Environment Agency

# Evidence

## A technical assessment of leachate recirculation

### Project summary SC030144/S6

This report from the Environment Agency is a technical review of leachate recirculation, which in part investigates how this could be used to improve the sustainability of landfill by accelerating gas production and flushing contaminants from the waste.

Leachate arises from infiltration of water into the landfill and from liquids already present in the waste. Leachate from landfills accepting non inert waste will contain a range of contaminants. If uncontrolled such leachate could cause water pollution.

Leachate may be collected from the waste using wells or drains. It can then be disposed of following treatment or reintroduced into the waste material through an artificial recharge system. This latter process is known as leachate recirculation. In this review, the definition was expanded to include the introduction of any liquids into a landfill.

Leachate recirculation mainly occurs through the unsaturated zone. Unsaturated flow will occur until leachate reaches the water table of a saturated zone either at the base of the site or within a perched horizon within the body of the waste. The main effects of leachate recirculation is to increase the amount of water held by the waste, either as freely draining liquid or as absorbed moisture, and to facilitate the movement of nutrients and biological waste products within the landfill. This may then affect physical, chemical and biological processes within the waste mass.

The programme of work comprised a review of current UK practice and the development of a conceptual framework identifying the key technical, environmental and operational (including monitoring) issues associated with leachate recirculation.

Leachate recirculation within landfills has been in widespread use since the 1970s for a range of different purposes.

The review of UK operators involved six of the major UK waste management companies, and an overview of activities at approximately 90 landfills was provided. The most common objectives for undertaking leachate recirculation were:

- seasonal flow balancing of leachate;
- stimulation of degradation to optimise rates of gas generation and utilisation.

A wide range of different leachate recirculation systems has been used, on varying scales and with varying degrees of success. Typical systems include:

- low pressure surface application;
- systems immediately below top liner;
- horizontal linear structures at depth within wastes;
- subsurface pads of drainage material;
- subsurface band drains;
- vertical wells;
- deep vertical trenches.

To help put the UK's experience into context, information on a number of large-scale and well-instrumented recirculation schemes in other countries was considered.

The report makes a number of observations on operational issues associated with leachate recirculation schemes. In summary these are:

- Infrastructure design – a wide range of performances were reported, with application rates from 1 to 30 $m^3$ per hectare per day. Some systems have accommodated very large volumes but it is unclear how long these could be sustained in the long term. The lateral zone of influence of systems was limited to approximately 5 to 15 m, typically <10 m.
- Clogging of injection infrastructure – there is little quantitative information on this problem, but clogging of injection infrastructure over a period of just a few weeks appears common when the injected leachate is from recently deposited waste.

- Flooding of gas wells – localised flooding of nearby gas wells was identified as a common occurrence during recirculation.
- Effects of settlement – many operators reported problems with failure of pipework in horizontal pipes and radials, attributed to settlement.
- Clogging of basal drainage layer – no evidence was found of this resulting from recirculation.
- Obtaining sufficient volumes to recirculate – on many sites the amount of leachate recirculated was insufficient to stimulate gas generation.
- Slope instability – no instances were reported that were directly attributed to recirculation, but this clearly remains a potential risk.

The report makes a number of observations on environmental issues associated with leachate recirculation schemes. The main issues are:

- Odours, gas release and the potential for air ingress – the schemes that seemed to produce odour problems were those where the surface of the liquid was exposed directly to atmosphere.
- Perching/surface outbreaks – these were commonly observed and may occur due to lateral movement along layers of daily cover, or by sub-cap systems being constructed to a fall instead of horizontal.
- Adverse impact on leachate quality – no evidence was found that leachate concentrations are increased by recirculation.
- Increased head on liner systems – no evidence was found that leachate recirculation increases the head on liner systems.

The report makes proposals for possible monitoring requirements. The exact requirements and frequency of monitoring will depend on the site, objectives and scale of the scheme and needs to remain proportionate and necessary. The range of monitoring needed to address the operational and environmental issues above may be separated into four functional groups. These are:

- operational performance;
- waste decomposition and leachate quality;
- water balance and volumetric;
- environmental risk.

The report recommends that greater attention should be paid to the conceptual design to meet the objectives of recirculation and to monitoring the operation.

The review has developed an overall evaluation framework, a checklist for evaluating schemes and initial suggestions for the monitoring that may be appropriate. The general checklist is:

- Objectives of scheme – Are the objectives of the proposed scheme clear? Are there multiple objectives or a single objective?
- Conceptual process description – Has a conceptual process description been prepared? Is the conceptual process description adequate for the stated objective?
- Physical infrastructure – Adequate description of proposed infrastructure? Does the proposed infrastructure match the objectives and conceptual process design?
- Operational procedures – Adequate description of proposed operational procedures?
- Environmental risks – Has a risk register been prepared? Have the potential risks been adequately identified and addressed?
- Minimum scope of risk register: Odours and uncontrolled gas release during construction and operation; control of head on liner; surface outbreaks from waste body; leaks from transfer pipelines; surface waters at risk of contamination; leachate flooding gas lines and impeding gas collection; slope stability.
- Monitoring - Has a scheme for monitoring environmental risks been prepared? Is the scheme adequate for the scope of the proposed recirculation?

This summary relates to information from project SC030144, reported in detail in the following output(s):

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