

CASE HISTORY

A REVOLUTION IN ANAEROBIC DIGESTATE TREATMENT

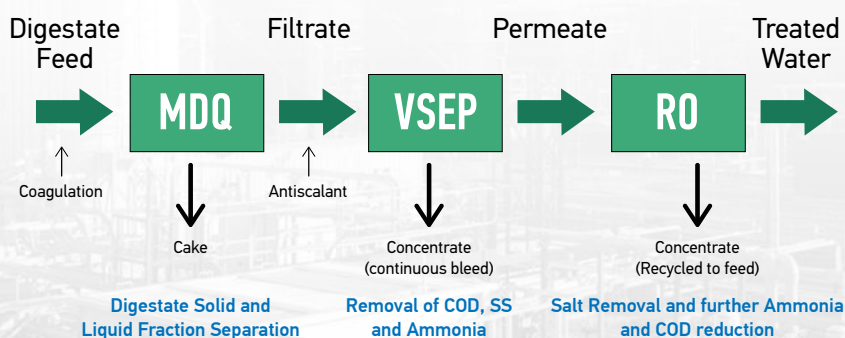
Esmil Process Systems founded in 1975 has over 40 years' experience in the field of industrial effluent treatment achieving recognition for process/systems solutions including the prestigious **"Queens Award for Environmental Achievement"** and **"DTI best supplier"**.

Esmil are able to provide cost efficient, environmentally friendly waste water treatment solutions using a combination of technologies including:

- Pretreatment;
- Ultrafiltration;
- Nanofiltration;
- Reverse osmosis;
- Membrane Bio-Reactors;
- VSEP (Vibratory Shear Enhanced Process) non fouling membrane systems;
- Sludge dewatering.

Esmil with our technology partners have conducted much research and have acquired vast experience in the field of digestate treatment. From bench scale studies to full scale plant operations, Esmil offer bespoke digestate waste water treatment for all AD feed types using state of the art membrane separation and dewatering processes and systems.

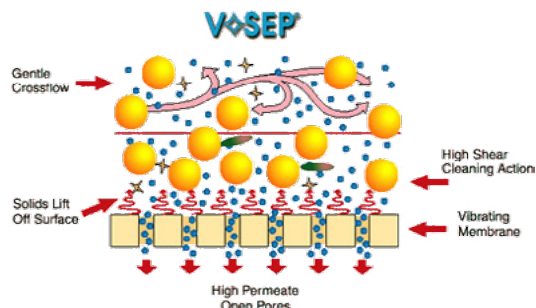
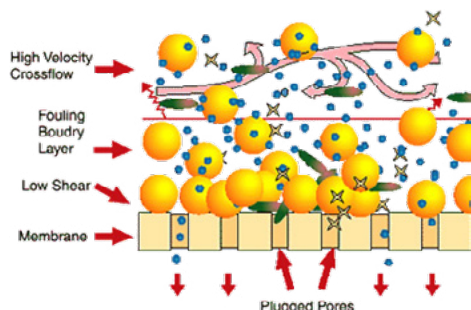
Esmil's digestate treatment system consists of 3-unit processes and is able to produce a dry solid cake and a recovered water (permeate) suitable for process reuse or disposal. Esmil can even offer a Zero Liquid Discharge digestate treatment solution if sufficient waste exhaust heat from the CHE units is available.



The first stage in the digestate treatment process is **digestate dewatering**. Dewatering is achieved through various physico-chemical processes and seeks to remove as much of the TSS from the whole digestate as possible.

The second stage of Esmil's digestate treatment process utilises proprietary technology based on a fouling resistant vibrating membrane system or **VSEP (Vibratory Shear Enhanced Processing)**.

High levels of suspended and dissolved solids in the digestate cause serious issues for standard membrane systems as they are highly susceptible to fouling and scaling. **VSEP technology** vibrates the membrane pack causing high shear forces at the membrane/fluid interface, greatly reducing the risk of fouling.



The high shear process keeps the membrane pores exposed allowing for maximum permeation of water. Contaminants and a fraction of the water are rejected by the membrane and remain on the concentrate side. This 'concentrate' will contain the majority of nutrients from the digestate liquor fraction and can be marketed as a high nutrient liquid fertilizer in the agricultural/horticultural markets. The concentrate has a high concentration of TAN which is readily taken up by plants with no emission risks in transport or application.

Esmil's final stage of digestate treatment utilises **spiral-wound reverse osmosis membrane** technology. This process polishes the permeate (treated water) from the VSEP units. Residual COD, ammonium salts and TDS are efficiently removed at this stage (typically 99% strip) and this concentrate stream is recycled to the VSEP feed to improve overall water recovery and improve the value of the VSEP concentrate stream.

The final permeate produced at this stage is either recycled back into process operations (dilution, plant washing & cleaning or boiler feed water) or discharged to a watercourse.

The overall process represents a revolutionary method for digestate disposal. Instead of being a cost, digestate is valorized representing a significant change in the operating costs of the AD operation. Typically, for every 1000 tons of digestate produced, between 650 and 700 tons of clean water are recovered (displacing bought in town/municipal make-up water). This water can also be discharged safely to water course without incurring transport/spreading costs.

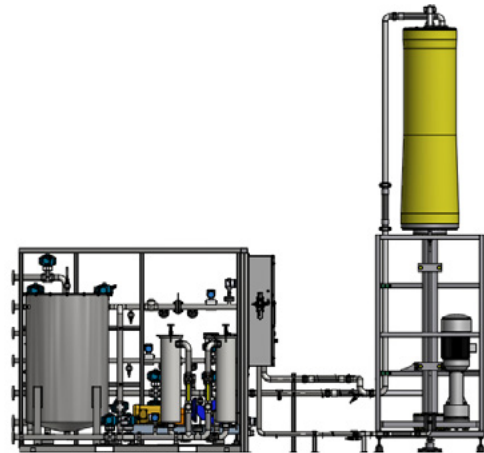
Between 300 and 350 tons of concentrated liquid fertilizer are recovered which may either be directly marketed (trucking off cost reduced by 2/3 compared to whole digestate), or dried to produce a chemical fertilizer equivalent. The concentrate now becomes a positive revenue stream for the AD operation.



Multi Disc Screw Press (MDQ) Unit



Spiral Membrane System



VSEP System

Case History I

- AD Digestate** animal manure/crop waste feed
- Feed rate** 10.0 m³.h⁻¹
- Process**
1. Pretreatment & de-watering;
 2. VSEP RO;
 3. Spiral RO (polishing unit).

Dewatering operations resulted in reducing the sludge volume by 6 – 10 x. A stackable cake was formed with a dry solids content of between 35 – 40%.

The recovered filtrate is treated using VSEP which separates the filtrate into permeate and concentrate streams. Remaining filtrate suspended solids and the bulk of alkalinity, COD, ammonia and other contaminants are rejected to the concentrate stream by the membrane. Dependant on feed quality, temperature and pH; expected water recovery at this stage ranges between 65-80%.



Dewatered Feed / VSEP Perm. / VSEP Conc./VSEP Perm.2/VSEP Perm.3/RO Perm./RO Conc.

After VSEP, the recovered permeate is treated using a spiral wound reverse osmosis unit. Treating the permeate feed with acid causes all remaining ammonia to be rejected by the membrane as ammonium salts.

The process achieved a **95% reduction in COD and 98% reduction of ammonia** after 2 membrane passes.

Parameters	Units	VSEP (Pass-I)			RO (Pass-II)		
		Feed	Conc.	Perm.	Feed	Conc.	Perm.
Total COD	mg/l	13080	12800	7990	7990	31960	600
pH	-	5.68	5.6	5.7	5.7	6.1	5.9
Ammonia	mg/l	5150	11300	1760	1760	7425	< 100
Conductivity	us/cm	40400	-	15400	15400	73100	1389

Case History I – Process results

Operating expenses for the digestate treatment process.

Description	Units	Cost per unit, GB £	Total Cost, GB £/m ³
Power	kWh.m ³	4.56	0.46
Water	m ³	0.55	0.02
Chemicals	kg (as supplied)	13.35	0.89
Consumables	units	8.40	0.80
Total			2.17

Case History I – Typical OPEX costs

Digestate Treatment Design Philosophy

As no two digestates are equal, it is essential to follow a step-wise testing procedure to ensure that the bespoke digestate treatment process performs cost efficiently and meets process specifications. Typically, this process incorporates these elements:

- Chemical testing to achieve cost effective fluid viscosity modification, coagulation and trash neutralisation.
- Lab scale dewatering and membrane trials to confirm process feasibility and proof of concept.
- On site pilot trials to quantify process noise, demonstrate operational repeatability and to corroborate design parameters.
- Extensive plant design and operating expense calculations.
- Build, installation and commissioning activities.
- Comprehensive service support including maintenance and system upgrades

Staff and Labor Force.

By directly employing key staff **Esmil Process Systems Ltd** has immediate access to all the skills necessary to provide the comprehensive service described above. These include professional engineers and environmentalists, skilled tradesmen and site operatives.

Esmil Capability Statement

Esmil's goal is to exceed your environmental and commercial expectations by the design, manufacture and supply of proven treatment plant to manage difficult industrial effluents.

For further information contact **Esmil Process Systems**.

Unit 5, the Courtyard, Glory Park, High Wycombe, UK,
HP10 0DG

+44 1494 526 155 info@esmil.co.uk
www.esmil.co.uk