SNAPSHOT

AUSTRALIAN MEAT PROCESSOR CORPORATION

Robust membrane systems for enhanced primary treatment and energy recovery of abattoir waste water

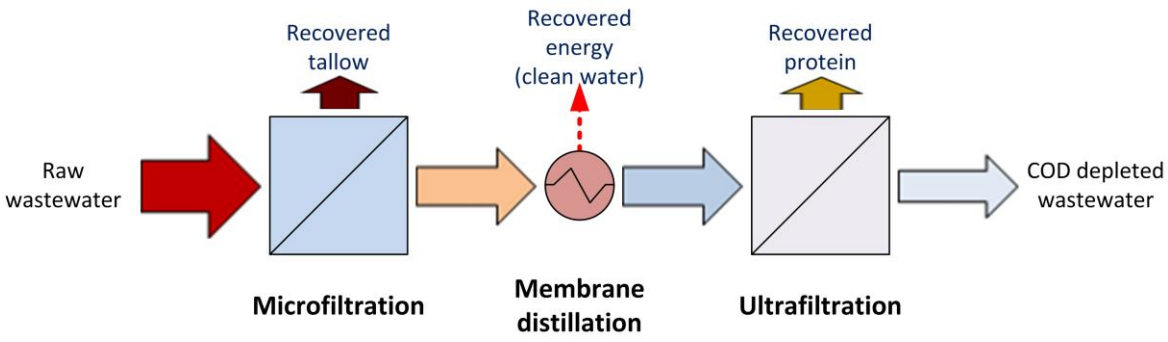
Project Report Reference: 2013/5024 **Date: June 2016**

Project Description

The primary aim of this project was to investigate robust membrane technology for primary treatment of abattoir wastewater. A specific focus was on improved recovery fats and proteins for by-product generation, and/or chemical oxygen demand (COD) removal. Energy recovery (heat) from liquid streams using membrane technology was a secondary aim of the project.

Project Content

Treatment of abattoir wastewater is a significant cost to operators and can represent numerous operational challenges due to the unique water properties and variable nature of the stream. Robust membrane filtration technologies may work in these challenging conditions and outperform widely used dissolved air flotation (DAF). Metal membrane microfiltration (MF) can be used for tallow recovery, ceramic ultrafiltration (UF) for valuable protein recovery and membrane distillation (MD) for thermal energy recovery producing reusable water.



Project Outcome

The use of MF on a real abattoir's combined effluent as well as a stick water stream consistently showed near complete removal of fats (99%) and very high COD removal (>86%). Sustainable operation required cross flow membrane configuration operating at warm water temperatures (consistent with those onsite) and use of backpulse cleaning. Solids captured during MF treatment of stick water were re-rendered and separated into tallow (including a clear, potentially high grade, tallow) and heavy solids. Solids captured during MF treatment of combined effluent were separable into lower grade tallow and heavy solids by decanting similar to what is already used for handling DAF sludge.

Further outcomes included:

- Dried solids produced after UF of stick water and concentrated by MD had a protein concentration of 75 wt%. This solid could possibly be used to enhance the protein content of meat meal. MD can convert captured thermal energy to produce up to 11% of the original feed volume to a reusable water; and
- Membrane clean in place (CIP) trials were effective at restoring fluxes in both MF and UF. Use of CIP on a

daily basis would not lead to significant chemical costs, nor significantly add volume or salt loads to the combined effluent.

Benefit for Industry

Economic analysis shown in the table was conducted on high flow/low concentration combined effluent and low flow/high concentration stick water waste streams. Payback periods < 1 year became evident for all cases shown when trade waste savings are included. On sites that don't pay trade waste, tallow product sold at the conservative price of $150/t shows potentially viability on higher concentration stick water.

Membrane process option	Capital cost	Operating cost per annum	Product revenue per annum[1]	Trade waste saving per annum[2]	Simple payback (years)	
					Products only	Products + trade waste savings
1. High flow- low concentration (combined effluent, 3.2 MLD)						
MF	$3,138,000	$381,000	$419,000	$6,708,100	83	0.5
MF + MD	$3,523,500	$408,300	$419,000	$6,724,600	329	0.5
2. Low flow- high concentration (stick water, 0.24 ML/day)						
MF	$433,000	$49,200	$171,500	$1,937,000	3.5	0.2
MF + UF	$1,144,300	$153,000	$241,200	$2,099,800	13	0.5
MF + UF + MD	$1,388,300	$162,100	$241,200	$2,107,600	18	0.6
MF +MD	$677,000	$58,400	$171,500	$1,943,900	6.0	0.3

[1]Tallow sale price of $150/t and protein sale price of $600/t
[2]Trade waste charges of $1.85/kg TN, $0.96/kg BOD and $0.93/kL flow. Potable water supply $2.57/kL.

MF consistently showed similar or better removal of fats and COD compared to high performing DAF with chemical dosing. However because MF does not need chemicals dosed to achieve this separation, replacing a DAF installed on the combined effluent stream with MF would lead to similar or better COD removal from waste water, but also allow for recovery of tallow. Applying MF upstream on the low flow stick water reduces the load on a downstream DAF and recovers potentially higher value tallow.

The following recommendations for further consideration of membrane technology:

- **Lowest technical risk option:** Pilot trial metal MF membranes for 3 to 6 month on low flow/high strength streams like stick water. Benefits include reduced load to DAF (or reduced COD to waste) and better value from recovered tallow suiting more industry sites;
- **Option most beneficial to DAF problems:** Pilot trial metal MF membranes for 3 to 6 months on combined effluent in cases of trade waste discharge to improve on DAF;
- **Application of UF or MD:** UF is recommended after MF pre-treatment of stick water if value in captured protein product. MD can be pilot trialed at a small scale to recover energy, reduce wastewater temperature, and produce re-usable water; and
- **Additional recommendation – application of MF with anaerobic process:** For sites utilizing anaerobic lagoons, MF may reduce maintenance issues by removing tallow while heavy solids are co-digested.

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