A number of today’s speakers have recently been experiencing signs of ageing.

However, they all continue to be extremely busy with work associated with the management of leachates from landfill sites.

Possibly surprisingly to some, this work looks likely to continue until long after we are all retired………

“A landfill is not just for Christmas etc.”

Most people now acknowledge that aftercare periods for landfill sites which we close today, will be measured in decades at the very least, and are very likely to extend into centuries.

Long after the last cubic metre of useable landfill gas has been used, leachate will continue to be generated, as decomposition products keep being leached out of the wastes.

That leachate will need to be managed and disposed of safely, back into the environment.
Costs of tanker transport, or of disposal into the public sewer system, are almost certain to rise much faster than general inflation, and so on-site treatment to surface water discharge standards will become increasingly attractive and competitive: especially in later stages of aftercare.
APPLICATIONS FOR REED BEDS:
Polishing of pre-treated leachates?
Treatment of raw leachates?

CAPACITY TO TREAT CONTAMINANTS:
Removal of dissolved methane?
Removal of suspended solids and iron?
Removal of BOD/COD?
Removal of dissolved methane?
Removal of ammoniacal-N?
Other contaminants?
Other issues??
Dissolved methane in leachates

- Methane is twice as soluble as oxygen,
- Typically, 25mg/l can dissolve in water,
- Landfill gases contain about 60% methane by volume, so 60% of this value is typically found dissolved in leachates, that is, 15mg/l.
  (law of partial pressures)

Shirley Landfill,
West Midlands.

Removal of dissolved methane
Shirley Landfill Statistics

- Area 15 hectares.
- Depth from 3 to 12m (mean 8m).
- Leachate flow 24 to 78m$^3$/d, mean 50m$^3$/d, (based on 4 years’ data).
- ammoniacal-N from 10 to 20mg/l.
- Dissolved methane up to 2mg/l.
- Consent, less than 0.14mg/l methane.

Reed bed design

- 50m long x 7m wide x 0.6m gravel depth.
- New leachate pumping chamber, d/s,
- Pre-cast concrete header tank, 5m$^3$, to encourage retention of iron precipitate.
- Hydraulic volume of 84m$^3$,
- Gives HRT of 1 to 3 days at design flow,
- Simple SCADA system,
- Effluent to sewer,
- Reed bed system commissioned mid 2013.
Simple SCADA system

Record rainfall levels in January to April 2014

Record leachate flows in January to April 2014.
Conclusions

- Reed bed performed well for complete methane removal, within design limits,
- Extreme weather (flows were > double maximum design values, and methane concentrations also reached double the design values used).
- This caused some breakthrough of methane at highest loading rates, but
- Removal rates were typically up to 0.6 to 0.7g methane per m³ bed per day – not apparently affected by season.
Shirley Reed Bed:
Typical removal rates

ammoniacal-N:
• SUMMER: 0.9 to 1.0 gN/m².day
• WINTER: 0.4 to 0.5 gN/m².day

Methane:
• 100% removal of dissolved methane, winter and summer, at loading rates up to 0.4 or 0.5 gCH₄/m².day

Efford Landfill, Hampshire.
Polishing of biologically pre-treated leachate
Small Dole Landfill, West Sussex.

Polishing of biologically pre-treated leachate
Monument Hill Landfill, Wiltshire.

Removal of suspended solids and iron from raw leachate
Detail of Great Escape “Tunnel Harry”.
(from Brickhill, 1950)
Routine desludging of iron precipitation from header tank

Reed bed performance: Passage of chloride through the bed

Reed bed performance: Solids removal.
Reed bed performance: Removal of iron.

Monument Hill Reed Bed:
Typical removal rates for ammoniacal-N

- **SUMMER**: 0.65 to 1.35 gN/m².day
- **WINTER**: 0.55 to 1.10 gN/m².day

Reed Bed refurbishment 2010

Excavation of gravel for cleaning
Gravel removed

Replacement of cleaned gravel

Re-levelling of replaced gravel

Re-planting of reeds

Conclusions (1)

- Well-designed reed bed treatment systems are simple, elegant, and effective in treatment of leachates from closed landfill sites,
- They are ideal to provide final polishing of biologically treated leachates, before surface water discharges, and will benefit from biological effluent typically being at >20°C all year.
- For direct treatment of raw leachates, to achieve complete and year-round removal of ammoniacal-N from influent concentrations of greater than 10mg/l, will require careful design, and will probably require vertical flow systems.

Conclusions (2)

- 100% removal of dissolved methane, winter and summer, at loading rates up to 0.4 or 0.5g methane/m².day in horizontal flow systems,
- Summer removal rates for ammoniacal-N of between 0.65 and 1.35 g NH₄-N/m².day,
- Winter removal rates for ammoniacal-N of between 0.4 and 1.10 g NH₄-N/m².day,
- For stronger BOD leachates, dissolved oxygen inputs can readily become the limiting factor,
- Designs must be conservative, in order to ensure that treatment achieves limits 100% of the time, even though flows may vary widely.
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Thank you for listening!