



Wehrle Environmental UK

Landfill Leachate Treatment Case Study:
Cleanaway, Ockendon, UK

**UK first from Cleanaway using Wehrle MBR
leachate treatment technology**



In this case study we describe the new leachate treatment plant at Cleanaway's Ockendon landfill site. Commissioned in Summer 2006, the system comprises an advanced membrane bioreactor (MBR) leachate treatment system incorporating Wehrle Environmental's cross-flow ultrafiltration (UF) membrane technology. We describe Cleanaway's project requirements, outline the effectiveness of MBR technology and report on Cleanaway's experience of the plant to date.



Figure 1
Cleanaway's Ockendon landfill site



Figure 2
Containerised Wehrle membrane system

Cleanaway Project Requirements

Landfill leachate typically has high ammonia, COD and chloride concentrations, which result in specific challenges for MBR technology. Biological treatment comprising nitrification is required to reduce the ammonia, and high quality materials are required to withstand the corrosive conditions resulting from the presence of chlorides.

In 2003, Cleanaway decided to investigate treatment options available to reduce ammonia concentrations in the leachate discharged from Ockendon landfill site (see Figure 1) to sewer and subsequently treated at the local water company's wastewater treatment works. In order to meet stringent Environment Agency consents for release of ammonia from treatment systems, the local water company had to restrict the concentration of ammonia they could receive into their sewer system. This resulted in them setting a limit of 100 kg/day ammonia loading in the effluent from the Ockendon site.

Based on an average leachate production of 135 m³/day, the ammonia loading restriction imposed by the water company equated to an average permissible concentration of 750 mg/l. As ammonia concentrations were known to fluctuate up to 1100 mg/l in the leachate from Ockendon it was not possible for Cleanaway to send all their leachate for remote treatment.

To resolve this problem, Cleanaway began discussions with a number of effluent treatment contractors, and Wehrle Environmental were selected as one of two companies to undertake pilot trials to determine the treatment process required.

Using one of their advanced pilot test systems, Wehrle Environmental undertook a detailed investigation of the flow variations and composition of the leachate. After running pilot trials with various membrane types (from a range of suppliers) and configurations at Ockendon, they concluded that the most cost-effective solution was to treat the leachate using MBR technology incorporating a specific ultrafiltration (UF) membrane selected to facilitate removal of COD and ammonia. During the three-month evaluation, Wehrle Environmental were also able to make a detailed assessment of specific site

conditions, which included a restricted footprint and a 3 m height constraint.

Based on their pilot evaluation, Wehrle Environmental were able to propose a cost-effective and efficient membrane solution that would allow Cleanaway to reduce significantly the ammonia loading of the leachate to well below the 100 kg/day consent. The order for the system was awarded to Wehrle Environmental in early 2006, and the plant officially opened in October 2006.

The leachate treatment system now installed at Cleanaway's Ockendon site is the first of its kind to be operational in the UK. To meet space constraints, the membrane component of the system was supplied fully assembled and pre-tested in an adapted 40' ISO container (see Figure 2). Special concrete tanks were provided to meet strict Environment Agency requirements and the Biological Treatment Tank was constructed with 70% of the capacity below ground level in order to meet planning height restrictions. Roofs have been installed on the tanks to reduce heat loss and to deflect any worries the neighbouring residents may have had about odours (although the process is essentially odour-free).

MBR Process

Alternative approaches to COD and ammonia reduction include treatment by conventional activated sludge (CAS) technology, comprising an aeration reactor with separate clarifier. Activated sludge generated in the aeration reactor is settled in the clarifier, a proportion is then wasted with the rest recycled to the inlet of the process to mix with incoming feed. In contrast to CAS, no clarifiers are required in MBR systems as separation of activated sludge takes place using cross-flow UF membranes.

Figure 3 shows the elements of the MBR system at Ockendon. The plant is designed to treat up to 200 m³/day of leachate, which is in excess of the current average production of 135 m³/day in order to treat the backlog of leachate and to provide for possible future expansion of the process. The plant receives three separate raw leachate streams (from both the operational and the closed landfills) with a typical COD loading of 525 kg/day and an ammonia concentration of 1100 mg/l.

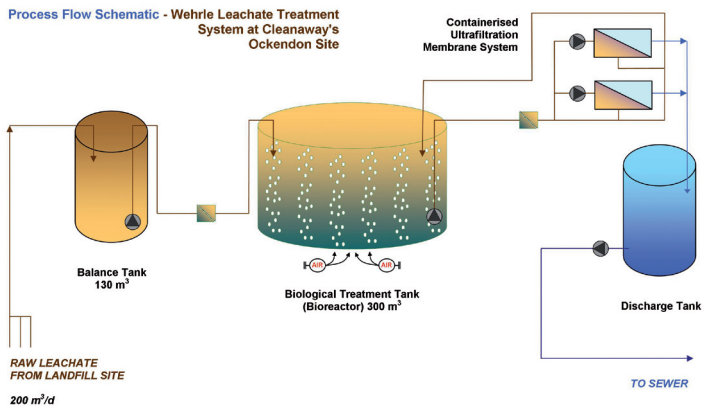


Figure 3
Schematic of Wehrle MBR System at Ockendon



Figure 4
Biological Treatment Tank



Figure 5
UF Membrane System

The combined flow is then pumped to the 130 m³ Balance Tank before being transferred through 800 µm stainless steel basket strainers to the Biological Treatment Tank. The liquid enters the 300 m³ Biological Treatment Tank (see Figure 4), the bioreactor, over the top of the tank wall before being pumped through the UF membrane system and returned to the tank to be blended with more raw leachate. A small amount of activated sludge is removed from the Biological Treatment Tank and blended with the permeate from the UF before being discharged through the existing sewer connection.

The biological process was designed by Wehrle Environmental to facilitate nitrification (the breakdown of ammonia into nitrate and nitrite in the presence of oxygen) and reduce the ammonia loading in the sewer discharge to less than 100 kg/day. Caustic is dosed into the Biological Treatment Tank to control the continuously monitored pH and optimise nitrification efficiency, and phosphoric acid is added to maintain the C:N:P ratio at the desired 100:5:1 level. Foaming is reduced by dosing with a specialist anti-foam chemical.

Oxygen required for the biological process is provided by two blowers which supply air to aerators installed inside the Biological Treatment Tank. A jet pump is used to circulate the activated sludge through the aerators. The use of the aerator ejector system ensures complete mixing of the Biological Treatment Tank contents. The dissolved oxygen in the sludge is continuously monitored and automatic adjustments are made to the oxygen feed in order to maintain optimum conditions for the sludge and also to minimise power consumption.

A biomass concentration in excess of four times the value of typical CAS plant is reached in the Biological Treatment Tank, with activated sludge concentrations typically in the range 16 to 20 g/l, resulting in a compact system.

Separation of activated sludge is undertaken within a highly efficient UF system that guarantees complete retention of solids larger than 0.02 µm. Recirculated activated sludge enters a stainless steel header system feeding two identical membrane loops within the container (see Figure 5) each

comprising a dedicated stainless steel recirculation pump and two modules, arranged in parallel. Each loop also has two dummy UF modules allowing for expansion at a later date if required. Each UF module contains in excess of 350 UF membrane tubes. Stainless steel is used to resist corrosion from the high chloride in the concentrated activated sludge.

Cross-flow tubular membranes were selected by Wehrle as the most effective solution, the activated sludge being pumped along the membrane surface at high velocity. This high flow velocity ensures adequate turbulence thereby minimising membrane fouling and enhancing cleaning efficiency.

The mixed liquor is filtered through the membrane wall, which provides an absolute barrier, producing an MBR permeate, free from bacteria, solids and pathogens. The amount of permeate produced is a function of the system pressure and activated sludge flow velocity.

The UF membrane modules are flushed automatically on a weekly basis using permeate collected in the Washing Tank. Chemical cleaning using acid and caustic based solutions will be undertaken on a quarterly basis.

The MBR system is automated using programmable logic control (PLC) and Wonderware user interface software (see Figure 6). All aspects of plant monitoring and control are accessed via the operator panel or, via telecom links, at remote computers throughout Cleanaway. Pressures, flows and process parameters are measured at strategic points within the process and transmitted back to the PLC which automatically controls all aspects of normal process operation, and provides warning alarms to plant operators as required.

System Start-Up

The biological process was 'seeded' using activated sludge from an SBR (Sequenced Batch Reactor) system and since commissioning the process has comfortably exceeded the permeate water quality required.

Cleanaway selected Wehrle to undertake this project as they had

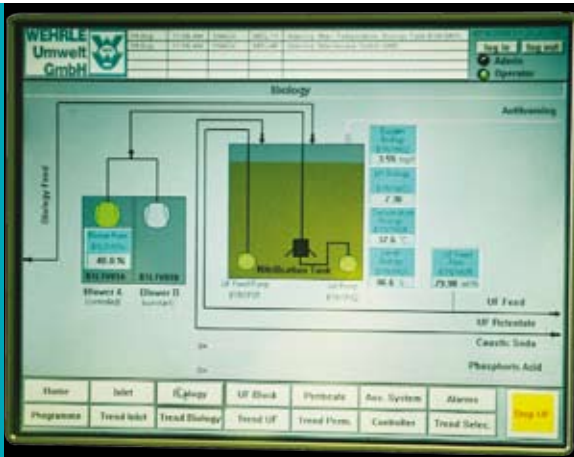


Figure 6
Wonderware plant control system user interface

“We were keen to install a system with low maintenance requirements”

Stephan Hoffmann, Cleanaway

demonstrable expertise in landfill leachate treatment at numerous installations around the world, because Cleanaway were convinced that the technology would operate effectively (following the successful outcome of the pilot trials), and due to Wehrle’s professional and friendly approach.

Because Wehrle Environmental had undertaken detailed site investigations and pilot studies they were also able to design the process to meet the site conditions. Stephan Hoffmann, the Cleanaway Project Manager, said “The limited space available on site and our 3 m height restriction were no problem for Wehrle.”

Stephan also commented that Wehrle Environmental’s engineered solution represented excellent value for money for Cleanaway and he was impressed with the fully automated and safe control system. He added “We were keen to install a system with low maintenance requirements, and with components resistant to the high chloride levels we have in the raw leachate.”

Wehrle Environmental provide a comprehensive after sales service including process chemicals and spare parts as required, as well as ongoing process optimisation services.

Conclusions

The first leachate treatment system of its kind in the UK relies upon Wehrle Environmental MBR expertise to provide a cost-effective solution for Cleanaway’s Ockendon landfill site. Wehrle Environmental’s ability to engineer a process solution has been implemented within the tight space constraints available on site. With the market for leachate treatment increasing due to tightening ammonia consents, the growth in the application of MBR technology is predicted to be high over the next few years. Wehrle Environmental’s global expertise and proven track record in leachate treatment will help other landfill sites meet their environmental responsibilities.

Further Information

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