**Project Life+ - BioLea.R - "Full scale use of liquid injection, for innovative control of waste moisture to enhance biogas production in pre treated waste landfill" (LIFE09 –ENV/IT/000101).**

**Partners:**

*G.A.I.A. SpA, Via Brofferio 48, Asti, Italy*

*POLITECNICO DI TORINO, Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture e Dipartimento di Scienza Applicata e Tecnologia, Corso Duca degli Abruzzi 24, Torino, Italy*

**Foreword**

The Bio.Lea.R project aims to demonstrate the performance of a landfill for less reactive, biologically treated waste (pre-treated organic wastes) compared to a conventionally managed landfill, with regard to both environmental (biogas and leachate production) and economical aspects. The objective is to control the pre-treated biodegradable waste moisture using innovative and monitored liquid injection in order to achieve the same biogas quantity in a shorter time than in conventional landfill.

With respect to the conventional landfill management approach, the following benefits of bioreactor landfills must be considered: i) a quicker stabilisation (10 to 15 years compared to 30 to 100 years with a classical landfilling operation) of biodegradable content can be achieved; ii) the biogas production period can be shortened and the biogas quality increased, thus providing a significant improvement of energy recovery; iii) when a leachate recirculation system is used, the environmental hazard is reduced because the volume of leachate to be treated is reduced, thanks to the liquid retention by the waste matrix. The waste must be maintained at nearly constant water content, especially under temperate climate, where waste disposed in landfill is generally too dry to guarantee the optimal biodegradation. The fluid necessary for obtaining optimal condition can be supplied either by the leachate recirculation or from rain water infiltration. Moreover, the leachate recirculation tends to uniform the spatial distribution of adapted microflora.

The Bio.Lea.R. project (within the frame of Life+ Program) aims to study a landfill managed as bioreactor, in order to exploit the biodegradable matter at its maximum extent and give the best yields of biogas. Bio.Lea.R. project has a demonstrative character on full scale, and focuses on two parallel and mutually useful studies:

- at laboratory scale, with a lysimeter filled with waste coming from the landfill under study and managed as bioreactor;
- at landfill scale, with monitoring of the bioreactor activities, in terms of biogas production, and

leachate recirculation efficiency and management (recirculation started in January 2014).

*Leachate recirculation and biogas extraction systems*

In Cerro Tanaro landfill the leachate recirculation system mainly consists of 8 sub-irrigation rings of 20 m diameter, located at the top of 8 gas extraction wells, below the final waste capping. In addition, 8 horizontal pipes of 10 m length are placed in the zones not reached by the influence areas of the rings, at 0.5 m depth, as well as 4 vertical injection wells where three HDPE pipes reach different depths. A manually-controlled pumping plant, located at the leachate storage tanks, supports the whole sub-irrigation system.

*Monitoring of biogas and leachate*

Both landfill cells are equipped with the same system for biogas extraction and monitoring (temperature, flow rate, composition by methane, carbon dioxide, oxygen, hydrogen sulphide). In-line analysis of biogas composition constitutes evidence of the cell response to the leachate recirculation, to verify the effectiveness of the process in enhancing biodegradation. The recirculated leachate is analysed weekly by temperature, pH, electrical conductivity, oxidation-reduction potential (ORP). At the same time, ammonium content and Chemical Oxygen Demand (COD) are analyzed on samples.

In addition, the cell managed as bioreactor is equipped with the system to monitor the leachate recirculation and collect the data about temperature and electrical conductivity measured by the geophysical sensors. We have designed and installed a network of geophysical sensors capable to explore the changes of electrical conductivity (or resistivity ρ, to say the reciprocal of electrical conductivity) and waste temperature at different depth of the landfill. These parameters ara a good indicator of spatial and temporal changes of liquid content within the bioreactor, as results of the infiltration process.

**Conclusions**

The combination of time-lapse geophysical monitoring, advanced inversion technique and traditional waste sampling techniques allow us to consistent structural framework of the landfill as well as experimental data on the flow, transport and degradation of waste. Experiments at different scales and environmental conditions, to say lysimeter and landfill, elucidate the processes that are involved in biodegradation, leading to an advanced characterization of biodegradation and prognosis of local process development.

The data of biogas production and emission of the two cells (with and without re-circulation of leachate) are compared to define optimal conditions of liquid recirculation/distribution to reduce

and concentrate the biogas production period. In this way, the project is useful for future implementations of non-hazardous landfills managed as bioreactors.

The project can warrant a more efficient biogas extraction, and consequently lower methane losses in the environment; in this view, the methane exploitation to produce electricity is another positive aspect, in view of fossil fuel substitution.

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