

GRAL 2009: Landfill

Leachate Treatment

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The UK approach to leachate management has for many years been based on:

- Applied and experimental research data
- Site-specific risk assessment
- Best Practical Environmental Option
- BATNEEC
- Principles of Sustainability



Nitrification



Consumption of alkalinity is 7.14 mg as CaCO₃ / mg N

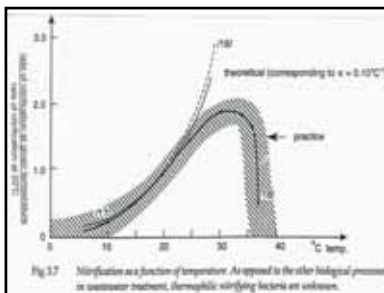


Fig. 1.7 Nitrification as a function of temperature. As opposed to the other biological processes in wastewater treatment, thermophilic nitrifying bacteria are unknown.

Denitrification



Release of alkalinity is 3.57 mg as CaCO₃ / mg N

The Sequencing Batch Reactor (SBR)

- Very important to avoid the toxicity of high concentrations of ammonia in leachates.
- Provides very stable and reliable treatment.





- Reed Bed Treatment Systems**
- Advantages
 - Environmentally Friendly !
 - Excellent for Secondary treatment (small land area needed)
 - Very low running costs
 - Developing body of experience
 - Disadvantages
 - Poor for undiluted leachate (or large land area needed)
 - Poor track record for ammonia removal







Arpley Landfill Site

- 130 hectares, west of Warrington
- Between River Mersey and Manchester Ship Canal
- >10 million tonnes of domestic, commercial and industrial wastes deposited since opened in 1988
- Operated by Cheshire County Council (3c Waste)
- Acquired by Waste Recycling Group in Spring 1999



Leachate Control at Arpley

- 3 Phases: Birchwood, Lapwing and Walton
- Increasing degrees of containment
- When acquired by WRG, leachate not under control
- No adequate leachate extraction infrastructure
- Leachate heads up to 8m above compliant levels



Initial data for leachate strength in phases at Arpley, chloride and ammoniacal-N (in mg/l)

Landfill Phase	chloride		ammoniacal-N	
	Mean	Maximum	Mean	Maximum
Birchwood	641	2560	274	848
Lapwing	2816	12700	1048	3380
Walton	3522	5500	1695	3910



Plant Design

- Maximum treatment rate 450m³/d
- Roofed and bunded raw leachate balance tanks
- 3 Large sequencing batch reactor (SBR) tanks, with automated pH control, and nutrient dosing
- Effluent balance tank
- Dissolved Air Flotation (DAF) system
- Final polishing in reed beds



Plant Performance

Determinand	Leachate	Effluent
COD	4730 – 5990	1010
BOD ₅	537 – 688	<1
ammoniacal-N	1240 - 1460	1.5

toxicity: no detectable effluent toxicity to monthly Microtox® tests

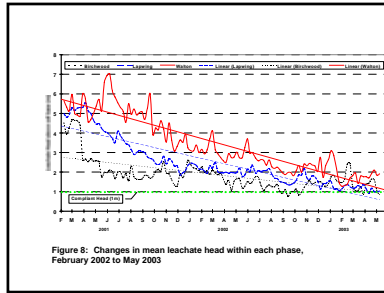
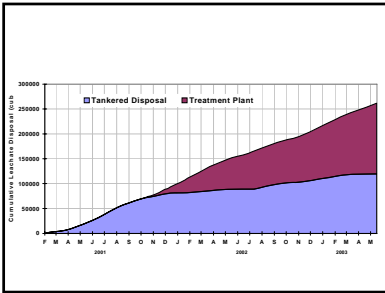


Figure 8: Changes in mean leachate head within each phase, February 2002 to May 2003

- Arpley**
- LTP commissioned Autumn 2001
 - Treating typically 400m³ of leachate each day
 - Safe effluent discharge to the River Mersey
 - Large impact on leachate levels
 - Leachate heads in compliance April 2004

- Buckden South Landfill Site**
- SE England, 400m from River Great Ouse
 - Domestic and industrial wastes to 1994
 - Taken over by WRG in 1994
 - Extensive remedial works needed, including management of high levels of leachate, containing pesticides



- Leachate Management Needs**
- To reduce high leachate levels
 - High concentrations of pesticides eg Mecoprop and Isoproturon
 - River Great Ouse the only practical discharge route for treated leachate
 - Very tight effluent standards required (requirement that Rainbow Trout have 96 hour LC50 > 50 percent effluent)



Treatability Trials carried out from April to July 1994

- Treatment Process:**
- SBR biological treatment
 - Reed bed polishing (2000m²)
 - Ozonation
 - Final reed bed (500m²)
 - Fully automated process
 - Treatment of 200m³ per day
 - Treatment plant commissioned – Dec 1994





Buckden

- Most advanced leachate plant in the UK
- Operated for more than ten years
- Toxicity-based consent never exceeded
- SBR proved robust, reliable and readily automated
- Ozonation effective, but site- specific



Efford Landfill Site

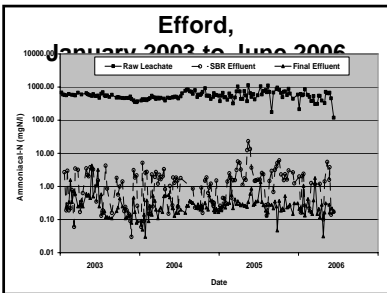
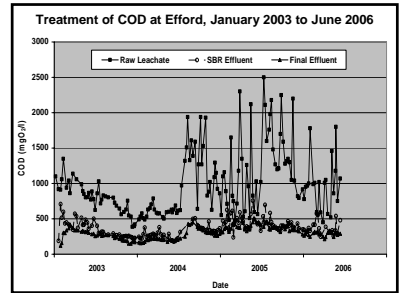
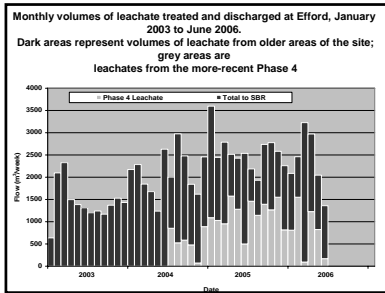
- Hampshire County Council
- Site Operated by Onyx Ltd, on behalf of HCC
- Very important nature conservation issues, at neighbouring Pennington Marshes
- Ecological assessments
- Extensive site engineering/remedial works, including perimeter clay cutoff wall
- Innovative hydraulic engineering



Efford Leachate Treatment

- Assessment of leachate volumes
- SBR and Reed Bed, 150m³/d capacity
- Traditional consultancy contract
- Effluent outlet to small, rural STW
- SBR plus reed bed process
- Plant Commissioned in autumn 2002.





- Leachate Treatment in South Africa*
- Enviro involved since 1992
 - Cost-effectiveness paramount
 - Water resources scarce
 - Appropriate technology needed for operators
 - Landfill standards high at largest sites
 - Rapidly advancing regulatory control
 - "Minimum Standards" document

Vissershok Landfill, Cape Town

- Long-established site
- 750,000 tpa municipal & industrial wastes
- Inputs include low-medium hazardous wastes
- Need to use effluent for dust suppression on roads, to replace existing use of potable water

Vissershok Leachate

- Very strong and methanogenic
- Up to 80 m³/d produced
- ~20% from hazardous waste cell
- COD values 4000-9000 mg/l
- Ammoniacal-N 1500-2000 mg/l



Typical Performance

	<u>leachate</u>	<u>effluent</u>
COD	8930	680
BOD ₅	588	20
ammonia-N	1517	2.3
solids	-	21
<u>mg/l</u>		

Mariannhill Landfill, Durban, KwaZulu Natal

- New landfill developed by eThekweni Municipality
- Opened in July 1997, life 25 years
- 250,000 tpa of household & commercial wastes
- Became a nature reserve in September 2002
- Plant Rescue Unit (PRUNIT) Nursery
- Very high standards indeed in housing area

Mariannhill Landfill

“Nothing short of a valley of environmental treasures, and engineering ingenuity”

Resource Magazine, South Africa, Feb 2004

Mariannhill Leachate

- 30-40 m³/d (more after tropical storms)
- COD typically 2000-3000 mg/l
- ammoniacal-N typically 400-500 mg/l
- surface water discharge required



From rubbish dump to nature reserve
 Site gives regular educational visits to schools

When a rubbish dump is closed to beautify the area, it is not a simple task. It is a complex process that involves the removal of the waste, the treatment of the leachate, and the restoration of the site. The Mariannhill Landfill in Durban is a prime example of this process. The site was closed in 2002 and has since been transformed into a nature reserve. The site is now a beautiful area with a variety of plants and animals. It is a great place for educational visits to schools.







In some situations, we lose our perspectives

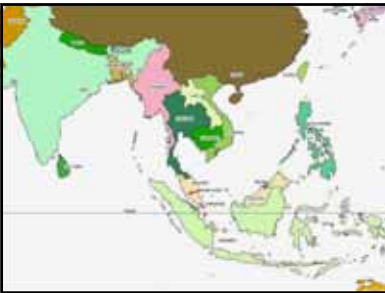


Leachate Treatment Plants in Tropical Climates

Although a key feature of biological treatment of leachate in temperate climates such as the UK is maintaining temperatures to achieve optimum treatment rates during all seasons, in tropical climates, the opposite problem may be faced.

Bacteria which nitrify ammoniacal-N to nitrate are seriously inhibited once temperatures approach 40 degrees Celsius.

Tropical rainfall is typically intense and seasonal, and provision must be made for significant flow balancing, as all leachate cannot be treated as it is generated.



Bukit Tagar Landfill, Malaysia

- 40km north of Kuala Lumpur,
- 140 million m³ capacity, most advanced landfill in Malaysia, 280 hectares with 400 hectare buffer,
- Site developed by private company KBE, under a 40-year Government concession,
- 6 metres of rain per annum,
- Advance cell of 1M m³ developed rapidly in 2005,
- Treatment plant commissioned in April 2006





Taman Beringin Landfill Site.

- Taman Beringin is a recently-closed 20Mm³ capacity landfill site, operated for 15 years less than 2km from the centre of the city of Kuala Lumpur.
- Wastes are more than 80m deep, and leachate was causing gross pollution of an adjacent watercourse.
- Housing, including blocks of flats, has been constructed to the very edge of the landfill site.
- Two previous leachate treatment plants had been constructed within the previous 10 years, and had been unsuccessful and abandoned .





Treatment Process Selected:

Treatment was designed to allow discharge of very high quality effluent into the adjacent watercourse, the Sungai Jinjang. A limit of 100mg/l of COD was a very challenging requirement.

The processes selected include;

- SBR treatment in a very large aerated tank.
- Dissolved Air Flotation (DAF) for solids removal.
- Final polishing using Granular Activated Carbon.





Motivated plant operators are a critical aspect



Technologies for Leachate Treatment

*The minimum acceptable standard
is complete compliance with a
specific discharge consent*

*Well-established and tested
techniques are available to provide
reliable and consistent treatment of
landfill leachates*

*There are no technical obstacles to
the treatment of landfill leachate to
extremely high standards*



**GOOD WORK, BUT I THINK WE
MIGHT NEED JUST A LITTLE
MORE DETAIL RIGHT HERE**