LEACHATE EVAPORATION

Where waste heat is available in adequate quantities, either in the form of landfill gas or waste heat recovery systems within power generation equipment, leachate evaporation offers an attractive solution to the problem of leachate disposal.

By means of vaporisation, moisture is removed and solids are concentrated for separate disposal. The volumes requiring disposal are thereby greatly reduced.

Organics offers systems that operate both above and below 100ºC, the latter requiring a vacuum to reduce the boiling point. All systems are designed specifically to operate with landfill leachate but may be applied to waste waters of a similar composition.

KEY FEATURES

LEACHATE VOLUME REDUCTION BY MEANS OF WASTE HEAT

PRESSURE AND VACUUM SYSTEMS AVAILABLE, SUBJECT TO THE WASTE HEAT GRADE

OPEN AND CLOSED LOOP SYSTEMS

CLOSED LOOP CONDENSATION SYSTEMS FOR ADDITIONAL THERMAL EFFICIENCY

OPEN-LOOP DISPOSAL TO ENCLOSED FLARE

MULTI-STAGE SYSTEMS FOR MAXIMUM CONCENTRATION

FLOW RANGE FROM 10 CUBIC METRES PER DAY TO 2,000 CUBIC METRES PER DAY

MATERIAL GRADES SELECTED FOR DUTY

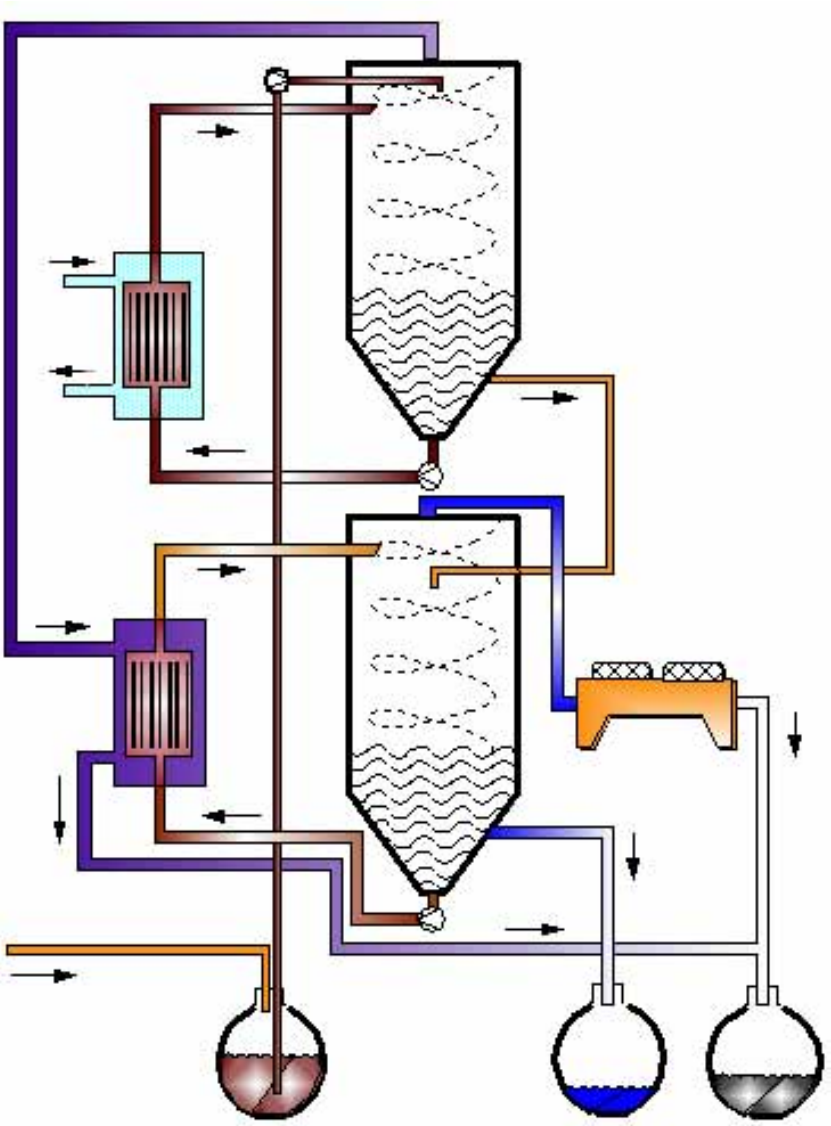
OPTIONAL ON-LINE MONITORING SYSTEMS

INTERNET CONNECTION AND LOGGING AVAILABLE

ISO 9001 REGISTERED FIRM

SYSTEM DESIGN

Cost-effective operation is usually achieved with two to four stage evaporators. Each stage is identical in design to the others and is equipped with a circulation pump, a fluidised bed heat exchanger and an evaporator vessel. The fluidised bed heat exchanger is used to prevent deposits from building up on the heat exchanger surfaces. The evaporator is designed to allow the steam and concentrate to flow in parallel along the pressure gradient towards the vacuum pump downstream of the final stage.



The first stage can be heated with primary steam from a steam generator. Alternatively, in deep vacuum systems, waste heat in the form of hot water may be employed.

Subsequent stages are heated by the waste vapours from the preceding stage. If the electrical conductivity of the concentrate from the final stage is too high the condensate may be automatically recycled to the receiver vessel of the circulating evaporator.

Dewatering of the concentrate proceeds continuously from stage to stage in the evaporator unit. The concentrate from the final stage can be drawn off and fed to a drying system or dewatered with a filter-press.

SOLIDS BUILD-UP

Solids-build-up is the most difficult item to assess in the design of the heat exchangers. It can only be evaluated on the basis of past experience. On the side of the boiling fluid, the deposits result not only from the normal fouling processes but are reinforced and magnified by the scaling from solids dissolved in the leachate. In practice leachate from each site will be different. It is necessary to design on the basis of a worst-case, against a background of specific leachate types.

BOILING LIQUIDS

Boiling heat-transfer plant and equipment are frequently referred to in the process industries as reboilers, in that waste heat is being used to produce new vapours. Most process reboilers are of the shell and tube construction. Boiling can, however, take place on the shell-side (outside of the tubes) or on the tube-side.

The heating medium is usually steam but may also be a heat transfer service fluid or a gas, vapour or liquid process stream.

The rate of vaporisation in a reboiler is sensitive to the available temperature differences. This is because the boiling heat transfer coefficient is itself a strong function of temperature difference.

Organics has worked with a wide range of heat-transfer systems and vaporisation equipment. Against this background, the company is able to assess the requirements and opportunities within a wide range of circumstances.

There are five possible mechanisms of heat transfer in evaporators:

- Single-phase liquid convection
- Liquid falling-film evaporation
- Nucleate (pool) boiling
- Two-phase convective boiling with sub-cooled or saturated liquid
- Dry wall convection

For a given mass flow rate through an evaporator, the heat transfer coefficient is greater with liquid falling-film, pool boiling and two-phase convection than with single-phase convection and dry wall convection. The heat transfer coefficient for dry wall convection is so low that this form of boiling is rarely employed.

The exact choice of system will be subject to site-specific facilities and options. These will include an assessment of the range of solids concentration in the leachate, the grade of the waste heat, the options for disposal of both the vapour and the concentrate, any environmental regulations that may be applicable and, last but not least, customer preferences.

DESIGN AND BUILD

All reboiler heat transfer equipment supplied by Organics is designed and built in-house with Lloyds 3rd Party Inspection systems being applied. Where other 3rd Party Inspectors may be prefered this can usually be accommodated.

Each reboiler or condenser supplied by Organics is designed in accordance with the recommendations of TEMA (the Tubular Exchanger Manufacturers Association). All calculations are subject to rigourous checking procedures.

ECONOMISERS

As well as supplying forced-feed reboilers for leachate evaporation, Organics is able to design, build and supply economisers for waste heat recovery from hot source gases. These units can be operated up to temperatures approaching 800ºC.

Economisers may be employed for heat recovery from engine exhaust gases, flare exhausts as well as any other high-temperature process off-gas.

SPECIFICATION DATA

Flow rates available:
10 to 2,000 cubic metres per day

Materials:
Organics specialises in explosion clad materials. This technology offers high quality operational surfaces at a competitive cost

Heat sources:
It is normal to employ high-temperature water or steam to drive an evaporator. Where such are not available, deep vacuum systems may be employed, the exact design being subject to the grade of heat available.

Energy requirements
Approximately 2,000 MJ of energy is required per cubic metre of leachate evaporated. This is equivalent to 120 cubic metres of landfill gas with 50% methane. A 1 MW engine-generator will provide adequate waste heat in its exhaust (at~50% of electrical power) to evaporate 20 - 25 cubic metres per day of leachate

Chemicals required
Subject to the exact process selected it may be necessary to dose the leachate with anti-foaming agents

Pre-treatment requirements
Coarse filtration for solids over 2 mm diameter

Land requirements
This is as much a function of the process capacity as the actual process selected. As an indication of land requirements a 20 cubic metres per day evaporator will occupy approximately 25 square metres

PROCESS SELECTION

In order to determine the optimum process route for a given situation it is necessary to carry out a detailed study of options that may be available.

The basic information required is the following:

1. Leachate flow rate
2. Leachate composition
3. Waste heat availability and type
4. Options for concentrate disposal
5. Site-specific restictions that may affect the choice of process route, such as emission limitations or site license restrictions

This information will enable the principal options to be established.

These may then be further refined by a study of available technical resources, land availability, management infra-structure and the degree of automation required.

The ultimate selection can then be based upon capital and operating costs.

RELEVANT EXPERIENCE WITHIN ORGANICS

As mentioned earlier in the text, Organics possesses the in-house capability to design all the heat transfer equipment that may be required for such applications.

Through a subsidiary company, Procensys Co Ltd, Organics manufactures all such equipment to Lloyd's standards and with Lloyd's certification.

During the course of the last six years one of Organics' main product areas has been the thermal procesing of leachate for treatment purposes. Systems that have been designed and built include forced-feed evaporators, kettle reboilers, saturated air-stream condensers for energy recovery, economisers for waste heat recovery from hot-exhaust gases and humidifier evaporators (See Datasheet ODSL15). System flow rates range from 200 cubic metres per day to 1,800 cubic metres per day.

For further information on this topic please contact our Technical Sales Department.

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