Case Study

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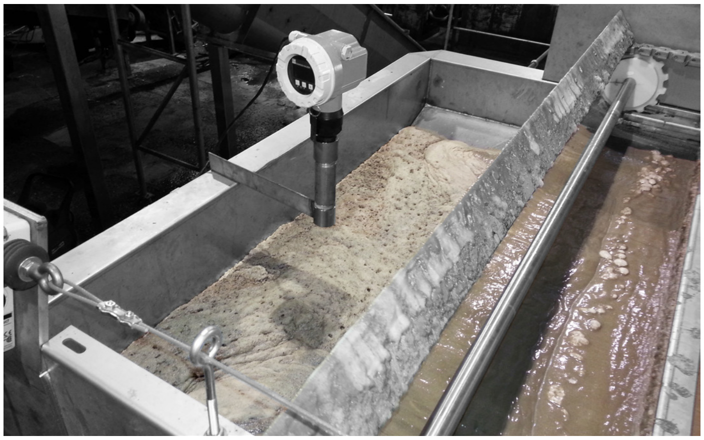
Using Dissolved Air Flotation to Recover Protein Rendering Waste

Overcoming suspended solids, oils, and wastewater challenges in abattoir rendering effluent.



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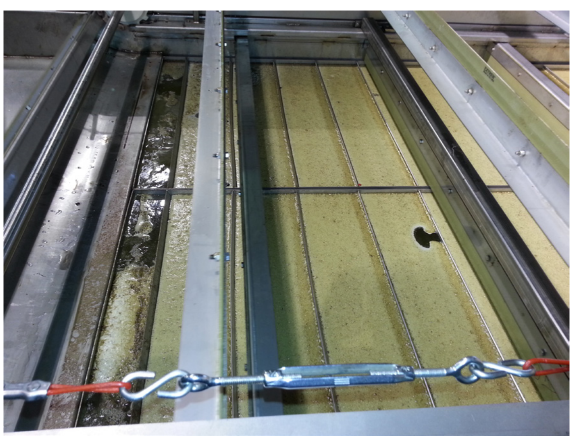
Project Brief

The Craig Mostyn Group's Talloman facility, located in Perth, Western Australia renders mixed abattoir material, fat and bone, blood, and feathers from poultry processing plants throughout the region into finished feed and meal products. Wastewater generated over various cooking, boiling, and evaporating processes requires comprehensive treatment before it is discharged into the city sewer.

One of the key steps in the wastewater treatment process involves the removal of suspended solids and other oily or fatty materials. FRC designed a process based on Dissolved Air Flotation (DAF) technology to perform this all-important duty.

Ultimately, the treatment requirements were met and as an added bonus, solids and oils recovered in the DAF process were re-entered into the rendering process, generating a significant stream of income from what was previously considered waste.



The raw wastewater generated from the rendering process is heavily laden with fats, oils, and animal proteins, which originate from the processing of mixed abattoir materials. These organic compounds contribute to high levels of biochemical oxygen demand (BOD) and chemical oxygen demand (COD), making treatment essential before discharge. If left untreated, these substances can accumulate, leading to environmental concerns such as excessive nutrient loads, foul odors, and regulatory non-compliance. Effective removal of these contaminants is crucial to maintaining wastewater quality and ensuring smooth plant operations.

Design Parameters

Wastewater Characteristics

Rendering facilities must meet strict water quality standards for all fluids discharged into the city sewer system. Talloman's regulated parameters include TP, TKN, BOD, COD, and FOG. The purpose of the DAF system is to reduce these concentrations as much as possible prior to biological treatment in the lagoons.

Constituent	Value
TP	178 mg/L
TKN	1,223 mg/L
BOD	22,100 mg/L
COD	38,400 mg/L
FOG	2,953 mg/L

The wastewater makeup varies depending on product runs so average characteristics were used in the design phase of the project.

DAF Design Parameters

The DAF system employed at the plant is a rectangular vessel constructed of stainless steel. It is fitted with a flight-and-chain skimmer assembly, recycle pump, air dissolving tube, bottom auger, and instruments for measuring flow rate and sludge levels.

Constituent	Value
Air Flow	2.1 lpm
DAF Feed Flow	15 m^3/hr max.
DAF Recycle Flow	20 lpm max.
Free Surface Area	15m^3

Process Calculations

Hydraulic Surface Loading Rate

The volume of wastewater applied per square meter of effective separation area.

$$\frac{\text{DAF Flow Rate + DAF Recycle Flow Rate } (m^3/hr)}{\text{DAF Effective Separation Area } (m^2)} = \frac{6.81 + 5 \ m^3/hr}{4.46 \ m^2} = 2.5 \ m^3/m^2/hr$$

Solids Loading Rate

The weight of solids separated per square meter of free surface area.

$$\frac{\text{Weight of TSS in Feed Flow to DAF (kg/hr)}}{\text{DAF Free Separation Area } (m^2)} = \frac{216 \text{ kg/hr}}{4.46 \ m^2} = 48.4 \text{ kg}/m^2/hr$$

For this application solids loading ended up being the critical design parameter, and the DAF unit was sized accordingly.

Air-to-Solids Ratio

The volume of air required to separate a given weight of solids.

$$\frac{\text{Liters of Air at STP (L/hr)}}{\text{Weight of TSS to be Separated (kg/hr)}} = \frac{126 \text{ L/hr}}{216 \text{ kg/hr}} = 0.58$$

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How DAF Works

A Dissolved Air Flotation (DAF) system is a water treatment technology used to remove suspended solids, oils, grease, and other contaminants. Here's how it works in five steps:

1. Pre-Treatment and Chemical Addition

- Wastewater is first pre-treated to remove large debris or coarse particles.
- Chemicals, such as coagulants and flocculants, are added to the water. These chemicals help aggregate fine particles and suspended solids into larger clumps (flocs), making them easier to separate.

2. Air Saturation in Water

- In a pressurization tank, air is dissolved into water under high pressure. This creates a solution saturated with microbubbles.
- The saturated water is then released into the DAF unit, where the pressure drops, causing the air to form tiny bubbles.

3. Bubble Attachment to Particles

- The microbubbles attach to the suspended solids and flocs, reducing their density.
- This attachment process causes the particles to rise to the surface of the water.

4. Flotation and Skimming

- As the particles float to the surface, they form a sludge layer.
- A mechanical skimmer continuously removes this floating sludge and directs it to a sludge collection system for further processing or disposal.

5. Clear Water Collection

- The treated water, now free of most suspended solids and contaminants, flows to the bottom of the tank and is discharged or sent for further treatment if necessary.
- Some of the treated water may be recirculated back into the pressurization tank for continuous operation.

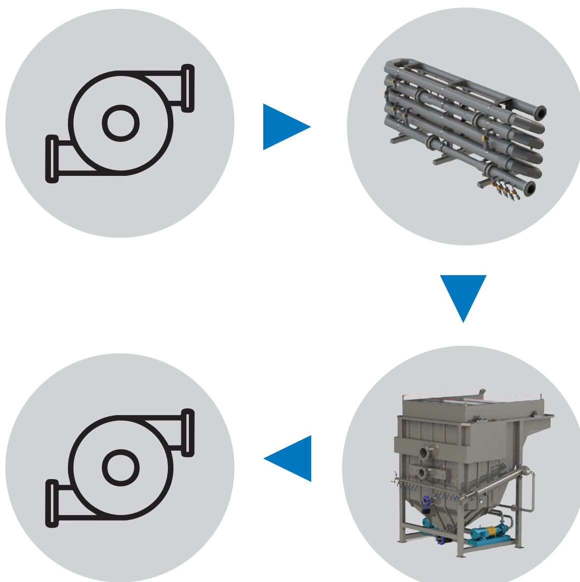
This process ensures efficient removal of contaminants, making DAF systems ideal for industries like food processing, oil refineries, and wastewater treatment plants.

Equipment Implementation

Feed Pump
Wastewater is pumped at a constant rate from a holding tank into the system.

Flocculator
Flocculant is injected to agglomerate coagulated particles into larger "macro flocs" that float more readily in the DAF tank.

Influent



To Lagoon
Clarified water is discharged from the DAF unit into the lagoon system.

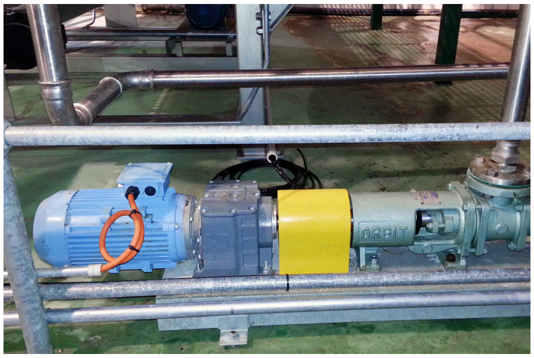
Effluent

Sludge Pump
As solids accumulate on the water's surface, a skimmer pushes them into a collection chamber for removal. A pump transfers the product into the rendering process equipment.

DAF
Water flows into the DAF tank and is hit with a stream of 30-50 micron sized air bubbles which attach to the solid particles and give them buoyancy to float to the surface of the tank.

Electric and pneumatic control panels automate **DAF system** operation.

The **lagoon** system further reduces phosphorus and nitrogen concentrations.



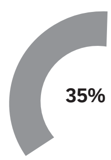
A **sludge pump** transfers recovered product to a collection tank.

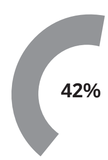
Lab Analysis

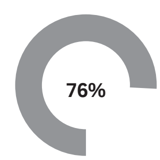
Five weeks of sampling data show a significant reduction over all the regulated constituents, proving the value of DAF technology in this application.

	Total P (mg/L)		Total N (mg/L)		BOD (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
Week 1	250	213	2680	2120	29800	11000
Week 2	140	98	1300	6	9300	4700
Week 3	200	110	690	740	23400	5300
Week 4	180	130	1500	660	22700	5200
Week 5	190	120	1400	740	20200	5100
Average	**178**	**115**	**1223**	**713**	**22100**	**5200**

Percent Reduction

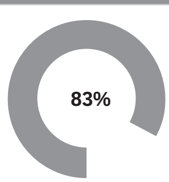


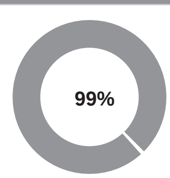




	COD (mg/L)		FOG (mg/L)	
	Influent	Effluent	Influent	Effluent
Week 1	65600	19200	-	-
Week 2	9800	4900	1690	5
Week 3	37600	7200	1870	4
Week 4	39600	6100	1630	5
Week 5	38000	6600	6620	3
Average	**38400**	**6633**	**2953**	**4**

Percent Reduction



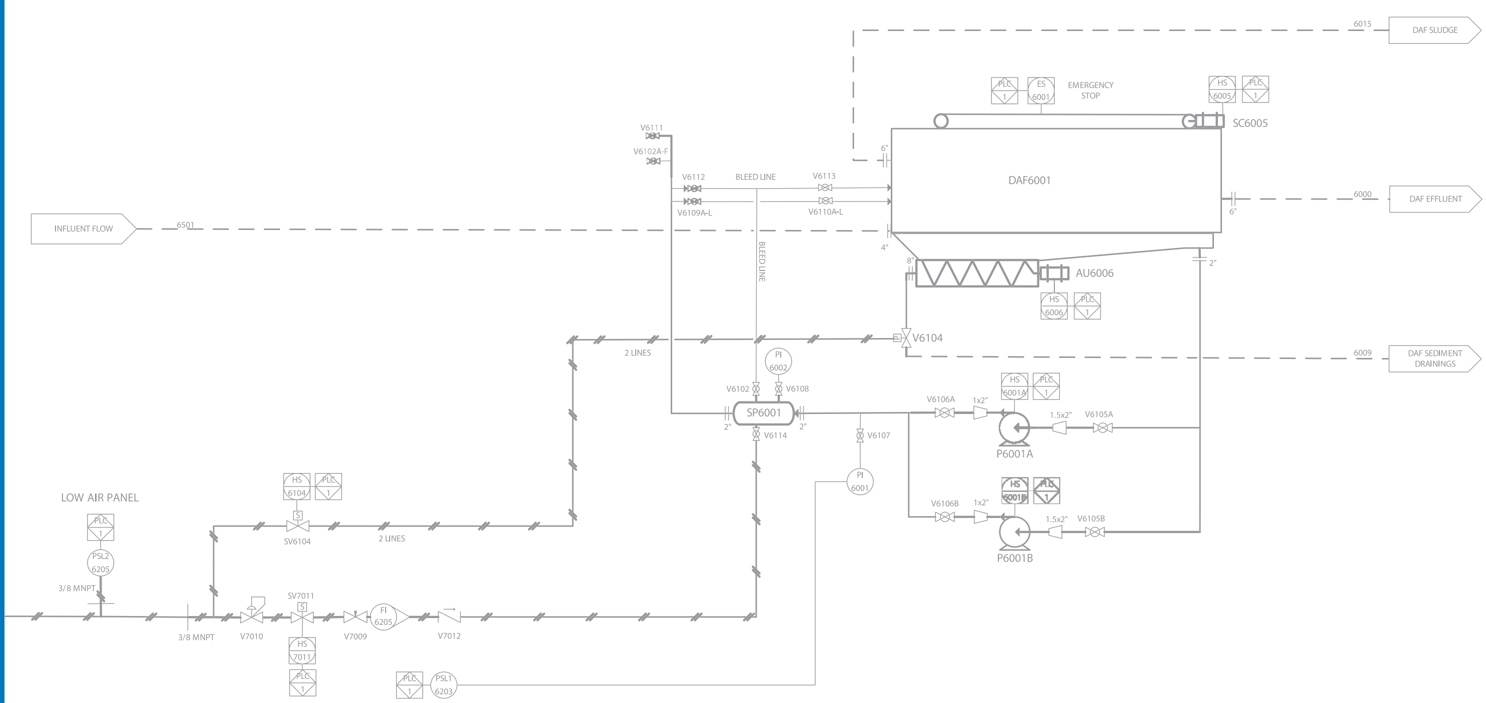


Conclusion

The implementation of the Dissolved Air Flotation (DAF) system has provided Talloman with a dual benefit: compliance with stringent wastewater discharge regulations and the recovery of valuable proteins and fats, which generate additional revenue.

Without the DAF system, rendered product washed down the drain would have placed excessive strain on the lagoon system, making it increasingly difficult to meet regulatory discharge requirements. Failure to comply could result in costly fines or, in the worst-case scenario, a mandated shutdown of operations—an outcome with significant economic and environmental consequences.

By integrating the DAF system, Talloman has mitigated these risks, reducing the burden on the lagoon system while ensuring regulatory compliance. Furthermore, the recovery of substantial product volumes has strengthened the facility's financial performance, turning what was once considered waste into a profitable resource.



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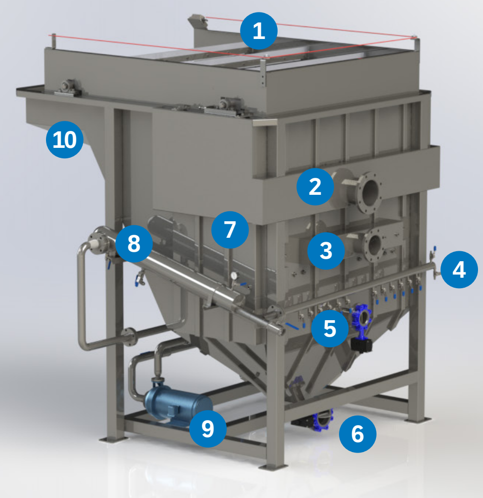
PCL-Series High-Rate DAF

PCL-Series DAF



1. Skimmer Flights
2. Effluent Flange
3. Influent Flange
4. Dissolved Air Dispersion Manifold
5. Sand Trap Outlet
6. Settled Sludge Outlet
7. Plate Pack (tank interior)
8. Air Dissolving Tube
9. ANSI Recycle Pump
10. Float Discharge

The PCL-Series DAF delivers efficient, reliable, and compact wastewater treatment, with high performance, energy savings, and environmental sustainability.

The FRC series of PCL Dissolved Air Flotation (DAF) units are high-built (tall) solid/liquid separators engineered for a variety of flow rates and applications. The PCL Series design utilizes a combination of cross flow plate pack technology and the sludge dewatering grid to generate sludge with high dry solids content.

This project utilized a PCL-Series Dissolved Air Flotation (DAF) system, a reliable solution for effectively removing suspended solids, oils, and grease from water. However, FRC Systems offers a diverse range of DAF systems tailored to accommodate varying flow rates and treatment needs.

Among these is the PWL-Series DAF system, designed to handle larger flow rates and provide high-efficiency water treatment for various applications. FRC's flexibility ensures a suitable system for every project requirement.

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