



Wehrle Environmental UK

Landfill Leachate Treatment Case Study: SITA's Beacon Hill Landfill Site, Dorset, UK

Improved Treatment of Landfill Leachate using MBR combined with NF Technology



In this case study we describe the treatment system installed at Beacon Hill (near Poole, Dorset), the first landfill site in the UK to combine membrane bioreactor (MBR) leachate treatment with nanofiltration (NF). We outline the potential problems encountered with treating landfill leachate, a difficult waste, and describe the benefits derived from using MBR technology for treatment.

Effluent treatment requirements in the landfill sector are site specific; high quality treatment processes are required at Beacon Hill. We describe the Wehrle treatment system designed for this site, which is compact, low maintenance and can be readily relocated to ensure a consistent final effluent which readily meets the required discharge consents.



Figure 1
Beacon Hill landfill site leachate treatment plant

Technological challenges of landfill leachate treatment

Landfill sites in the UK fall under regulatory control under the PPC Regulations (2000). Leachate treatment at landfill sites must be compliant with “best available technology” (BAT) to meet the standards of IPPC. Membrane bioreactor (MBR) systems are becoming the technology of choice for many effluent treatment problems and are considered BAT across a range of industrial sectors, including landfill. Wehrle MBR technology meets BAT criteria.

The treatment of landfill leachate poses specific challenges for MBR technology. The leachate is typically high in COD and ammonia, requiring a biological treatment that extensively reduces COD and nitrifies the ammonia to oxidised nitrogen species (nitrate and nitrite). Furthermore, the membrane system must be robust enough to withstand the corrosive, chloride-rich leachate (see Table 1). MBR remains the only feasible membrane technology for the treatment of this difficult waste, offering a space-efficient treatment option where an appropriate aeration step is followed by particle removal in an Ultrafiltration (UF) system achieved by a physical membrane barrier.

Table 1
Typical process data for raw and treated effluent at Beacon Hill

Parameter (mg/l)	Raw leachate	MBR effluent	NF permeate
COD	5000	1200	<100
BOD	250	<10	<10
Ammonia	2000	<2	<1
Total P	15	<5	<1.5
Total Suspended Solids	250	<50	<25
Sulphate	200	200	<10
Chloride	1400	1200	1200

Client requirements at Beacon Hill landfill site

The specific leachate quality requirements to meet PPC and other licence conditions are site specific. SITA manage a large number of sites in the UK, and work with leading technology companies such as Wehrle to achieve a progressive approach for the recycling and waste management industry. SITA are committed to best environmental practice and operate under a comprehensive ISO 14001 environmental management system. SITA has adopted its own internal quality environmental monitoring system (QEMS).

At SITA's Beacon Hill site, strict licence conditions (625 mg/l COD) have been set, whilst SITA's QEMS demands that higher standards of treatment are achieved than these minimum regulatory requirements. SITA chose to use Wehrle as principal contractor at Beacon Hill.

Wehrle designed and constructed a compact, mobile process solution to ensure a sustainable effluent production. Located within a future landfill void space, the treatment system will need to be relocated in future (Figure 1). COD and ammonia in the leachate is significantly reduced using three biological nitrification reactors in series. Solids are removed by cross-flow UF, with a subsequent NF treatment system polishing the effluent for COD and solids.



*Figure 2
COD and ammonia is treated in three bioreactor tanks*



*Figure 3
UF takes place in the 40' ISO container, followed by NF*

The treatment process at Beacon Hill

The Wehrle system installed at Beacon Hill receives an average of 60 m³/day of leachate at a balance tank, allowing three days storage. Leachate is pumped to three 40 m³ biological tanks in series, passing through 800 µm stainless steel basket strainers (Figure 2).

Optimal biological nitrification is ensured in the bioreactor tanks by means of continuous pH control using caustic dosing, and the maintenance of a 100:5:1 C:N:P ratio through phosphoric acid addition. Initial seeding of the biological system used activated sludge from a MBR landfill treatment system in Germany. Aeration in each bioreactor operates at a relatively high biomass concentration (16-20 g/l). Continuous dissolved oxygen monitoring enables automated adjustment of the oxygen feed to maintain treatment whilst minimising power consumption.

Aerated effluent is transferred to the UF system. This fully pre-assembled and pre-tested system is housed in a 40' ISO container (Figure 3). A dedicated stainless steel pump effects transfer through three cross-flow tubular membrane modules arranged in series. Each module contains in excess of 350 UF membrane tubes to act as a physical barrier to solids and pathogens sized >0.02 µm.

To polish the MBR effluent in order to meet the stringent requirements set at this site, NF technology is used. The effluent feed is pressurised prior to its transfer to two spirally wound NF membrane units arranged in parallel. NF reduces divalent ion concentrations (including calcium, magnesium and sulphate), and removes residual organic substances and ultra-fine solids to reduce COD. The permeate is discharged to sewer; this still contains most of the monovalent salts and thus avoids harmful salt build-up on-site (see Table 1).

At Beacon Hill, the treatment systems are controlled using a PLC with HMI display. Telemetry allows interrogation of the PLC and operation of the automated control system. Continuous pressure, flow and process data inform the PLC for a fully automated process. Membranes undergo weekly flushing with permeate to maintain performance. There is a quarterly chemical cleaning schedule for the membranes using caustic and acid reagents; the small quantity of these reagents used permits their recycling to the on-site balancing tank.



“The attention to detail was impressive. The quality of final effluent produced is well above the level required”

Adam Bentham, SITA UK

Conclusions

MBR is already in use for landfill leachate treatment across the UK. At SITA's Beacon Hill site, the first use of MBR with NF technology has been commissioned using Wehrle technology. This has significantly improved effluent quality and now enables the operators to achieve an effluent discharged to sewer that reliably and readily meets strict licence conditions at this site.

The robust system treats this difficult and corrosive waste, producing a final effluent typically <100 mg/l COD, <25 mg/l solids and <1 mg/l ammonia. Utilising telemetry for monitoring and process control, this fully automated treatment system offers a viable, low maintenance and cost effective solution to landfill leachate waste treatment. The system design is space efficient and can be readily relocated when necessary.

By coupling NF with MBR, leachate is treated to a superior quality for COD and solids; the final effluent is of high enough quality to be reused on site should an application benefit from this. High chloride levels in the raw effluent predominantly pass through the process for sewer disposal, eliminating the possibility of salinity build-up on-site through recirculation of the NF return flow.

Contact Details

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