



Development of modular water treatment equipment based on MBR technology for the treatment of meat processing industry wastewater

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Abstract

Due to its high decomposition efficiency and its compact size, the MBR (Membrane Bioreactor) wastewater treatment technology plays growing role in the treatment of wastewaters highly contaminated with organic material. The membrane bioreactor is a combination of a bioreactor and a membrane filtering technology, and which can operate continuously. The goal of our project is to create a new MBR technology with high reliability and a wastewater treatment equipment, based on the aforementioned technology that can be built in an ISO container, with minimal need for space and that has particularly high

efficiency of decomposition. The innovation in this technology is that it will operate using extremely low transmembrane pressure (flux being circa 35 L/m²/h) to allow for the long-term operation of it, with low maintenance need and without fouling. Usage of low pressure and large specific membrane surface further enables the production of an energy-efficient device. According to the preliminary studies, this new MBR based technology developed for meat industry wastewater treatment will have an energy demand lower than 0.55 kWh/m³.

TECHNOLOGICAL IMPLEMENTATION

The greatest potential of large municipal of treated effluents from large municipal wastewater treatment plants. Reasons for this are:

1. Concentrated large volume flows 10 000 - 100 000 m³/day.
2. The requirements for raw water are more relaxed than for irrigation. (microbiological cleanliness, presence of heavy metals, micropollutants are less important). Industrial use is also more acceptable to the population for psychological reasons.
3. Industrial plants usually already have a raw water purification system in place that can pre-treat incoming water (river, lake, well) for the specific process purpose. In addition, the so-called tap water quality is usually not sufficient for industrial plants, which have to further treat the water on their own, for example to soft water or desalinated water quality. These additional treatment costs are usually well above the costs of pre-treatment/water procurement.
4. For many plants, the quality of the water available in many cases barely exceeds the parameters of biologically treated water, e.g. flooded river water.
5. Appropriate legislation/permits can "encourage" companies to use treated wastewater.
6. Additional source of income for water utilities.

Table 1 - Water quality data from the reuse technology of the biological treated wastewater on Paros Island, Greece

	Treated waste water	Limits	Values
pH	7.36	6.5 – 7.6	7.1
Turbidity NTU	25	<2	<2
Total suspended solids mg/l	30	<2	<2
Biochemical oxygen demand BOD5 mgO ₂ /l	25	<10	<8
Total nitrogen mg/l	8.86	-	4.13
Total phosphorus mg/l	1.48	-	1.48
E.Coli number CFU/100 ml	-	<2	<1
Total Coliform count CFU/100 ml	-	<20	5

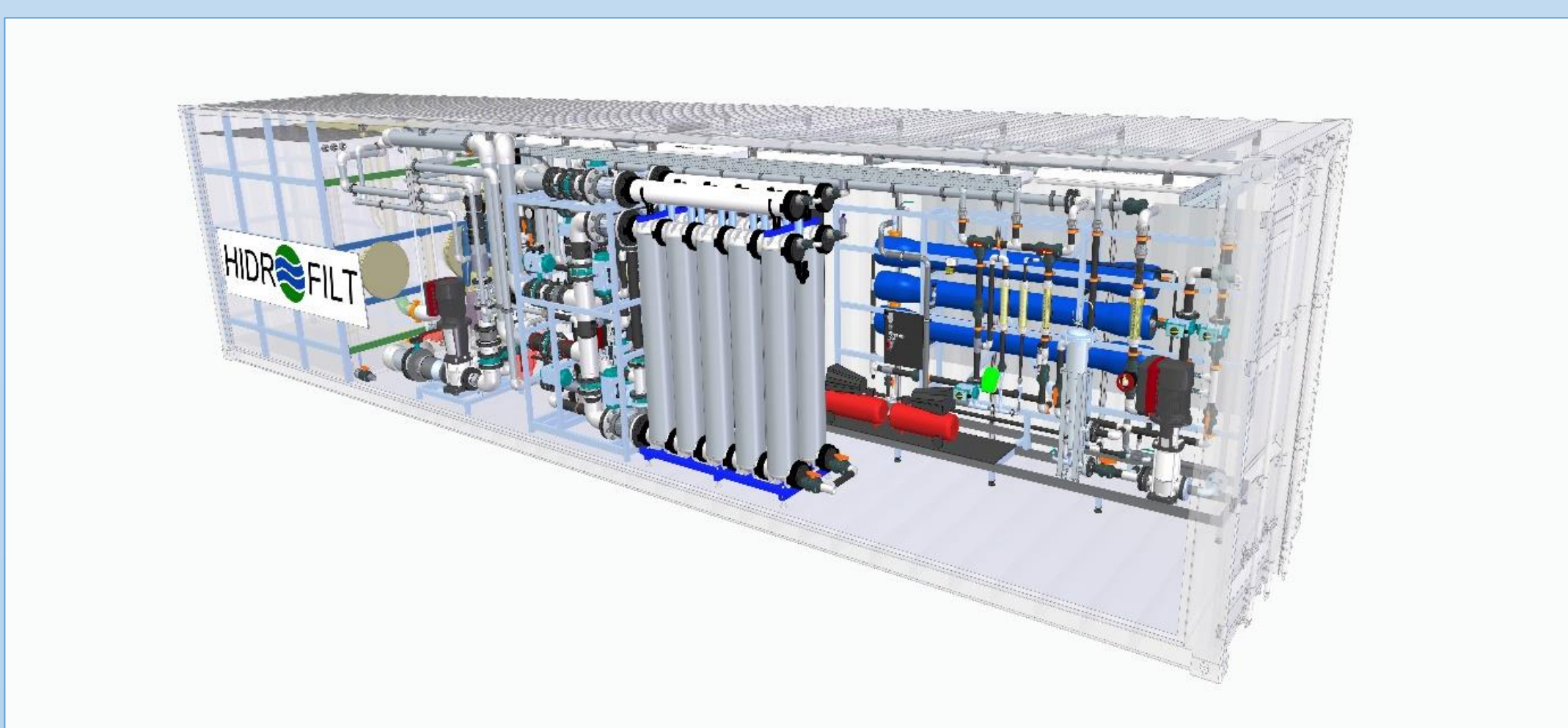


Fig. 1 Containerised wastewater treatment system 3D design

In order to meet industrial feedwater needs, the biologically treated wastewater must be treated by tertiary treatment units. These units should be individually designed as part of a single technology, taking into account needs and possibilities. Generally speaking, it is membrane filtration equipment or a combination of membrane filtration equipment and possibly conventional processes. Membrane technology can be used to reduce germ count, organic matter and salinity. A key task is to retain organic matter and recycle it back into the biological treatment process without drastically increasing the salinity. On a small scale, a containerised version can accommodate up to around 200 m³/day, while on a larger scale, an in-building design is preferable.

DEVELOPMENT OF A MODULAR WASTEWATER TREATMENT PLANT BASED ON MBR TECHNOLOGY FOR THE TREATMENT OF MEAT INDUSTRY WASTEWATER

The novelty of the technology developed is that it operates at extremely low transmembrane pressures, in order to allow the membranes to be used over the long term with low maintenance and without clogging. Due to the low transmembrane pressure and the large membrane surface area, the equipment is energy efficient. By using a novel membrane arrangement that allows multiple permselective microfiltration membranes to be operated in parallel in series, we have achieved the best energy-efficient LPMBR technology design by using

an ultra-large membrane area ultrafiltration membrane with the highest energy efficiency. A new prototype product using innovative technology has been created by integrating a minimum energy demand circulation system, LPMBR membrane structure and bioreactor. By using the technology and equipment resulting from the project, meat processing companies will be able to modernise their existing water treatment and recycling systems and recycle their waste water economically.

Acknowledgement

The outcome of the project "Development of a modular wastewater treatment plant based on MBR technology for the treatment of wastewater from the meat industry (2019-1.1.1-PIACI-KFI-2019-00310)", funded by the National Research, Development and Innovation Office, is a containerizable, highly reliable and highly degradable LPMBR technology and a wastewater treatment plant based on it.