

EXPLOITATION OF A CLOSED LANDFILL ACCORDING TO THE PRINCIPLES OF SUSTAINABLE DEVELOPMENT

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Abstract

The present paper describes the closure procedure of a unit (out of the six existing ones) from Oradea Ecological Landfill that is the realization of a roof type and its integration into the ecologic circuit through the accomplishment of a plant with photovoltaic panels which are producing electricity. The photovoltaic solar energy is produced through solar photovoltaic cells, which convert the sunlight directly into AC/DC power. When this plant is finished, the producer should cover its electricity needs and the surplus quantity will be introduced in the national energy system.

Key words: closure, roof, photovoltaic, panel, electricity, conversion

INTRODUCTION

The development of the contaminated lands in general and of closed landfills in particular for the placement and exploitation of renewable energy is a relatively new practice in Europe but with a growing potential. (Bold, 2003) In general, contaminated lands may have environmental conditions that are not well suited for commercial or residential area and low on demand, in the meantime offering open space in areas where solar installations may be less likely to involve community concerns and aesthetic impact. (Bramryd, 1997)

According to Romania's Energetic Strategy, the country's potential for renewable energy is huge, though underexploited. One of the goals of the strategy is to raise the share of renewables in the final energy consumption to 35% by 2015 and to 38% by 2020, reducing also the impact of the primary sector on the climate change, i.e. CO₂ emissions, and meeting the long term energy needs according to the principles of sustainable development, solar energy is one of the fastest growing renewable energy power sources in Europe.

According to the solar radiation map of Romania, published by the E.C., in Oradea and near Oradea the yearly sum of global irradiation received by optimally inclined Photo Voltaic (PV) modules may reach 1.550 kWh/sqm, being above the European average.

MATERIAL AND METHOD

Oradea's modern landfill is a well-engineered facility which is located, designed, operated, and monitored to ensure compliance with federal regulations. The solid waste landfill was designed to protect the environment from contaminants which may be present in the solid waste stream. (Mihăiescu et al., 2010)

At Oradea landfill, the leachate collected through the gravitationally drainage pipe system is treated by the reverse osmosis treatment plan, putting back the water into the nature in high quality state. The operator collects potentially harmful landfill gas emissions and converts the gas into energy.

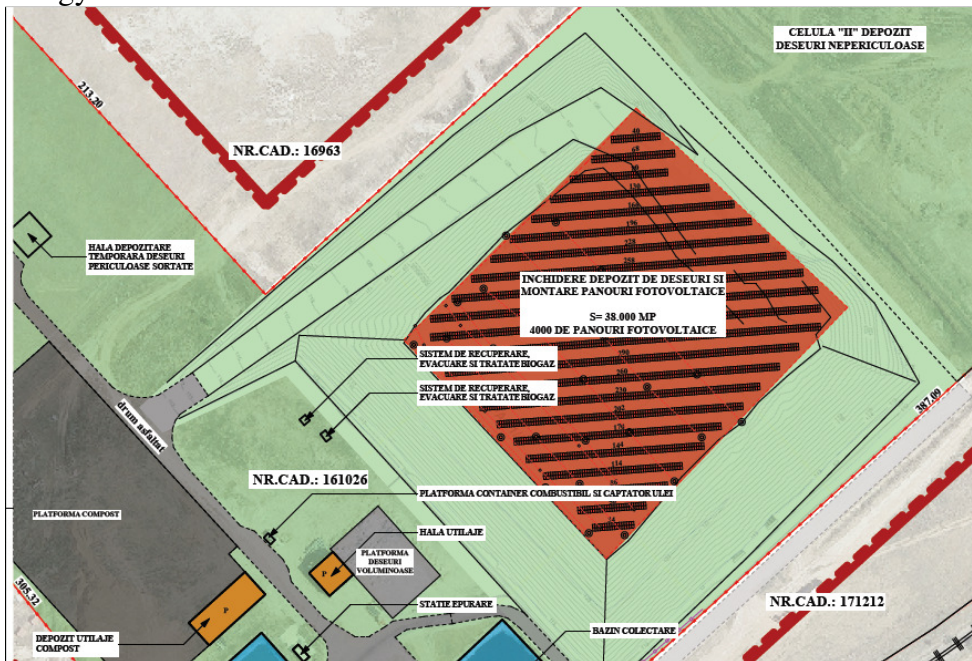


Fig. 1. Layout plan that includes the proposal of panels' placement

The solar photovoltaic energy is the energy produced by solar photovoltaic cells, arranged in panels that convert sunlight directly into electricity.

The solar cells made by semiconductor materials similar to those used in electronics in the case of chips from semiconductor devices, often were used before, for powering without using batteries of the pocket calculator, watches, etc. (Vasile, Ciuclea, Marinescu, 2015)

The performance of a photovoltaic cell is measured by the intensity of electric power produced by it. (Horzel, Lorenz, Cornagliotti et al., 2011). For this reason, a photovoltaic panel has an efficiency of 20% in the best

case, which leads to the achievement of a greater number of panels to improve the efficiency of the photovoltaic plant.

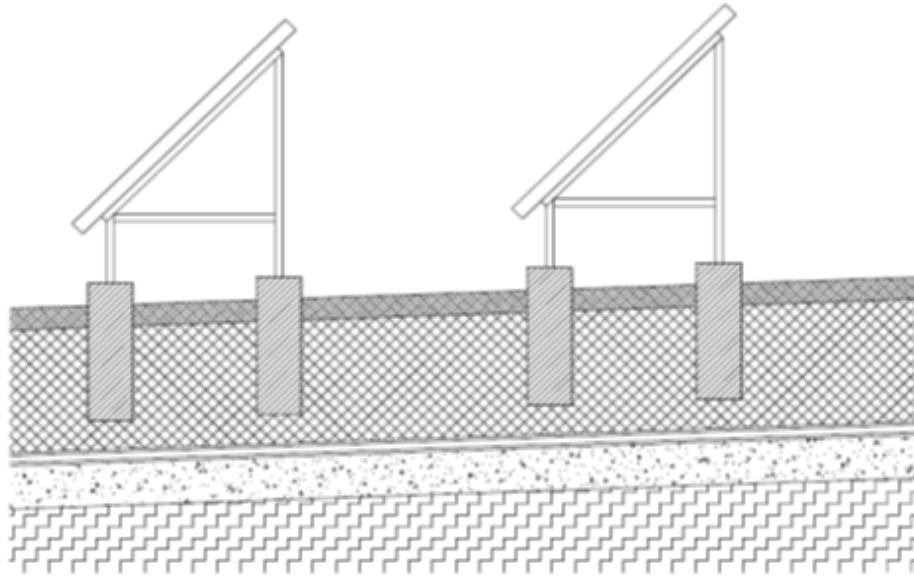


Fig. 2. Clamping mode on the landfill roof

The operator of Oradea's municipal non-hazardous landfill has to realize the final landfill closure on the first unit (3.8 ha), which means that the coverage of this unit must be performed with a roof model according to European regulations. This requires choosing among multiple variants of roofs the one which is consistent with supporting a photovoltaic plant (Jitea, Dinoiu, Moldovan, 2015).

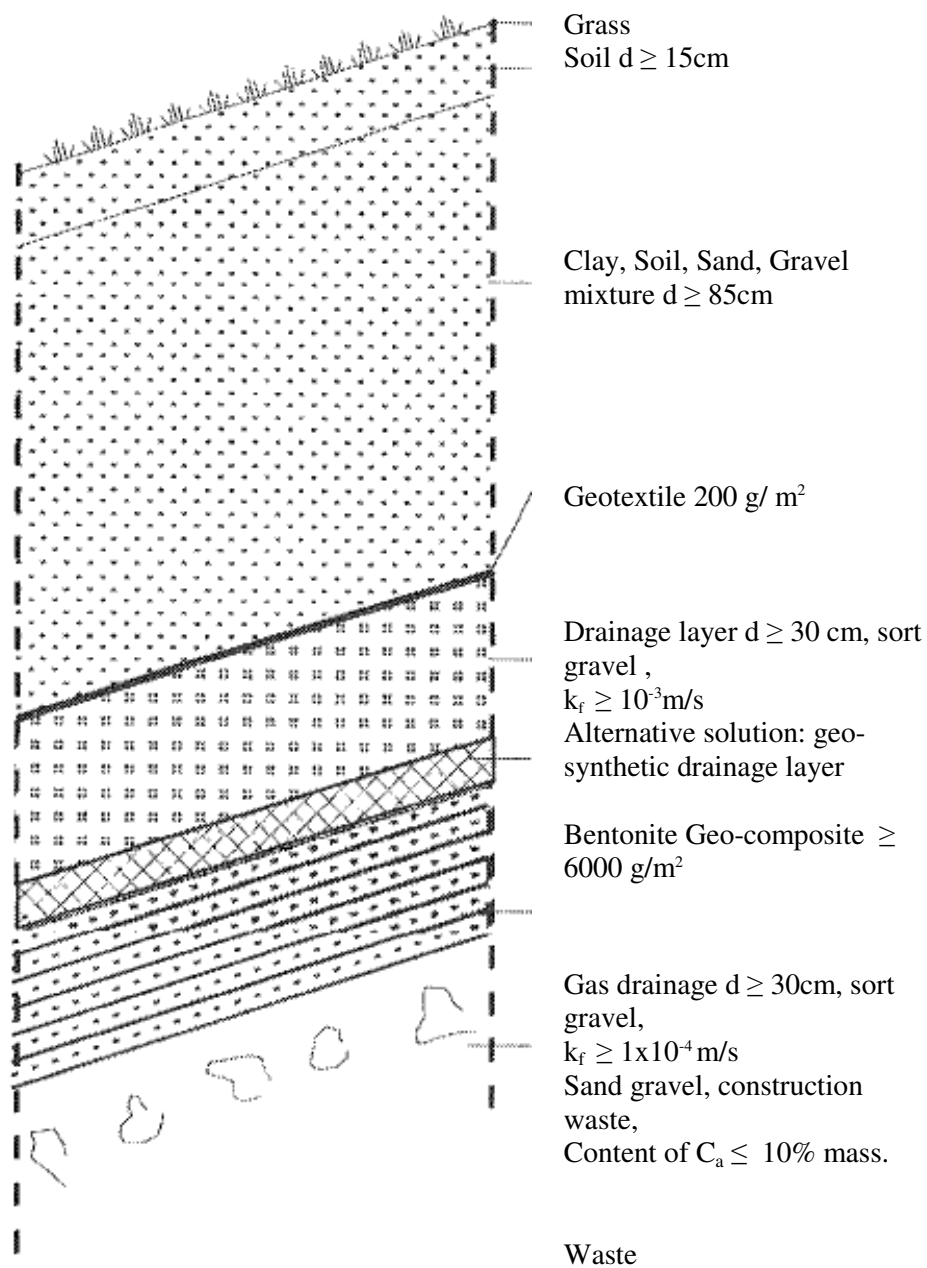


Fig. 3. Oradea - Nagyvarad landfill cultivation layers according to Romanian Government Regulation 757/2004 (Pasztai, 2009)

RESULTS AND DISCUSSION

The solar panels made up of several units, are used separately or linked to batteries to power the independent consumers or to generate electricity. In contrast to a thermal solar panel, a solar photovoltaic panel converts light energy of sunlight directly into electricity. The solar cells are the main components of a solar panel. Once sunlight is absorbed by these cells, it is converted involving the subatomic particles and the flow, (directed by electrons) that appears, represents the electricity. The process of converting light into electricity is called the *photovoltaic effect*.

To satisfy the conditions of electricity production, the solar cells will be assembled into solar panels by using various materials, which will provide:

- transparent protection against radiation and harsh weather conditions;
- robust electrical connections;
- protection of rigid solar cells from mechanical actions;
- protection of solar cells and electrical connections from moisture;
- ensuring an adequate cooling of solar cells;
- protection against touching;
- possibility of handling and light assembly.

The solar cells use semi-conducting material layers of only a few microns in thickness. The new technology has made possible as these panels to be perfectly integrated in the facades of the houses, on the roofs of the houses or in this case on the roof of a landfill, etc.

For the realization of the PV plant, the following steps have to be followed in the preparatory phase:

- obtaining the building site approval form;
- elaboration of technical solution to power grid connection (site plan, development of the site plan, engineering plan describing the technical solution opted for, approval notice from the distributor);
- obtaining the construction permit based on the following documentation: technical project, electrical resistance study, authorizations and permits listed in the town planning certificate, documentation for the environmental agreement;
- preparing to obtain the establishment permit from A.N.R.E. (national regulatory organ in the field of energy). This step shall be finalized at the beginning of the project.

The landfill settlement plans - which prevent the settlement of the landfills in environmentally sensitive areas - as well as on site environmental monitoring systems - which monitor for any sign of

groundwater contamination and for landfill gas - provide additional safeguards. (Siege, 1990)

The mass of deposited waste reached the level admissible by the Environmental Agreement, i.e. 18.5 m, thus this part of the landfill has to be closed. The closed final landfill of IA and IB units, having a total surface of 38.000 sqm, represents half of the existing landfill. Activities shall be planned and implemented according to Order 757/2004 of the Ministry of Environment regarding the approval of technical norms on waste landfill - transposing Directive 1999/31/EC - and include: earthworks, application of water insulation technology, biogas emission reduction - including CO₂, CH₄ - by capturing it with the already existing system, biodiversity cultivation. The captured biogas shall be also turned into energy. (both electricity and biogas quantity shall be calculated by specialists).

This plan will be built on a flat horizontal surface of 2 ha, actually on the roof of the unit, according to the construction permit and the chosen technological solution.



Fig. 4. Final stage

Putting in function the PV Plant will be done through realizing the connection with the main network, assuring the measurement of production.

Market integration of the investment will be made after obtaining the producer license, green certificate accreditation, registration at Trans-Electrica (national operator of energy network), O.M.E.P.A. (national operator for measuring the energy transited on the energy market), concluding convention with O.P.C.O.M. (administrator of the energy market in Romania).

Eco Bihor, which manages the landfill, has the necessary expertise to obtain the permits and prepare the necessary documentation for all authorizations.

CONCLUSIONS

The improvement of the electricity supply is the main objective of both the present and future of this industry. If the first photovoltaic cells had 4% efficiency and were produced in 1950, today the third generation of photovoltaic cells contains cells with an efficiency of 20%, and it seems that in a few years it will grow.

For the accomplishment of the solar plant, on the surface of 2 ha of the closed unit, the utility of the land that was already taken out from the agricultural circuit will be recovered. Thus, for the same photovoltaic plant, will no longer be necessary the removal of other plot of land from the agricultural circuit.

The purpose of the covering system of the landfill is the lasting and constant protection of the environment. In addition, the deposit must be integrated in the context of the natural landscape.

Due to the fact that the covered surfaces of the landfills cannot be integrated in the ecological and social circuit only through their conformity with the European regulations, the authors found a common solution by accomplishing this photovoltaic panel plant which will materialize into a future project.

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