# Ecotoxicity of a mixture of sludge from paper production and municipal sewage sludge

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## Aim of study

- 1. Sludges from paper production and municipal sewage sludge contain many valuable nutrients, including macroelements and micronutrients.
- 2. However, in addition to the useful nutrients of the above wastes contain heavy metals and other pollutants that may have a negative effect on the environment.
- 3. An optimal condition for the natural use of waste is their proper composition in order to reduce the risk caused by the introduction of heavy metals into the soil environment.

The aim of the study was to assess the ecotoxicity of sludge from paper production and sewage sludge and their mixtures



Photo 1. Sludge from paper production

#### Table 1. Physicochemical properties of waste

Properties	sludge from paper production SP	sewage sludge SS
Dry mass %	27.82	23.30
рН <sub>(КСІ)</sub>	7.47	6.98
C organic g/kg	-	269.0
N g/kg	0.15	13.70
P g/kg	1.13	2.80
K g/kg	1.44	1.55
Mg g/kg	2.88	2.80
Ca g/kg	119	273
Cr mg/kg	47.29	7.59
Ni mg/kg	16.62	2.70
Cu mg/kg	132	35.5
Zn mg/kg	257	426
Cd mg/kg	Cd mg/kg 0.87	
Pb mg/kg	33.9	10.2

Permissible content of heavy metals in municipal sewage sludge, used in agriculture and land reclamation: Cd – 20 mg; Cu – 1000 mg; Ni – 300 mg; Pb – 750 mg; Zn – 2500 mg; Hg – 16 mg; Cr – 500 mg  $\cdot$  kg<sup>-1</sup> s.m

#### Table 2. Diagram of the incubation experiment

No	Treatment	Share in the mixture %
1	Control – soil	100
2	Sludge from paper production SP	100
3	SP + sewage sludge SS*	50:50
4	SP + soil	50:50

\* Patent no PL411157-A1





Photo 2 and 3. Pellets of the SP + SS mixture\*

#### Table 3. Biotests used in assessing the toxicity of waste

Trophic level	Organisms	Test	Test reaction	Time
Producers	S. saccharatum, L. sativum, S. alba	Phytotoxkit	Germination and growth inhibition	72h
Decomposer	V. fischeri	Microtox <sup>®</sup>	Luminescence inhibiotion	15min

Screening tests. Non-toxic sample PE <20%, low toxicity 20%  $\leq$  PE <50%, toxic 50%  $\leq$  PE <100%, very toxic = 100%

#### Table 4. Phytotoxicity of waste

Treatment	% Germination inhibition		% Roots growth inhibition			
	S. alba	L. sativum	S. saccharatum	S. alba	L. sativum	S. saccharatum
SP	0	15	0	78	86	44
SP + SS	0	0	0	20	19	18
SP + soil	0	0	6	37	33	30

#### Table 6. Microtox – Vibrio fiecheri

Treatment	% Luminescence inhibition
SP	50
SP + SS	35
SP + soil	20

### **Sludge from paper production SP**



Mixture: SP + SS



## Conclusion

1. SS was characterized by higher content of macronutrients as compared to PS.

- 2. The content of heavy metals in PS and SS did not exceed the permissible limits conditioning their agricultural and recultivation use
- 3. The waste used and their mixtures are ranked for their toxicity in the following order:

# PS > PS + soil > PS + PP

4. Waste mixtures can be used for environmental management.5. However, before environmental management, biological and chemical tests should be performed.