



Technical Article

## Dairy Crest improve wastewater treatment with Wehrle MBR Technology

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*In this article Tony Robinson, General Manager at Wehrle Environmental, describes the upgraded wastewater treatment system installed at Dairy Crest's Foston site, in Derbyshire, UK. He explains how, following the successful installation and operation of a Wehrle system at their Davidstow Creamery, Dairy Crest called in Wehrle to help manage the expansion of the site's wastewater treatment plant. Best available technology was utilised that enabled Dairy Crest to produce treated effluent of superior quality suitable for river discharge. Existing equipment was reused on site following extensive investigations by Wehrle's engineers. Designed, installed and operated by Wehrle, the upgraded system now incorporates advanced membrane bioreactor (MBR) technology with filtration of the biomass undertaken using crossflow ultrafiltration (UF) membranes, housed with the control system and motor control centre in a robust and pre-engineered ISO container.*

### **Upgrade at Foston**

Dairy Crest's dairy facility at Foston opened in 2002. The site had existing wastewater treatment equipment comprising DAF (dissolved air flotation) and BAFF (biologically aerated flooded filter) systems, with final discharge originally to a local sewer.

These facilities worked effectively but with a planned expansion of processing on site, Dairy Crest knew that additional wastewater treatment capacity would be required to make sure the highest quality effluent would be discharged from the site. Dairy Crest's objective was to make sure its environmental responsibilities were exceeded by utilising proven high quality, best available technology at the forefront of innovation.

Based on the successful installation of a Wehrle MBR system at Dairy Crest's Davidstow advanced cheese manufacturing plant (Cornwall, UK), Wehrle's extensive international expertise was called upon to evaluate requirements prior to expansion of

the wastewater treatment plant. Extensive investigations and pilot trials were undertaken at Foston over a three month period. The result was a recommendation from Wehrle's engineers to continue using the existing Balance Tank and DAF, but with the latter retained and re-optimised to treat the waste prior to entering a new crossflow MBR system.

*Figure 1  
Wehrle containerised installation*



Wehrle's system design now allows the direct discharge of the highly treated water to a local river. The specific site objective for the upgrade was to design for an initial increased plant capacity of 650 m<sup>3</sup>/d.

Proven as a best available technology in the dairy sector, the Wehrle crossflow MBR process offers a number of distinct advantages, including enhanced treatment performance. The system provides excellent and reliable final water quality, as well as a small footprint, minimal sludge yield and relatively low environmental impact.

At Foston, the UF filtration stage is supplied as a containerised, pre-assembled and tested plant, minimising site work associated with installation and commissioning. The UF plant incorporates robust tubular membranes with two UF 'loops', each loop being equipped with 6





membrane modules (see Figure 1). Membranes are currently fitted to three modules on each loop, providing for the possibility of 100% expansion of membrane treatment capacity in the future.

The additional organic load to be treated (due to increased flow of 650 m<sup>3</sup>/d) required the optimised and reliable operation of the existing preliminary DAF treatment stage. This was to ensure that total loading to the Wehrle MBR system did not exceed design limits.

*Figure 2 – Wehrle Wastewater Treatment System at Foston*



For additional process security, as is required for the potential upgrade of the plant capacity to 1000 m<sup>3</sup>/d in the future, it is intended that the BAFF tank is also upgraded, removing internal packing media and aeration system, to convert the tank to an additional bioreactor. At that stage, both bioreactors would feed the UF system, each loop then having all 6 membrane modules operational.

**Advanced Wehrle Technology**

Wastewater from the Dairy enters a new 200 m<sup>3</sup> Divert Tank if necessary before being directed to the existing Balance Tank. With a capacity of 400 m<sup>3</sup>, the Balance Tank provides an equalised flow with a hydraulic retention time of over 14 hours at maximum hydraulic throughput.

Equalised effluent from the Balance Tank is pumped through the existing DAF process. This was designed to treat 28 m<sup>3</sup>/h and provides enhanced flotation for removal of gross suspended solids and FOG (fats, oils and

greases). Wastewater next enters the new 650 m<sup>3</sup> Bioreactor (see Figure 2), operating at an activated sludge concentration of typically 15,000 mg/l. The whole process is depicted in Figure 3.

The MBR system is designed to treat an influent flow as specified in Table 1. Activated sludge from the Bioreactor is pumped through a header system feeding two identical membrane loops each containing tubular UF membranes housed in modules, arranged in parallel.

Cross-flow tubular membranes are used, the activated sludge being pumped along the membrane surface at high velocity, with a proportion recycled back through the feed pump and the remainder diverted back to the header system for return to the Bioreactor. The high flow velocity ensures adequate turbulence which minimises membrane fouling, which is the main advantage of using a tubular cross flow membrane system. Wehrle's extensive experience on a number of dairy projects around the world enabled them to select the optimum membranes for this application, maximising flux rate and hence minimising the membrane area required.

*Figure 3 – Wehrle Process Flow Diagram*



A proportion of the activated sludge is filtered through the membrane wall, which provides an absolute barrier to form solids-free MBR permeate. The amount of permeate produced is a function of the system pressure and activated sludge flow velocity. The MBR system typically operates at an extremely high level of flux rate (permeate flow rate per unit membrane area), in excess of 170 l/m<sup>2</sup>h, producing treated waste water suitable for direct river discharge (see Table 2). Additional





membranes modules can easily be added in the future to increase MBR capacity by up to 100%.

Advanced monitoring instruments constantly measure temperature, pH, total organic carbon, turbidity and ammonia parameters in the treated effluent (see Figure 3) to confirm the river discharge consent is being met. The upgraded system is automated using programmable logic control (PLC) and interfaced via the installed *In Touch* SCADA system. PLC units monitor the discharge parameters and if the effluent is out of specification, fail-safe controls are used to divert the flow back to the inlet of the system.

Table 1 - Wehrle MBR Plant Design Data

Maximum Hydraulic Flow (m <sup>3</sup> /d)	650
COD Load (kg COD/d)	1950
COD/BOD <sub>5</sub> ratio	< 2
Ammonia concentration (mg/l)	< 20
C/N/P ratio in feed wastewater	100/5/1
COD reduction BOD <sub>5</sub> reduction	95 % 99 %

The control system, motor control centre and the UF membrane system are all installed in a standard container. This allowed pre-installation and testing at Wehrle's fabrication facility prior to delivery to site, thus reducing on-site time and minimising the commissioning period.

All aspects of plant monitoring and control can be accessed via the PC-based *In Touch* system. Pressures, flows and process parameters are measured at strategic points within the process and fed back to the PLC which automatically controls all aspects of normal process operation, and provides warning alarms to Wehrle site operator as required. Wehrle operate the system on behalf of Dairy Crest as part of a comprehensive service agreement.

Table 2 - Final Quality from MBR System

BOD <sub>5</sub> (mg/l)	< 10
TSS (mg/l)	< 5
Iron (mg/l)	< 5
Ammonia NH <sub>4</sub> -N (mg/l)	< 2
pH	6 - 9

### Conclusions

The upgraded wastewater treatment system at Dairy Crest's Foston plant is a versatile advanced solution able to deal with shock-loadings and produce a high quality effluent that consistently exceeds the quality required for river discharge. The inclusion of Wehrle MBR technology has provided increased treatment capacity with improved treatment plant performance and operational flexibility. Wehrle's ability to engineer a process solution that utilised existing equipment whilst meeting present and future requirements has been implemented with the main membrane component installed in a standard container allowing a significant amount of installation and commissioning works to be undertaken prior to delivery to site. Operation of the system is handled by Wehrle on behalf of Dairy Crest.

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