Available online at
www.proenvironment.ro

ProEnvironment 3 (2010) 347 - 351

ProEnvironment

Original article

Closure Alternatives for Municipal Waste Landfills. Study Case: Municipal Waste Landfill Medias, Sibiu County

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Received 10 June 2010; received and revised form 25 October 2010; accepted 10 November 2010
Available online 1 December 2010

Abstract

In the recent decades, the environmental impact produced by municipal solid wastes has received special attention. All new EU countries are involved in the process of implementation of the European Council Directive 31/99/EC on the landfill of waste in the European Union. As consequence National legislation, adapted to fit the EU requirements, focuses on integrated waste management and environmental control of municipal solid waste landfills, from start-up to closure and assimilation into the environment. In Romania, by Government decision, HG 349/2005**,** was established the obligatoriness of closing unconform waste landfills located in urban areas starting at July 2009. As consequence the owner of municipal waste landfill Medias started the proceedings of closure for the landfill. The aim of this study is to compare, from an environmental point of view, different alternatives for the closure of the municipal solid waste landfill Somard-Medias (Romania).

Keywords: municipal wastes, waste landfill, waste directive

1. Introduction

At present the problem of waste management is manifesting itself ever more acutely because of the rise in waste quantity and diversity, as well as their increasingly pronounced impact on the surrounding environment [2, 3, 5]. In Romania, storage remains the main option of eliminating municipal waste [1]. Out of the total municipal waste generated, approximately 98% are stored each year. Many municipal landfills date back to the seventies and eighties.

The continuation of storage activity on existing landfills has carried on, in some cases, until the present day. At the time of the waste storage process start, existing legislation did not impose the organization of ecological landfills, outfitted to enable them to collect wastewater, minimizing air pollution as much as possible and clear strategies for their eventual closure.

Following an evaluation of urban waste repositories, carried out in 2004, a 240 operational repository inventory which did not comply with the waste storage directive [6], has been established. During the negotiations regarding Chapter 22 – Environment, Romania has committed to cease the storage carried out on 139 repositories by July 16, 2009, and, on the 101 remaining, between July 16, 2009 and July 16, 2017. Due to the lack of elementary environmental protection measures on

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existing landfills, the usage of a unitary measuring system, with respect to site closure, is impossible. Each existing landfill requires rigorous analysis and the adoption of the most convenient measures regarding the removal of the environmental impact, while also factoring in local environmental and sometimes even economic conditions [4]. The Somard-Medias landfill, with its closure scheduled for 2010 (*HG 349/2005, Annex 5, Table 5.2 – „b"-class landfills scheduled to permanently cease activity in the 16 July 2009 – 16 July 2017 timeframe*) requires a special approach due to the fact that sludge, resulting out of the industrial activities in Medias, has been deposited in two clay storage pits on its surface [7, 8]. Closing and ecologisation investment of the Somard-Medias landfill does not lead any kind of economic profit. Therefore, economic indicators cannot be analyzed as usual. The benefit of shutting down and sanitizing the Somard-Medias landfill is the improvement of environmental quality in the landfills vicinity and surroundings (Tarnava commune, Medias county).

This is obtained by eliminating/reducing air, water and soil pollution. Consequently, the optimal method of shutting down and ecologising the landfill depends on the type and composition of stored waste, the owner's financial possibilities, in the conditions of fulfilling the legal and administrative requirements [8].

2. Municipal waste landfill settings (description)

The municipal waste landfill Somard-Medias (Sibiu county, Romania) a mixed type deposit, containing no dangerous and dangerous wastes (industrial slurries), was put in operation in the years 1974-1976 in the purpose of storing the municipal and industrial wastes generated by Medias town.

At present it covers a total surface of 4 ha, entailing aprox. 1000000 m^3 of wastes, organized in a rectangular shape of 350 x 200 m municipal wastes, bordered at the northern and southern part by two clay storage pits of 80 x 80 m designated to accommodate industrial wastes. The maximum height of the waste dump is 10 - 15 m.

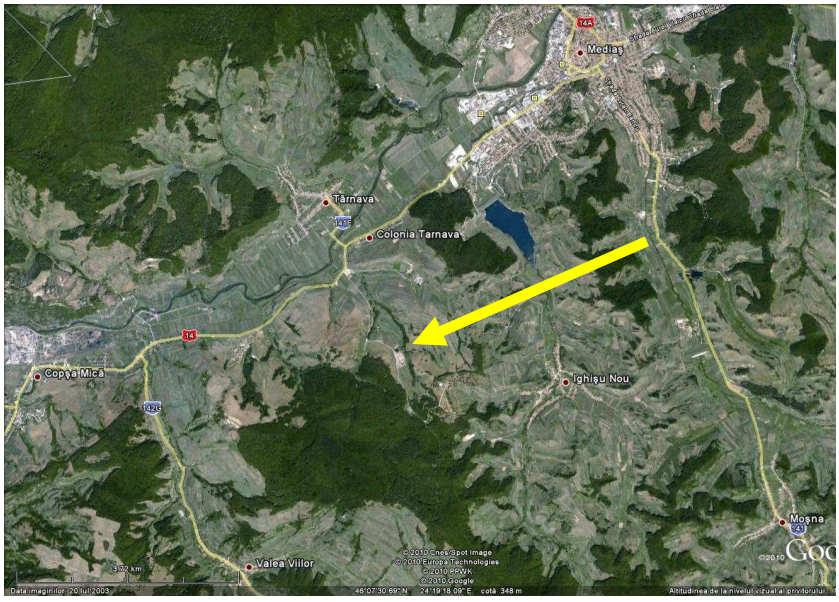

Figure 1.
Somard-Medias municipal waste landfill geographical setting

The municipal waste landfill is located at 5 km SV of Medias town, on the left slope of the semi permanent valley of Somard, the minimum distance to the river valley being 5 m. The soils in the area are low fertility grade. At a depth of 1 m is found a 2.5 m clay layer which is exploited in a location 500 m north of the waste landfill. The existence of the impermeable clay layer, at the waste landfill bottom, ensures a low permeability, preventing the unpurified waters (generated by the waste landfill) infiltration in the deeper layers. The deposited wastes originate from households (municipal wastes and non dangerous wastes) as well as from industrial activities (dangerous wastes). The total composition of wastes accumulated in the deposit is estimated as follows: municipal wastes - 75%; demolition wastes - 10%; industrial and dangerous wastes - 15% (slurries, deposited in the 2 clay ponds, each with a 0.05 ha surface, the southern clay storage pits filled and sealed with a clay layer, the northern clay pond 60% filled with a layer of stagnant water) (figures 2 and 3).

Figure 2. Southern part of the waste landfill

Figure 3. Northern part of the waste landfill with the clay storage pit

The municipal waste landfill shows a series of deficiencies as consequence of the lack of a drainage and evacuation system in order to safe evacuate the leachate, which lead to uncontrolled runoff waters loaded with pollutants (ammonia, cooper, zinc, etc.) in concentrations which exceed the maximum allowed concentrations prescribed by Romanian legislation NTPA-001/2005.

The nondegradable wastes (plastics, metals, electronic and household devices) were deposited, without separation, together with the degradable wastes, thus creating conditions for further solubilization of the metallic parts by the acidic waters generated by fermentation processes and supplementary pollutants loads in the leachate.

The unpurified waters generated by the presence of the waste landfill are uncontrolled drained towards the adjacent land and semi permanent Somard valley. The lack of a deposit gas (45 - 60% CH_4 and 40 - 55% CO_2) drainage and evacuation system, can lead to self ignition of the wastes with subsequent pollutants and smell emissions.

3. Brief analysis of the environmental impact

The waste landfill is not equipped with water supply network and therefore a wastewater drainage network doesn't exist. The water which percolates the deposit is not collected and treated. Only recently was realized a concrete ditch on the western part of the waste landfill in order to collect and safely divert towards the valley the surface flow waters generated on the slope above the deposit.

Due to the natural conditions (the presence of a clay layer under the base of the waste dump) the waters which wash and percolate the deposit are usually standing on puddles on the surface of adjacent plain surfaces and not infiltrate in the deeper layers. During intense rain events, the stagnant water can be flushed and conducted to the semi permanent Somard valley. A specific wetland vegetation developed in these areas. The closest surface water course is Somard creek which is formed at a distance of 150 meters and 5 m vertical elevation. Due to the existence of the impermeable clay layer and the downwards slope, the infiltration and runoff of the waters, which wash or percolate the landfill, is possible. Somard creek has a semi permanent character which in normal situations diminishes the pollutant potential of the waste landfill.

There are no other permanent surface water courses in the vicinity of the waste landfill. Tarnava Mare river which flows through Medias town is located aprox. 4 km in the north of the site. In the areas close to waste landfill location can appear pollution phenomena generated by: 1) wind transport of the deposited materials, together with pollutants originating from the waste landfill, which affect soil and vegetation; 2) soil contamination with pollutants carried by the waters which wash or percolates the deposit; 3) overlays with the historic heavy metals soil pollution in Copsa Mica area (generated by air emissions from industrial area). The studies carried on waste landfill area showed the presence of a reduced contamination on environment. Chemical analysis of the stagnat waters in the clay basins revealed no contamination with heavy metals. This fact leads to ideea of studying the posibilities for on-site insulation of the waste landfill.

4. Proposed alternatives for the somard-medias municipal waste landfill closure and ecologising

According to the legal requirements the municipal waste landfill closure must be done in conditions in order to ensure avoidance of water, air, soil pollution, including greenhouse effect, as well as of any kind of risks for human health.

Considered alternatives:

1. Removal and relocation of the clay basins and waste dump insulation. The alternative consists in removal and transportation to a waste water treatment plant of the stagnant waters located in the northern clay basin. The clay basins will be totally removed and transported to a suitable waste landfill. The operation will be continued by waste landfill insulation according to the specific requirements regarding avoidance of water soil and air pollution followed by revegetation with location specific species.

2. On site waste landfill insulation. On site insulation of the clay basins containing dangerous wastes, performed after removal and epuration of the stagnant waters. The operation will be continued by waste landfill insulation according to the specific requirements regarding avoidance of water soil and air pollution followed by revegetation with location specific species.

3. Total removal of the waste landfill. Removal and transportation in totality of the deposited materials according to their specific degree of hazard to legally compliant waste landfills. In order to ensure total rehabilitation the total estimated volume is aprox. 1000000 m^3, an extra 10000 m^3 of soil will be required. At the end of the operation the land will be restored to its natural conditions.

The costs involved by the operation of total removal of the waste landfill, followed by rehabilitation, as well as considerations related to the low environmental impact remaining after the applying one of on-site insulation alternatives, direct to the recommendation of applying an insulation alternative.

5. Minimal requirements for the municipal waste landfill Somard-Medias closure and ecologising works

A series of measures and works can be proposed in the purpose of the municipal waste landfill Somard-Medias closure and ecologizing. The measures should focus on efficient rehabilitation of the site as well as on reduction of the environmental impact of the waste landfill. The technical, economical and environmental measures should ensure the waste landfill, minimize the environmental impact, especially on water and ensure environment safety [4]. General measures to ensure safe landfill closure include:

- ***Management of waters*****:** contaminated runoff or leachate derived from landfill must be intercepted and directed towards 'dirty water' treatment ponds, or temporary storage pond in the purpose of epuration.

To avoid excessive volumes of water entering the dirty water treatment systems, runoff from undisturbed catchments around the landfill should be kept separate from landfill runoff and associated disturbed areas. Is recommended to be realized contour ditches in order to channelize the conventional clean waters directly to Somard creek.

- ***Stabilization works on the landfill***: these include levelling the dump, reshaping the slopes in order to ensure stability and ensure channelling of unpurified waters towards the collector ditches.

- ***Capping works***: the purpose of a capping system is to ensure long lasting protection against the development of smells, landfill leachate, penetration of groundwater by pollutants, gas emissions into the atmosphere, onset of fires, deterioration of the surface vegetation layer done by gas trapped inside the landfill and the propagation of insects and birds.

Also of importance is the integration of the landfill area into the local landscape. The entire capping system has to be built in accordance with the waste landfill class and needs to fulfil the following general requirements: to hold back and to ensure the drainage of rainwater, to form a stable and resistant base for the vegetation, to ensure adequate safety against erosion, to be able to withstand high temperature variations (freezing, high temperatures), to prevent the propagation of animals (mice, moles), to be resistant in the long run, to be airtight against the gas stuck in the landfill, to be accessible and easily maintainable.

Generally the capping and insulation systems must contain the next components, starting at the surface and continuing downwards, the vegetation and soil layer is followed by a layer designed to drain the rainwater, a package of materials designated to block the infiltration of fluids into the body of the landfill and, depending on the stored waste's properties, a fermentation-gas drainage system, set on top of a levelling layer.

- ***Monitoring and maintenance*****:** the landfill post-closure program must include inspections of the capping system, checking for differential settlement and indicators that the integrity of the capping system has not been compromised. Periodic analysis of surface waters and groundwater must be performed in order to certify the efficiency of the insulation works. The frequency of the inspection program will be largely determined from the observed rate of settlement. Also according to legal requirements, maintenance has to be provided for a period of 30 minimum years.

6. Conclusions

The closure of unconform landfills is a requirement and an obligation resulting out of the national commitments to apply European waste management directives, as well as the necessity to reduce to a minimum their impact on the environment and human health.

Local conditions impose a specific approach depending on the specificity of each waste landfill, thus generating different closure options as well as costs. By taking into account economic aspects relating to the costs, it is possible to recommend the landfill closure in the simplest way possible: stabilization and levelling works, optional a fermentation-gas drainage system, impervious layer, water drainage layer, soil layer, revegetation, collecting the leachate pending purification as well as post-closure monitoring.

Such an approach can prove environmentally friendly, and theoretically, allow a continuation of activities on a nearby location, in accordance with the laws in force. Regarding the hazardous waste landfill (the clay storage pit), its bulky component has to be relocated to a different location, which respect in-force legislation, while its liquid component can be treated at Medias waste water treatment plant.

The project is to be completed by arranging a revegetation layer, by seeding and planting local trees, which will ensure reintegration into the landscape.

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