

ANALYSIS OF THE EXISTING SITUATION IN THE MUNICIPALITY OF PRILEP AND THE STRATEGIC APPROACH TO THE RESOLUTION OF SOLID WASTE MANAGEMENT PROBLEMS

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A large part of the processes and products that are connected with the modern way of life in the Municipality of Prilep have negative effects on the environment. Among the significant consequences are also the rising costs for disposing of the excessive quantities of solid waste. In the past period, the bad practices of solid waste management led to degradation of the ecological systems, and as well to losing the precious natural resources and creation of potential health risks. The biggest part of the communal solid waste and other types of waste that are collected, have been disposed without any whatsoever pre-treatment on the municipality landfill Alinci or on the illegal landfills. According to the data from LEAP, there is a large number of illegal landfills created by the population which are not scoped within the services of the solid waste disposal. In order to reduce the quantity of the solid waste, the one which has to be deposited and/or in order, at least, the harmful influence of the solid waste on the environment to be reduced (for instance: emission of the gases created by the decomposition of the solid waste, extracted water and similar), the modern solid waste treatment systems scope different technologies for processing and exploiting of the solid waste. The choice of the technological procedure for solid waste processing has to be based on analyses of profitability and consideration of the measures of solid waste management in accordance with the best available technology, which does not require very high costs. According to the present situation in the Municipality of Prilep, modern technologies for processing of solid waste, which is created in enormously big quantities, are not applied.

Key words: Prilep municipality, degradation of ecological systems, illegal landfills, modern technologies

АНАЛИЗА НА ПОСТОЈНАТА СИТУАЦИЈА ВО ГРАДОТ ПРИЛЕП И СТРАТЕШКИ ПРИСТАП КОН РЕШАВАЊЕ НА УПРАВУВАЊЕТО СО ЦВРСТ ОТПАД

Голем дел од процесите и производите што се поврзуваат со современиот начин на живеење во Република Македонија имаат негативни ефекти врз животната средина. Меѓу значајните последици се и растечките трошоци за одлагање на прекумерните количества отпад. Во изминатиов период лошите практики на управување со отпадот доведоа до деградација на екосистемите, како и до губење на драгоцени природни ресурси и создавање на потенцијални здравствени ризици. Најголем дел од комуналниот цврст отпад и другите отпадоци што се собираат се депонираат без каков било преттретман на општинската депонија Алинци. Според податоци од ЛЕАП има многу диви депонии што ги создава населението кое не е опфатено со услуги на собирање отпад. Со цел да се намали количината на отпадот кој мора да се депонира и/или со цел да се отстрани или барем да се намали штетното влијание на отпадот врз околината (на пр. емисија на гасови настанати од разградувањето на отпадот, исцедни води и сл.), современите системи за згрижување на отпадот користат различни технологии за обработка и искористување на отпадот. Изборот на технолошката постапка за обработка на отпадот мора да се темели на анализа на исплатливост со уважување на мерките за управување со отпадот според најдобра достапна технологија која не бара многу високи трошоци. Според моменталната ситуација во општината Прилеп не се применети современите технологии за обработка на комуналниот отпад.

Клучни зборови: општина Прилеп; деградација на екосистеми; диви депонии; современи технологии

1. INTRODUCTION

The Municipality of Prilep is located in the central part of the southern region of the Republic of Macedonia. It is stretched out over the Prilep Plain, which constitutes the northern part of the largest lowlands in the Republic of Macedonia, Pelagonia. The city is elevated at 620–650 m above sea level and constitutes the administrative centre of the region. Transportwise, the city is connected with Bitola by road and railway, in addition to the roadway to Ohrid (via Resen) and to Kičevo. The scope of local industry is modest, not quite extensive for a city with Prilep's population.

The 2002 census records 24,398 households in the Municipality of Prilep, which accommodates a population of 73,351 people (Table 1). This equals an average size of 3.16 persons per household, which is slightly under the national average of 3.58 persons.

Table 1

Population growth of the City of Prilep during the period of 1948 to 2002

Population of the City of Prilep (according to data from the Census, State Statistics Office)							
Year	1948	1953	1961	1971	1981	1994	2002
Population of Prilep	36171	42048	48924	57837	68820	71899	73351

If we take the population growth of 2% as a growth indicator to be also applied for the period of 2002–2009, in that case Prilep population this year would be 74,635 inhabitants.

2. CURRENT SITUATION IN PRILEP IN REGARD TO WASTE MANAGEMENT

The current waste management situation in the Municipality of Prilep may be described as substandard in terms of human and financial resources, as well as insufficient and ineffective in regard to the monitoring and enforcement of regulations, which results in various dysfunctional systems in the Municipality and many related negative effects on the environment and the health of the people. The general level of awareness about the environment and problems concerning the waste in Prilep is low; in fact, the people are not even aware of the problems resulting from inappro-

priate waste management and the negative effects upon their health, the environment and nature.

According to available data obtained from the Public Communal Enterprise (PCE) *Komunalec*, as a company responsible for waste collection in the City of Prilep, for the past three years (2007, 2008 and the current 2009), collection of communal waste is carried out for 19,469 households, 597 companies in the economic sector, 33 schools and churches and 707 shops in the city. If we were to compare the number of households in the City of Prilep according to the last Census, which counted 24,398 households, with the number of households currently covered by PCE *Komunalec*, as the sole enterprise in the city responsible for waste collection, then it would transpire that 20% of the households in the City of Prilep do not use the services of organised waste collection. Since the average number of inhabitants per household in Prilep is 3.2, this means that 15,773 produce waste that is deposited in an unorganised fashion to illegal landfills. If we calculate according to the data from the State Statistics Office, which states that in 2008 each citizen of Macedonia produced an average of 349 kg of waste, we obtain the figure of 5505 tons of waste generated only in 2008, and it is unknown how it is disposed of.

The annual quantity of communal waste in the city and inhabited places covered by the services of PCE *Komunalec* and is calculated on the basis of the capacity of the work and the work carried out. Accurate measurements at the landfill itself are not made. If we also add to this quantity the waste generated by the villages, which is also disposed of exclusively in illegal landfills, the graveness of the problem gains all the more significance.

Collection of the communal solid and technological waste is performed in special containers, consisting of: 250 containers with a capacity of 1.1m³ deployed mainly in the central city region, 40 containers with a capacity of 5 m³ deployed on the territory of the City of Prilep, including the industrial zone and 120 l garbage bins allocated at individual households (which are privately owned by private persons). 400 bins with a capacity of 3-5 litres have been distributed in public areas, while the commencement of the "Selection of PET Packaging" pilot project saw the placement of 90 containers (mainly in school yards and the central city region) for disposal of PET packaging.

The experience of the Public Communal Enterprise thus far provides a dynamic of collection,

transport and disposal of the waste and this applies to companies/commercial/industrial entities, where the collection is performed once weekly, and several times at the request of the entities. Furthermore, the collection of the waste from the containers located in the central city region/public transport areas is performed every day, twice a day, throughout the whole year. The garbage cans in the urban communities are emptied once weekly. Depending on the quantity of waste, the waste collection is carried out during the day shift, with planning being performed according to the needs. The collection of waste is carried out in an unhindered, systematic and immediate manner. Certain delays may occur only in the case of bad weather conditions.

On the basis of the previously defined quantities of communal waste generated on the territory of the Municipality of Prilep, on an annual basis, as well as on the basis of the fraction structure of the waste defined by the National Solid Waste Management Plan (DHV Prowa-SWC, an EU funded project, managed by the EAR, no: EUROAID/115138/D/SV/MK, 2005, Special Study on Waste Composition), considering that the amount of waste produced in Prilep in 2008 was 29,811 tons, it may be presumed that the following types and quantities of waste per fraction are being generated (Table 2).

Table 2

Types of waste in the City of Prilep by fractions for 2008

Fraction	Percentage (%)	Total (tones)
Organic	26.2	7810
Wood	2.7	805
Paper	11.6	3458
Plastic	9.7	2892
Glass	3.5	1043
Textile	2.9	864
Metals	2.6	775
Danger waste	0.2	60
Composites	2.2	656
Complex products	0.3	90
Inert waste	3.6	1073
Other categories	3.6	1073
Small size parts	30.9	9212
Total	100	29811

Quantities and structure of collected waste in Prilep

According to the acquired data from the PCE *Komunalec*, as the most relevant organisation whose responsibility is collection and disposal of waste, a more detailed measurement of waste quantities per vehicle commenced in August 2008 and is still ongoing. Pursuant to the cubic capacity of the vehicles and their planned daily/monthly deployments, we were able to determine the quantities of waste collected for each month separately. According to the data received from the PCE *Komunalec* on the overall generated waste in the City of Prilep, per month, it has been estimated that 29,075 tons of communal waste was deposited in the Alinci landfill in 2007.

During 2008, 29,811 tons of waste were produced, which is a 2.5% increase in comparison to a year earlier, while in 2009 a significant rise has been noticed in the disposal of waste until the month of August, in comparison to the previous two years. Compared to the data of the same period in the last two years, the growth of the deposited waste between August 2007 and August 2008 is 19%, while for the period from August 2008 to August 2009, the growth is 20% (Fig. 1).

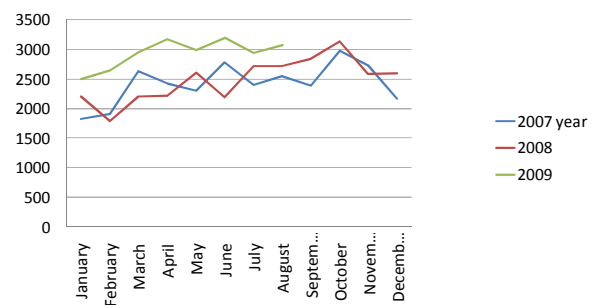


Fig. 1. Quantities of collected waste for 2007, 2008 and 2009 in Prilep

City of Prilep landfill

The Alinci landfill for the City of Prilep is located 2 km north of the village of Alinci and approximately 2.5 km east of the village of Veselčani. To the north, the villages of Galičani and Berovci are at a distance of 2.8 and 2.5 km, respectively, while the M5 motorway running from Prilep to Bitola passes the location to the northeast at a distance of approximately 600 m. The existing landfill is located on the southern slopes of the

Omec Hill, at a distance of approximately 90 m from its southern boundary. This illegal landfill serves for the disposal of waste from the City of Prilep, and it covers an area of about 20,000 m², of which approximately 15,000 m² is covered with waste.

The illegal landfill was created on land that had not been prepared in a way to meet the standards for protection of the environment. Until two years ago, the dumped waste was not covered and therefore fires repeatedly broke out. It lacks installation of a system for venting of waste gasses, capturing filtrate and the surface has not been appropriately sealed. The location has been fenced off at a distance of only several hundred metres from agricultural land and grazing fields. During the visit of the site, a jet of filtrate was noticed to be draining from the landfill and leaking into the surrounding land.

The southern slope created from masses of waste is relatively steep and it can easily cause a landslide. In order to improve these conditions, research is being made into methods of occasional coverage with land, and there is a plan to expand the landfill with the new quantities of arrived waste around the Omec Hill.

A small gate has been constructed at the entrance to the landfill; the access road is not paved, and the only equipment being used is a bulldozer designed for excavation of land. Groups of garbage scavengers can be found at the landfill.

Taking into consideration the above conditions, it quickly becomes clear that certain measures for rehabilitation of this site must be taken.

Proposed measures for the rehabilitation of the alinci landfill

The proposed measures to be taken for the communal landfill of the City of Prilep to gain all the features of a landfill that would meet EU standards are the following:

During exploitation

- construction of a rainwater drainage system,
- to pave the access road with asphalt (has it been paved?),
- reprofiling the inclinations of the slants,
- to cover the inactive parts of the landfill.

For Closure

- recultivation of the site, final reprofiling and closure,
- construction of a filtrate collection system,
- installation of a venting system of waste gasses (gas windows),
- restriction of access to the location.

Construction of a drainage system of atmospheric water. Since it is presumed that simply covering the waste with land will not satisfactorily prevent penetration of surface waters into the body of the landfill, a drainage system shall need to be installed on the slope over the terrain covered by waste and to discharge the collected rainwater into the field in the opposite direction of its collection.

The atmospheric water collection system shall consist of channels appropriately dimensioned and with a slope of at least 1% towards the flat part of the valley under the Omec Hill.

Pavement of access roads. In order to prevent dust emissions, paving of the access roads is recommended. This measure should be carried out during the commencing phases of the works on the landfill. Asphalt, bitumen or cement are materials that would be taken into account for paving the access roads, the inclination of the access road should not be in the direction that would lead drainage water to be discharged back into the deposited waste.

Reprofiling of the waste. Reprofiling of the waste is significant to achieve a stable inclination of the landfill with deposited waste and to construct an appropriate ending closure after the dumping of the waste. The reprofiling should be carried out during the commencement of work of the landfill. The required slant needs to have an inclination of 1:2.5, instead of the existing 1:1 and the maximum of 2:1 that has been recorded, which needs to be softened. If necessary, the layers should be tiered, with a view to achieve greater stability the bottom, as well as for the construction of the final layers for sealing the last layer.

Closure of inactive part of the landfill. Those parts of the landfill that have been filled with was, pursuant to the waste disposal plan, have to be closed off appropriately with certain layers. A compensatory layer would be used with thick-

ness of approximately 0.50 m, using unbound materials. This procedure of covering the inactive parts shall take part during work on the landfill.

Recultivation of the site including reprofiling and closure. After finishing the work on the site and by the commencement of deployment of the new zone, the abandoned part needs to be reprofiled and sealed/closed. The following installation is recommended as a surface layer:

- compensatory layer (50 cm),
- recultivated layer with kf of $<10^{-7}$ (100 cm).

The reprofiling of the landfill should be carried out in a way that the surface soil sealing would be allowed for the entire body of the landfill. The surface should be slanted towards the atmospheric water collection system, with a view to easier discharge of the surface waters from the area of the landfill.

Installation of a filtrate collection system. Since installation of a system to collect the filtrate under the entire body of the landfill would be a highly intensive expenditure, it is recommended the filtrate to be collected at the bottom (foot) of the slope (after reprofiling of the waste). The collected filtrate should be discharged in the filtrate collection system of another landfill.

Installation of a gas ventilation system. Ventilation ducts, so called "gas windows" need to be installed with a view to discharge gas before it is burned. These gas valves shall be constructed as concrete pits with a filter consisting of a layer of ballast. The duct shall be installed through the compensatory layer and the layer for recultivation, in the very body of the landfill. It is estimated that single a ventilation duct of this kind should be installed per each unit surface measure of 2000 m².

Restriction of access to the location. In order to prevent illegal dumping of waste or toxic materials, the access to the location needs to be restricted by setting up a fence and establishing a regular guard service.

Further dumping. The dumping of the waste should not be carried out towards the north, because a new regional landfill shall be constructed on that location. The distance between the newly projected and the existing landfill is approximately

90 m, and this distance needs to be maintained for the working space required for the construction of the new landfill.

Determining the type and quantity of waste that shall establish the obligation of the legal entities and natural persons to prepare waste management programmes

First and foremost, a database needs to be established recording all the legal entities and natural persons that operate economically in the Municipality of Prilep. After their identification, all the industrial facilities need to be reviewed which according to the Law on the Environment (Official Gazette of the Republic of Macedonia no. 53/05, 81/05, 24/07) and the Law on Waste (Official Gazette no. 68/2004, 71/2004, 107/2007, 102/2008 and 143/2008) are obligated to prepare an environmental protection programme, i.e. installations that fall under the IPPC (Integrated Pollution Prevention and Control) regime and Article 21 of the Law on Waste which states that all generators of waste who annually create quantities exceeding 150 t non-hazardous waste or 200 kg hazardous waste, are obligated to prepare a waste management planning document. These entities are required to submit their planning documents for non-hazardous waste to the Municipality for review and approval, while the planning documents for hazardous waste need to be submitted to the competent authorities that deal in matters related to the protection of the environment (the Ministry of Environment and Physical Planning) for review and approval. The Municipality of Prilep has already prepared a list/database of installations that are located on its territory. These have to be verified whether they are subject to the IPPC regime. The information deriving from the completed application for an integrated ecological permit or an operating plan compliance permit, it needs to be entered into an appropriate industrial facility waste management database, and this shall contribute to an suitable monitoring of the quantities of waste created by the legal entities and natural persons. Pursuant to the Article 24 of the Law on the Environment, for the installations that do not fall under the IPPC regime an elaboration for the protection of the environment has to be prepared and submitted to the MOEPP for approval. The document should clearly highlight all types of waste. This type of information may be provided to the Mu-

nicipality and to feed the waste management appropriate database.

3. CONCLUSION

On the basis of the analysis of the situation, the problems that are evident from the analysis of the situation and the reasons for the current waste management situation, the following measures are hereby proposed:

- Consistent implementation and adherence to the procedures for obtaining integrated ecological permits or operating plan compliance permits, both on the local and on the regional level.
- Introduction of a cadastre of polluters (waste as a pollutant) which shall record all the industrial facilities that produce waste and based on the annual quantities of generated waste, they would be obliged to submit their own in-house waste management programme.
- Making a record of the number of illegal landfills, approximate estimation of the quantities of dumped materials, as well as the type of dumped materials. Installation of larger mass containers for appropriate disposal of the waste.
- The monitoring for 2009 should primarily be introduced by filling in the waste identification and transport forms, as well as by preparation of annual waste management reports.

These forms are obligatory for the enterprises, which of course include the Public Enterprise, too.

- Raising awareness of the citizens.

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