



POSSIBILITIES OF ENVIRONMENTAL IMPROVEMENTS OF SOIL CONDITION WITH THE APPLICATION OF EXCAVATED SOILS AND ARTIFICIAL COMPOSED SOILS

ID 095

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ABSTRACT

Waste management and soil protection strategy are among the priority of EU policy for stimulation and implementation of the environmental technology. This paper is focused on the potential for environmental improvements of disturbed soils with the application of the excavated soils or non-hazardous waste from different industries (building industry, foundry and wastewater treatment), which mixed with excavated soils generates the artificial composed soils. Potential uses for artificial composed soils include dykes alongside the highways, restoration of abandoned gravel pits and stone-pits and building new areas for recreation purposes on subsided or damaged areas.

Key words: remediation practises, excavated soils, artificial composed soils, soil protection strategy.

INTRODUCTION

As the national economy expands the amounts of waste from different industries and wastewater treatment increases as well. On the other hand, high environmental standards coupled with extremely high costs for disposal sites, a lot of waste is disposed of without any environmental controls. Therefore, regulation and activities for a more efficient system of waste treatment is one of the major tasks of the Resolution of the National Programme for Environmental Protection (Official journal of the Republic of Slovenia 02/2006). Possibilities for use of the excavated soils and artificial soils include creation of a topsoil horizon.

The present study aimed to 1) discuss potential problems for excavated and artificial soil application; 2) discuss conditions for usage license gained for excavated and artificial composed soils; 3) present some practical examples of excavated and artificial composed soils.

Materials and Methods

In the Republic of Slovenia the Environmental Agency has methods for sampling and preparing artificial soils. Methods were chosen according to the international standards

(ISO 10381-1:2002, SIST ISO 11464). Methods used to analysis soil parameters were pH, total organic carbon, conductivity, texture, phosphorus, nitrogen and cation exchange capacitate. Contents of heavy metals (Cd, Cu, Ni, Pb, Zn, Cr, Co, Mo, As) in soils were determined using inductively coupled plasma mass spectrometry methods (ICP-MS), while the hydride technique on atomic absorption spectrometer (AAS) was used for the determination of Hg after the acid solution was microwave heated. Polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbon (PAHs) were determined by using gas chromatography (MS/ECD); content of benzene, toluene and xylene (BTX) was determined by gas chromatography (GC/MS). Mineral oils (Σ CH) were determined using IR spectrometry.

RESULTS

Excavated soil mixed together with minerals and organic-mineral waste which originates from industrial and wastewater treatment are known as artificial composed soils (Official journal of the Republic of Slovenia, 03-2003). Soil quality estimation from pedological, chemical and technical viewpoint has a ratio with more than 50% portion of authentic soils and non hazardous waste. Among waste recycled building materials such as concrete, asphalt, ceramic, bricks, tiles, foundry sand and also wastewater treatment were used. Results revealed that the artificial soils in certain portions are suitable in remediation practises for environmental improvements of the soil conditions. (Table 1, 2)

Table 1.: Contents of an organic and organic hazardous matter (Official journal of the Republic of Slovenia, 03/2003).

Parameter	Excavated soils		Artificial composed soils	
	Suitable for agricultural areas	Suitable for Un-agricultural areas	Suitable for Agricultural areas	Suitable for Un-agricultural areas
As (mg/kg d.w.)	20	30	20	30 / 0,3
Pb (mg/kg d.w.)	45 - 65	100	50	100/ 0,3
Cd (mg/kg d.w.)	0,5 - 1	1,1	0,7	1,1 / 0,3
Cr (mg/kg d.w.)	70 - 100	90	40	90 / 0,3
Co (mg/kg d.w.)	/	30		
Cu (mg/kg d.w.)	50	60 / 90	30	60 / 0,6
Ni (mg/kg d.w.)	30 - 50	55	30	55 / 0,6
Hg (mg/kg d.w.)	0,3 – 0,8	0,7	0,3	0,7 / 0,01
Zn (mg/kg d.w.)	160 - 200	300/450	100	300 / 18
PAH (mg/l)	2	2	2	2
BTX (mg/l)	0,1	1	0,1	1
PCB mg/l)	0,1	0,1	0,1	0,1
Σ CH (mg/kg d.w.)	20 - 200	20 - 200	20 - 200	20 -200 / 5

Artificial composed soil from remediation stone-pit of Flintstone in composition to recycled building materials to wastewater treatment in the ratio 6 to 3 to 1 and in

composition of soils to siliceous sand to foundry sand in the ratio 7 to 3 to 1 were used with positive results.

Table 2.: Contents of physico – chemical parameters (Official journal of the Republic of Slovenia, 03/2003).

Parameter	Excavated soils		Artificial composed soils	
	Suitable for agricultural areas	Suitable for Un-agricultural areas	Suitable for agricultural areas	Suitable for Un-agricultural areas
Stones : > 2 mm	0	0 – 50	0 - 10	0 – 50
(%) > 200 mm		0	0	0
> 63 mm	0	/	/	/
TOC (%)	0,7 - 5	< 0,3	0,7 – 5	< 0,3
TOC (mg/l)	100 - 200	100	100 – 200	50
pH	6,5 - 8	6,5 - 8	6,5 – 8	6,5 – 8
SEP (µS/cm)	< 400	< 400	< 400	< 400
N cel. (%)	< 0,04	< 0,05	< 0,4	< 0,05
P cel (%)	< 0,08	< 0,05	< 0,08	< 0,05



Figure 1.: Artificial composed soil implemented for building the dyke alongside highway Ljubljana – Zagreb (Slovenia - Croatia).

DISCUSSION

Result of our survey summarized that excavated or/and artificial composed soils meet all the criteria of the Slovenian legislation about the implementation of the excavated or/and

artificial composed soil into the environment. Therefore, it may be possible: 1) to use artificial soil renew our landscape after the negative result of coal mining; 2) for covering low-grade quality agricultural areas; or 3) for building new areas for recreation purposes where the environment was damaged. Furthermore, it might be useful considering the reduction of expenses as well as huge amounts of waste building industries, foundries, wastewater treatment which have to be disposed on appreciate prepared environment friendly dumping sites.

REFERENCES

- (1) Official journal of the Republic of Slovenia 2/2006.
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- (3) ISO 10381-1, Soil quality – Sampling, Part 1: Guidance on the design of sampling programmes.
- (4) SIST ISO 11464, Soil quality – Pre-treatment of samples for physico-chemical analyses.