

Low energy treatment technology for leachate valorisation

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Today in the European Union, annually 16 tonnes of materials used by each person and 6 tonnes of it are converted into waste. Solid waste can be disposed in various ways, such as incineration (with or without energy recovery), landfilling, recycling and composting.

Due to the economical and industrial growth that Europe has been through in the last decades, the resources have been consumed at a very accelerated rate. Since resources are not infinite, they are facing the risk of shortage. Therefore, European authorities enforce that the member states implement policies to lessen the stress created on the resources and the amount of waste created and to extract the value from the waste.

Landfilling has been the most commonly used solid waste disposal. Even recycling has been ascended, an important amount of the waste generated in Europe is still sent to landfills, especially in the Mediterranean and Eastern Europe countries. There are 101 landfills in Spain and 39 landfills in Greece, currently. Spain and Greece have sent an average of 298.2 and 409.2 annually between 2009 and 2013 to landfills, which represent a percentage of 81% and 61% respectively. These countries also receive high solar radiation. Therefore, they are selected as the demonstration sites for the project.

Landfills present long-term threats to soil, air, groundwater and surface water due formation of greenhouse gases (methane gas and carbon dioxide from decomposing garbage) and leachate. Leachate is the liquid fraction of the already existing moisture/liquid within the solid waste and the continuously formed liquid with dissolved and suspended solids extracted from the waste while rainfall percolates through it. Not only during their useful life, but also fifty years after their closure, landfills keep on producing leachates. Approximately, 10 m³ of leachate is generated per 115 tonnes of solid waste.

In the absence of treatment, leachate is recycled back to the waste to maintain the biological activity in the composting solid waste by keeping it moist or send it to sewer or to a wastewater treatment plant (WWTP) in case they do not treat it on site.

The recirculation of leachate creates a more concentrated liquid that worsens the odour and attracts flies, which can transpose germs and diseases. This creates a bigger potential risk for human and environment and unpleasant working conditions.

The LIFE LEACHLESS project will promote water resources management actions in accordance with the Water Framework Directive 2000/60/EC by enabling managers of landfills and waste treatment centres to achieve good qualitative and quantitative status of their effluents.

Large amounts of leachates are generated in Europe and, because of their composition, having a high pollution load. The LEACHLESS project proposes a treatment model that will be carried out "in-situ" using a cost-effective novel technology that combines solar evaporation/condensation plus forward osmosis (Fig. 1). The prototype will be powered by renewable energies (solar energy, biomass and residual heat), which will minimise the carbon footprint of the process.

The final effluent quality will be very high, allowing reuse (preferred) or discharge into watercourses. In the particular case of this project, the final effluents will be reused for cleaning and gardening purposes. A minority semi-solid residual stream will be also generated in the process. Due to its special composition (rich in metals and inorganic elements), this stream will be valorised in ceramic industries to improve the final products characteristics.

LIFE LEACHLESS will strive for achieving the following results:

- Treatment up to 15 m³/day of leachate in a prototype introduced in containers for easy transport and installation that allows flexibility in operating condition.
- To obtain a high quality final effluent, 100% free of pathogens and xenobiotic compounds that can be reused or discharged into watercourses.
- To reduce the cost of leachate treatment over 80% when comparing with a traditional leachate treatment plant, by using solar radiation, biomass and residual heat as energy sources.
- To reduce by 80 to 90% the environmental impact associated with leachate streams proceeding from waste disposal in landfills or waste treatment centres.
- To eliminate the need of leachate transport to municipal wastewater treatment plants (WWTPs) and thereby, to eliminate the associated transport costs and the risk of emerging pollutants from leachate entering the overall water circuit and carbon footprint.

- To have a technology applicable in those European countries (members and candidates) with the highest volume of municipal waste sent to landfill, which are also those, which most leachate generate. These countries (Spain, Greece, Italia, Italy, Portugal, Malta, etc.) are themselves the ones with the higher number of sunlight hours, which favours the operation of such technology.
- Improving the operation of landfills and reducing the associated environmental impact (contributing to the increased number of landfill adapted to the waste disposal Directive, 1999/31/CE).
- 100% valorisation of the by-products generated in the process. The amount of sludge generated as a by-product is very low (1-3% of the total volume of leachate). However, the sludge generated can be valorised since it is interesting for the ceramic industry.
- 60% reduction of the leachate storage reservoir size in landfills and waste treatment plants. Pollution removal at the source.
- Dissemination of good practices. Creation of a network of contacts for disseminating project results and extending the project scope.
- 2 replication studies for transferring the project findings in 2 "follower facilities" (1 in Spain and 1 in Greece) and 1 in Pordenone's landfill in Italy when the project is completed.
- LIFE LEACHLESS will allow the authorities to increase the competitiveness and improving environmental legislation by better management of leachate.
- Dissemination of project results at national and international level through the Dissemination Plan and Networking Activities.

LIFE LEACHLESS is a reference project to demonstrate the integral treatment of leachate and the valorisation of the liquid (water) and solid fraction (by-product) on a first full-scale application. The results of the project will be representative for its technical and economic viability, its replicability on different sites.

Fig 1. Process Diagram of LIFE LEACHLESS project.

