

Containerized Plug & Play Sludge Dewatering Plants as a Energy and Cost-Effectiveness Solution for Small and Middle WWTP'S

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Abstract – This article examines the advantages of application of containerized sludge dewatering plants, as well as the rationale for the use of MDQ multi-disc dehydrators. The main focuses are placed on considering the technical features of the equipment in terms of capital and operating costs, as well as equipment maintenance.

Keywords – sludge dewatering, MDQ multi-disc screw press dehydrators, plug & play containerized sludge dewatering plant, Esmil MODULE D, cost-effectiveness, plant footprint, operating costs.

Introduction

Municipal wastewater treatment results to the production of large quantities of sewage sludge, which requires proper and environmentally accepted management before final disposal. It is important to note that proper management of sewage sludge is crucial for the protection of human health and the environment [1].

The implementation of the Urban Waste Water Treatment (UWWT) Directive 91/271/EC in EU-15 countries over the last 20 years has led to improvements in their wastewater collecting and treatment systems. However, it has effected in an almost 50% increase in annual sewage sludge production in these countries [2].

Heigh inflation and energy crises also have an impact on sewage sludge management and wastewater treatment plant (WWTP) operations. During periods of financial crisis, funding for infrastructure projects such as WWTPs can be reduced or put on hold, which can lead to delays in necessary upgrades or repairs to the plants. It can result in increased inefficiencies and potential environmental risks associated with inadequate wastewater treatment.

Moreover, higher energy prices increase the operational costs of WWTPs. These facilities require significant amounts of energy to treat wastewater and manage sewage sludge, and as energy prices rise, the cost of operating these plants can increase substantially. This can result in higher costs for consumers and municipalities that rely on WWTPs to manage their wastewater.

In summary, economy can have significant impacts on sewage sludge management and WWTP operations, highlighting the need for sustainable and resilient wastewater treatment infrastructure that can withstand economic and environmental challenges [3, 4].

Containerized plug & play sludge dewatering plants

Wastewater treatment operations face many challenges, and many of those challenges can be avoided or overcome by using a “containerized” approach. The advantages of mobile mechanical dewatering plant included:

Ready-to-use equipment – all equipment that is a part of the mechanical dewatering plant is mounted in a container. The installation arrives at the site completely ready-to-use. Plug-and-play technology significantly reduces time that needed to launch the plant, it can be installed and operational within days and not years.

Minimum need for designing – the dewatering plants has already been designed and developed. A ready-to-use solution reduces the time for design and approval of documentation, as well as the associated costs.

Compactness - containerized plants are housed in pre-assembled shipping container, the mechanical dewatering plant as a 20- or 40-foot container occupies only 15 or 30 m² respectively. It can be easily deployed in a confined area of a wastewater treatment plant, a factory or even a marine vessel.

Mobility - It is possible to use the dewatering plant both in stationary conditions and for sludge treatment at various facilities. The body of the installation is made based on a sea container with high strength and uniform dimensions, which makes it possible to transport equipment to the site by widely available modes of transport.

Less odors – the container mechanical dewatering plant have closed construction which allows significant decrease the amount of odors and by using air purification system minimized the sanitary protection zone.

Depending on the technical requirements, the containerized dewatering plants can be equipped with the equipment that fulfill the customer's needs. During the decision-making process, it is necessary to take a consideration CAPEX and OPEX.

What are the best and most sustainable dewatering solution

In recent years, significant progress has been made in improving dewatering technologies and processes [3, 6, 7, 8]. Innovations in equipments have made these processes more efficient and cost-effective. However, it's important to note that there is no one-size-fits-all solution for dewatering. The choice of technology depends on a variety of factors, including the characteristics of the waste stream, the size of the facility, available budget, and staffing resources [5].

Belt filter presses and centrifuges are very common to the municipal wastewater market, they presented their advantages and disadvantages in relation to each other. In summary, a belt filter press (BFP) is a low-cost, low-energy, low-polymer solution that is simple to operate, but requires more operator attention and typically produces lower cake solids than a centrifuge.

By comparison, a centrifuge produces a drier cake and has a higher throughput capacity in a smaller footprint, but also has higher capital costs, power costs, and maintenance costs [10].

The belt filter press represent an almost universal process (all sludge types) and one of the least energy-hungry of the dewatering processes:

- belt filters: 10-25 kWh · t⁻¹ of suspended solids;
- classic filter-press: 20-40 kWh · t⁻¹ of suspended solids;
- centrifuge: 30-60 kWh · t⁻¹ of suspended solids.

The multi-disc screw press dehydrator requires little operator attention and low maintenance. The dehydrators are operated using minimal energy and requires the least amount of other resources (flocculant, rinsing water, wear parts), as well as minimal maintenance and staff supervision, compared to any other dewatering equipment. The disadvantage can be hydraulically load capacity, with required multiple units. But in the other hand, to increase the dehydrator capacity in one main MDQ dehydrator can be added up to five multi-disc screw. This ability give

additional points for flexibility and opportunity to increase MDQ productivity without necessity buying the new equipment.

The dewatered sludge after treatment in the dehydrator can reach a residual moisture content of 60-82% with an average flocculant dose of 1.5 – 3.5 kg/t of sludge dry matter.

In the Table 1 compared different equipment for municipality sludge dewatering [11, 12, 13].

Table 1

Compared equipment for sludge dewatering

Parameter	Multi-disc screw press	Screw press	Belt press	Centrifuges
Footprint	●	●	●●●	●
Polymer consumption	●	●●	●●	●●●
Power consumption	●	●	●●	●●●
Flush water consumption	●	●	●●●	●
Maintenance cost	●	●	●●	●●●
Labor Cost	●	●	●●	●

Containerized plant Esmil MODULE D (Fig. 1) which equipped with MDQ multi-disc screw press dehydrators can be one of the best solution for WWTP's. Low energy and flocculant consumption with reduced the operation cost.

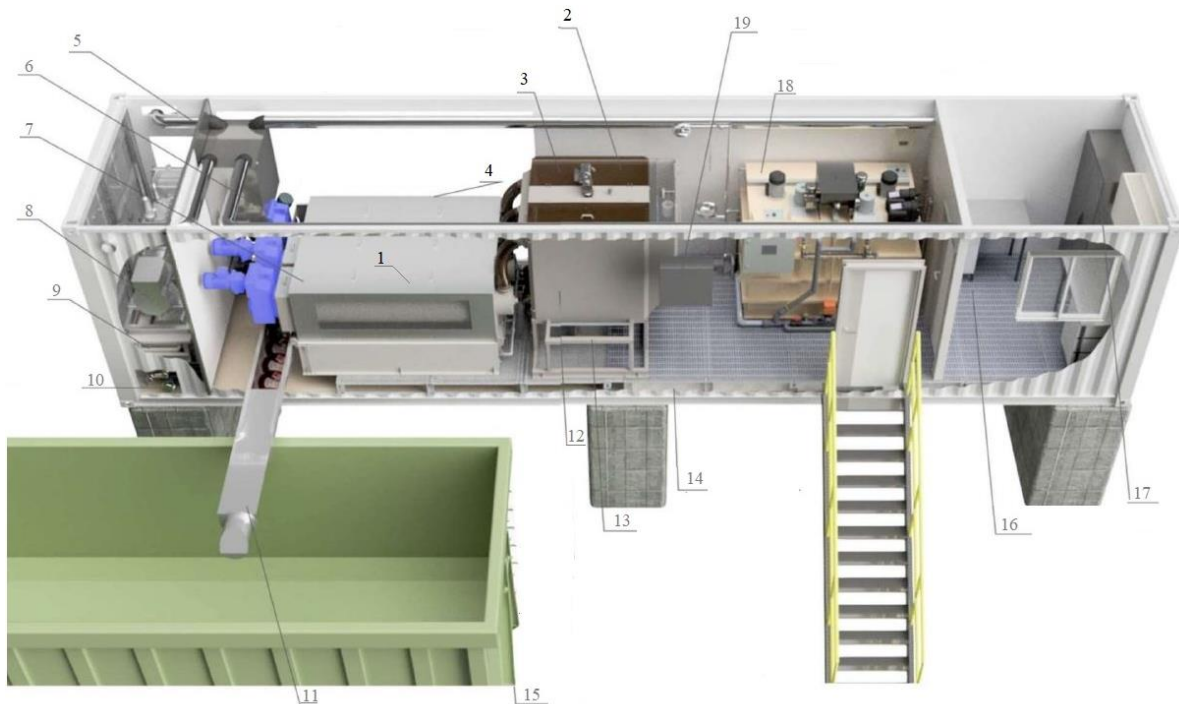


Fig.1. Containerized sludge dewatering plant, Esmil MODULE D.

- (1) Dehydrator, (2) dynamic mixer, (3) thickening lattice, (4) sludge pump, (5) heat recovery ventilation system, (6) sludge macerator, (7) dewatering drum, (8) diesel generator, (9) fuel tank, (10) connection blocks, (11) sludge removal conveyor, (12) fixed mixer, (13) water tank, (14) office space for service personnel, (15) tank for dewatered sludge, (16) office space for service personnel, (17) complex control cabinet, (18) flocculant solution preparation station, (19) touch panel cabinet.

Conclusions

Containerized plug & play system provides the wastewater treatment plant`s with all-in-one solution for sludge treatment. The fully mobile equipment, eliminates construction works, design cost and administration works for permits, independent energy source (if necessary), heater and ventilation system. Mobility of the containerized plants also allows to use it as a temporary solution in emergency situations or as shared equipment for several small WWTP's. The containerized sludge plant has small footprint, makes it a preferable choice to constructing a new sludge dewatering building.

In summary, containerized dewatering plants, such as the ESMIL Module - D, offer not only technical advantages but also financial advantages. The equipment is considered a more liquid asset in finance terms due to its modular design, which allows for easy relocation and reuse in other WWTPs. It means that the initial investment in a modular dewatering plant can be recouped through multiple uses, making it a more cost-effective solution. Additionally, the reliability of the dehydrator MDQ in the ESMIL Module - D ensures that maintenance costs remain low, which also helps to keep the price in a good level. Overall, the financial advantages of modular dewatering plants make them an attractive option for WWTPs looking for cost-effective solutions.

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