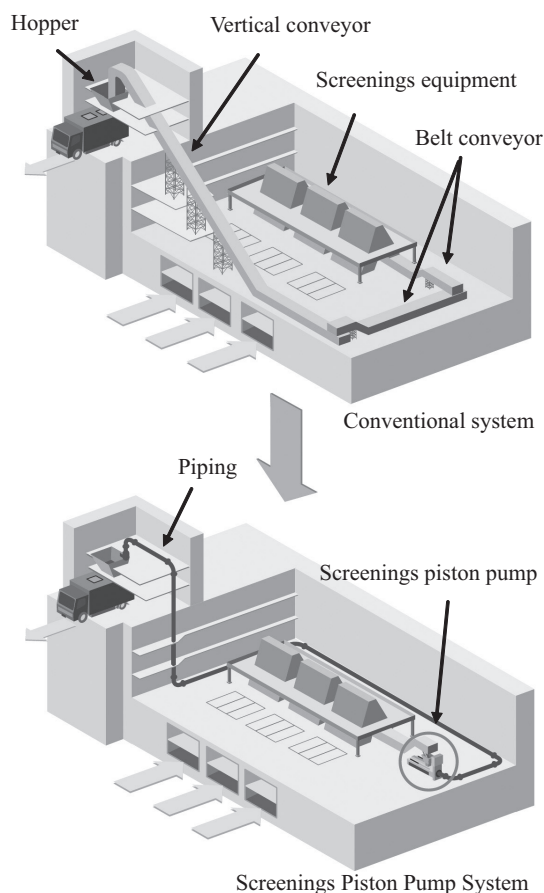


Fig. 1 Conventional system and screenings piston pump system

Table 1 Power comparison example (Maximum hourly wastewater flow : 200 000 m³/day)

Conventional facilities		Screenings piston pump system	
Belt conveyor	1.5 kW	Belt conveyor	1.5 kW
Belt conveyor	1.5 kW	Screenings piston pump	2.2 kW
Vertical conveyor	3.7 kW		
Total	6.7 kW	Total	3.7 kW

matter which is larger than the diameter of the hydraulic cylinder enters the screenings piston pump, this cutting edge cuts the large foreign matter to enable pumping into the conveying pipe.

The standard hydraulic unit power is 2.2 kW or 3.7 kW and is selected depending on the actual pump head and the transportation distance (length of the piping route). The standard specification is shown in **Table 2**.

4. Example of Calculation for Device Selection

- Sewage flow: 300 000 m³/day (maximum hourly wastewater flow)
- Concentration of screenings: 1–15 mg/l⁽¹⁾
- Screenings generation rate:
 $300\,000\text{ m}^3/\text{day} \times 1\text{--}15 \times 10^{-6} = 0.3\text{--}4.5\text{ m}^3/\text{day}$

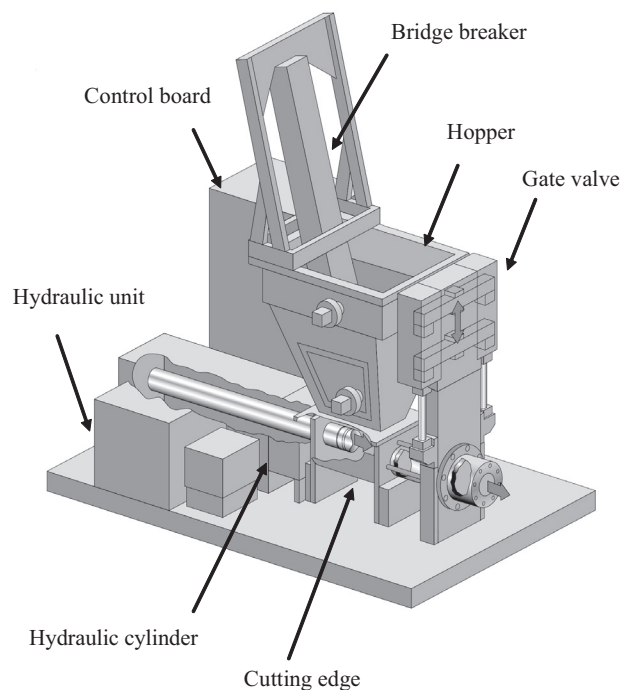


Fig. 2 Screenings piston pump

Table 2 Standard specification

Discharge flow	1.0 m ³ /h	
Max. Discharge pressure	1.1 MPa	1.8 MPa
Discharge size	φ125 mm	
Pump stroke	800 mm	
Hydraulic unit power	2.2 kW	3.7 kW
Unit weight	About 2 100 kg	

- Pump operating time: 6 h/day
- Necessary hydraulic pump capacity:
 $4.5\text{ m}^3/\text{day} \div 6\text{ h/day} = 0.75\text{ m}^3/\text{h}$

The discharge flow of the “PisPo_mini” pump is 1.0 m³/h. Accordingly, it is possible to meet the requirements of this plant with 1 unit.

5. Conclusion

The “PisPo_mini” screenings piston pump system realizes space saving, labor saving, and energy saving. As a screenings transportation system for grit chambers of separate sewer systems, it is considered an effective system from various viewpoints, including ease of layout, etc., not only in new construction, but also in plant renovation projects, particularly when an increase in screenings transportation is expected.

In the future, the authors hope to contribute to protection of the global environment by developing equipment and systems with excellent maintenance control features and high energy saving performance.

Reference

- 1) Guideline and Manual for Planning and Design in Sewerage Systems. 1994 versions. Japan Sewaeg Works Association.

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