ANNALS OF FACULTY ENGINEERING HUNEDOARA
– INTERNATIONAL JOURNAL OF ENGINEERING
Tome IX (Year 2011). Extra Fascicule. (ISSN 1584 – 2673)

[1.] Maja DJOGO, [2.] Aleksandar DVORNIĆ, [3.] Mirjana VOJINOVIĆ MILORADOV, [4.] Jelena RADONIĆ, [5.] Goran VUJIĆ

DETERMINATION OF POLLUTANT PARAMETERS IN LANDFILL LEACHATE WATER OF VOJVODINA REGION

[1]UNIVERSITY OF NOVI SAD, FACULTY OF TECHNICAL SCIENCES, DEPARTMENT OF ENVIRONMENTAL ENGINEERING, TRG DOSITEJA OBRADOVIĆA 6, 21000 NOVI SAD, SERBIA

ABSTRACT: Leaching occurs when soluble organic and inorganic components are dissolved out of a solid material by percolating water. The leachate in landfills ultimately leak, percolate and could contaminate the groundwater. Hence its analysis can be an indication of environmental pollution. The main objectives of the study were the characterization and identification of major pollutant parameters in leachate samples from municipal waste landfills in Vojvodina region (Novi Sad, Subotica, Kikinda and Zrenjanin). All water samples had low concentration levels of dissolved oxygen (from 0.03 to 0.21 mg/L), except water samples from non sanitary landfill in Zrenjanin which indicates high organic contamination of water samples. High values of BOD_5 of the samples from sanitary landfill (784 - 1275 mg/L) show high pollution of leachate water with biodegradable organic matter. Better quality of some leachate samples from non sanitary landfills has shown signs of aerobic degradation and also there is dilution factor that highly affects quality of water samples. Obtained results show that Ni^{2+} is the most predominant metal in the landfills (0.591 - 5.029 mg/L). Zn^{2+} was found as the most abundant at the sanitary solid waste landfill (1.444 - 1.517 mg/L). Concentration levels of the toxic cadmium were under the limit of detection, 0.02 mg/L, in all samples. The obtained results indicate low water quality of samples collected from sanitary and non sanitary municipal waste landfills. Because non sanitary landfills don't have impermeable bottom layer, there is presence of high risks for contamination of soil, surface and ground water in Vojvodina area. This type of field investigation of the quality of landfill leachate in Vojvodina was conducted for the first time.
KEYWORDS: Groundwater contamination, landfill, leachate, residues of metal

❖ INTRODUCTION

Land filling is one of the most common methods of waste disposal in the world. Leaching occurs when soluble organic and inorganic components are dissolved out of a solid material by percolating water. During landfill operation, leachates are produced, mainly due to the infiltration of rainwater through the refuse tips. Leachate production and management is now recognized as one of the greatest problems associated with environmentally sound operation of sanitary landfills, because these liquid wastes can cause significant pollution problems by contacting the surrounding soil, ground or surface water, and therefore they are considered as major pollution hazards unless precautionary measures are implemented. The leachate problem is made worse by the fact that many landfill sites are still operating without an appropriate impermeable bottom liner or an effective collection and subsequent treatment system. The different characteristics of leachate depend on waste composition biodegradation, types of micro-organisms, waste compaction, soil moisture, and the flow rate and temperature of the waste.

Collection of leachates, identifying and quantifying of their typical composition characteristics is most important step in monitoring and management of solid waste leachate so the main objectives of the study were the characterization and identification of major pollutant parameters in leachate samples from municipal waste landfills in Vojvodina region.

❖ MATERIALS AND METHODS

Water samples for physical and chemical analysis were collected from municipal solid waste landfills in Novi Sad, Subotica, Kikinda and Zrenjanin. Table 1 presents the descriptors of the sampling sites with GPS coordinates within the previously mapped municipal landfill point network in Vojvodina area. All samples were taken in the winter period (from December 2008 - March 2009) under comparable meteorological conditions at all sites (median temperature 4°C).

Physical and chemical parameters were determined in the Laboratory for monitoring of landfills, waste waters and ambient air, Department of Environmental engineering, Faculty of Technical Sciences, University of Novi Sad. Electrical conductivity, pH, dissolved oxygen and temperature measurements were performed *in situ* with a portable Multi 340i WISSENSCHAFTLICH-TECHNISCHE WERKSTATTEN GMBH device. Biological oxygen demand was determined using BOD Trak HACH device. Phosphorus, nitrates and nitrites in water samples were determined using HACH DR5000 UV-visible spectrophotometer. The metal analysis was done by the digestion of the water sample in order to determine total amount of metals in samples. The digested samples were then analyzed with the atomic apsorption spectrometer S2Series+VP 100 Thermo Scientific using the flame technic.

Table 1. Descriptors of the sampling sites

Sampling site	Locality	GPS coordinates	Depth
Kikinda	KI3	20°29'30,52"E 45°52'12,65"N	3 m
	KI4	20°29'35,74"E 45°52'10,92"N	4 m
Zrenjanin	ZR1	20°29'09,46"E 45°21'08,48"N	Surface water
	ZR2	20°21'54,04"E 45°21'04,55"N	Surface water
	ZR3	20°29'56,63"E 45°21'16,27"N	Surface water
Novi Sad	NS3	19°50'54,23"E 45°18'45,61"N	Surface water
Subotica	SU1	19°41'13,33"E 46°04'51,51"N	Surface water

❖ RESULTS

The obtained results of physical and chemical parameters of the water samples are presented in Table 2.

Table 2. Results of physicochemical parameters of the water samples

Parameter	Unit	KI3	KI4	ZR1	ZR2	ZR3	NS3	SU1
Water temperature	^{0}C	27	13	7	8	9	5	11
Air temperature	^{0}C	4	4	7	7	9	0	0
pH	-	8,59	8,65	7,91	7,68	8,59	8,03	7,48
Conductivity	µS/cm	20800	19540	1436	472	8800	4620	908
Dissolved oxygen	mg/L	0,19	0,21	4,50	6,74	3,67	0,03	0,15
BOD_5	mg/L	784	1275	142	18	86	68	202
Phosphorus total	mg/L	13,6	6,85	7,07	0,72	2,53	2,42	5,71
Nitrite	mg/L	0,310	0,400	0,018	0,016	0,353	0,681	0,037
Cr^{6+}	mg/L	1,08	0,306	<0,03	<0,03	0,058	0,576	<0,03
Zn^{2+}	mg/L	1,444	1,517	0,860	1,119	0,968	0,28	0,408
Ni^{2+}	mg/L	4,613	5,029	4,539	4,172	4,214	0,591	0,627

All water samples had low concentration levels of dissolved oxygen (from 0.03 to 0.21 mg/L), except water samples from non sanitary landfill in Zrenjanin which indicates high organic contamination of water samples. High values of BOD_5 of the samples from sanitary landfill (784 - 1275 mg/L) show high pollution of leachate water with biodegradable organic matter. Better quality of some leachate samples from non sanitary landfills has shown signs of aerobic degradation and also there is dilution factor that highly affects quality of water samples. Obtained results show that Ni^{2+} is the most predominant metal in the landfills (0.591 - 5.029 mg/L). Zn^{2+} was found as the most abundant at the sanitary solid waste landfill (1.444 - 1.517 mg/L). Concentration levels of the toxic cadmium were under the limit of detection, 0.02 mg/L, in all samples. Figure 1 represents the variability of the investigated physicochemical parameters and Figure 2 represents metal content in water samples.

❖ CONCLUSION

Evaluation of this experimental study indicated poor water quality of samples collected from sanitary and non sanitary municipal waste landfills. Because non sanitary landfills don't have impermeable bottom layer, there is presence of high risks for contamination of soil, surface and ground water in Vojvodina area. A release of leachate to the groundwater may present several risks to human health and the environment. Leachate impacts to groundwater may also present a danger to the environment and to aquatic species if the leachate-contaminated groundwater plume discharges to wetlands or streams. The quality of the water in the piezometers and the leachate water of the municipal solid waste is very important for the good ecological status of environment in general and, according to the newly systematic campaign which is planned, the part of these activities is in progress.

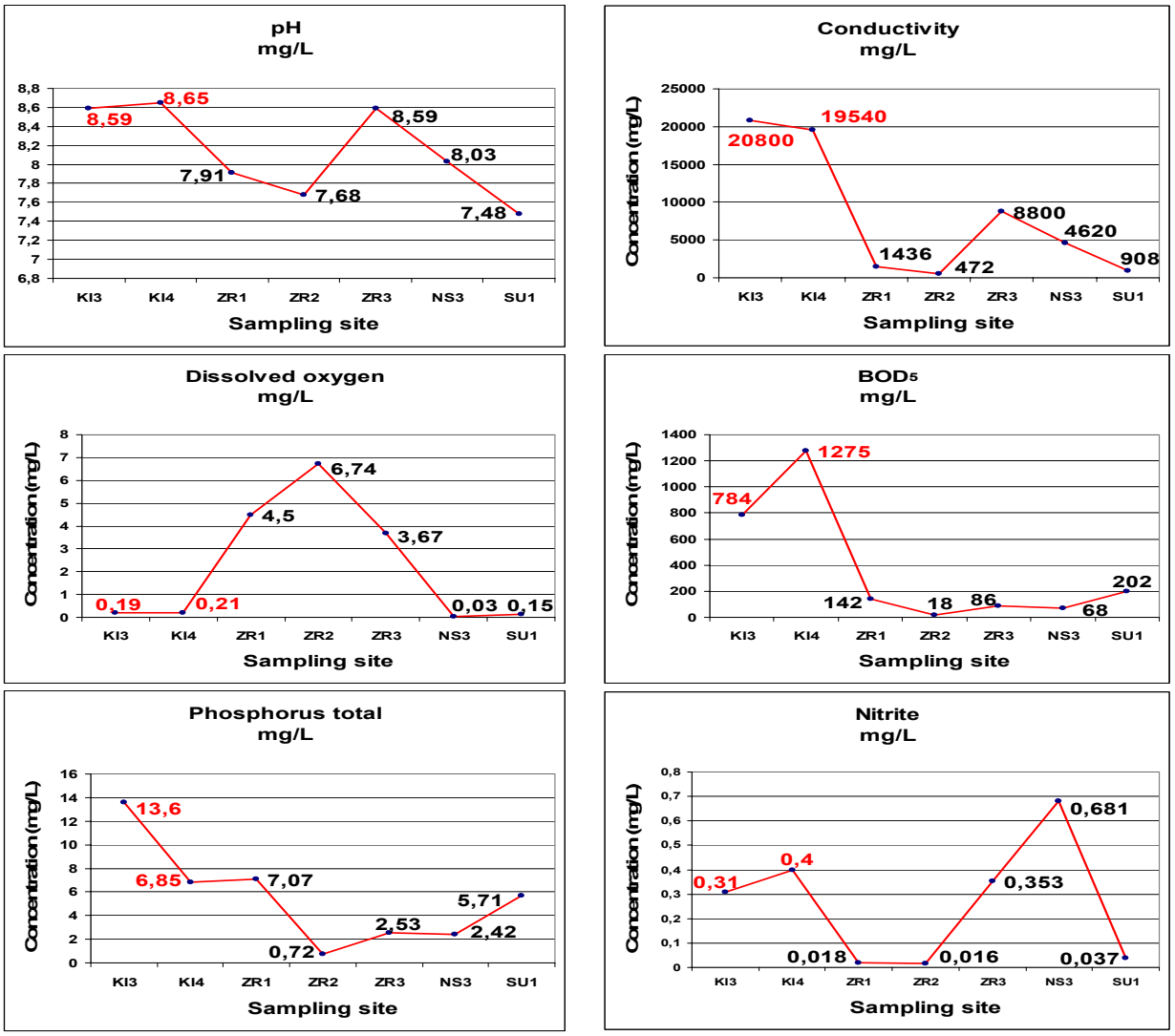

Figure 1: Variability of physicochemical parameters of the water samples from sanitary (values marked in red) and non sanitary municipal waste landfills

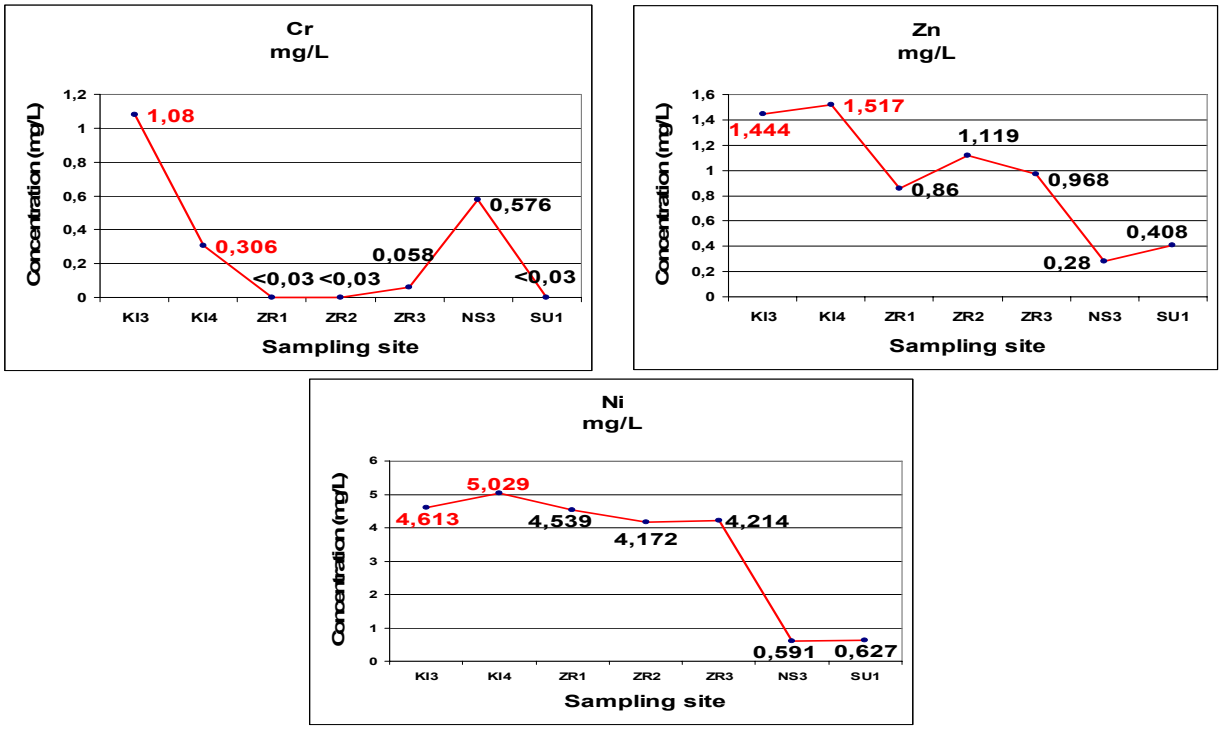

Figure 2: Metal residues in water samples from sanitary (values marked in red) and non sanitary municipal waste landfills

❖ REFERENCES

[1.] Faculty of Technical Sciences, Department of Environmental Engineering: Project - Preliminary qualitative and quantitative analysis of leachate water and gas from the waste landfills for establishment of continuous monitoring, Novi Sad, 2009.

[2.] JENSEN DL, LEDIN A, CHRISTENSEN TH (1999): Speciation of heavy metals in landfill – leachate polluted groundwater. Wat. Res. Vol. 33, No. 11, 2642-2650

[3.] MIKOVIĆ D, VOJINOVIĆ-MILORADOV M, MILORADOV M, SREMAČKI M: Prednosti recirkulacije filtrate pri sanaciji smetlišta. Međunarodna konferencija Otpadne vode, komunalni čvrst otpad i opasan otpad, Vršac, 2008, 257-261

[4.] OGUNDIRAN OO, AFOLABI TA (2008): Assessment of the physicochemical parameters and heavy metals toxicity of leachates from municipal solid waste open dumpsite. Int. J. Environ. Sci. Tech. 5 (2), 243-250

[5.] REYES-LÓPEZ JA, RAMÍREZ-HERNÁNDEZ J, LÁZARO-MANCILLA O, CARREÓN-DIAZCONTI C, GARRIDO MML (2008): Assessment of groundwater contamination by landfill leachate: A case in México. Waste Management 28, S33–S39

[6.] TATSI AA, ZOUBOULIS AI (2002): A field investigation of the quantity and quality of leachate from a municipal solid waste landfill in a Mediterranean climate (Thessaloniki, Greece). Advances in Environmental Research 6, 207-219

[7.] VADILLO I, BARTOLOME A, CARRASCO F (2005): Groundwater contamination by landfill leachates in a karstic aquifer. Water, Air, and Soil Pollution 162, 143–169

ANNALS OF FACULTY ENGINEERING HUNEDOARA
– INTERNATIONAL JOURNAL OF ENGINEERING