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TECHNOLOGICAL AND ENVIRONMENTAL INDICATORS FOR RINSING OF MATERIALS RECOVERED FROM LANDFILL

Deimantė Stankevičienė, Algimantas Bučinskas, Gintaras Denafas

22-23/09/2016

Workshop "Technologies for material recovery from landfills and mining residues" | **Deimantė Stankevičienė, Algimantas Bučinskas, Gintaras Denafas**

ABSTRACT

- Investigations were carried out in Alytus regional landfill, using waste samples taken from the landfill. Samples were taken from different depths of borehole, made in the landfill.
- After analysis of recovered materials quantities and composition two waste fractions were selected for an experimental study: textiles and plastics. These fractions were washed with distilled and tap water. Ash content and volatile substance in textile and plastic waste were determined before and after washing. Permanganate oxidation (ChDS(Mn)) and heavy metal analysis of filtrate from the landfill was performed.
- The highest values of ChDS(Mn) were located at a depth of between two and seventh borehole depth meter of the landfill, after washing with water: plastics – 19,27 mg O_2/l and textiles – 28,8 mg O_2/l. In all samples heavy metals (Zn and Cu) were detected, and a number of samples traces of Mn, Ni and Pb were found. After washing, ash content of the two factions decreased by an average of 10% and amount of volatile fraction increased. According to this analysis it is evident, that washing improves energetic properties of materials (if it is used for energy generation), recovered from landfills, and contributes to the reduction of environmental pollution.

LOCATION OF STUDY

- This is one of the first study to determine landfill mining feasibilities in Lithuania. Project was performed in Alytus Regional Landfill.

Figure 1. Location of the Alytus regional landfill in Lithuania

THE AIM OF THIS STUDY

1. Using distilled and tap water perform laboratory washing of waste fractions (plastics and textiles), taken from Alytus regional landfill;
2. Investigate properties of the washing water - permanganate oxidation and concentration of heavy metals;
3. Investigate characteristics of suspended particles of textiles and plastics, which were washed from the waste – volatile fraction and ash content;
4. Perform comparative tests of waste fractions before and after washing – namely volatile part and ash content.

TECHNOLOGICAL CHART OF LANDFILL MINING

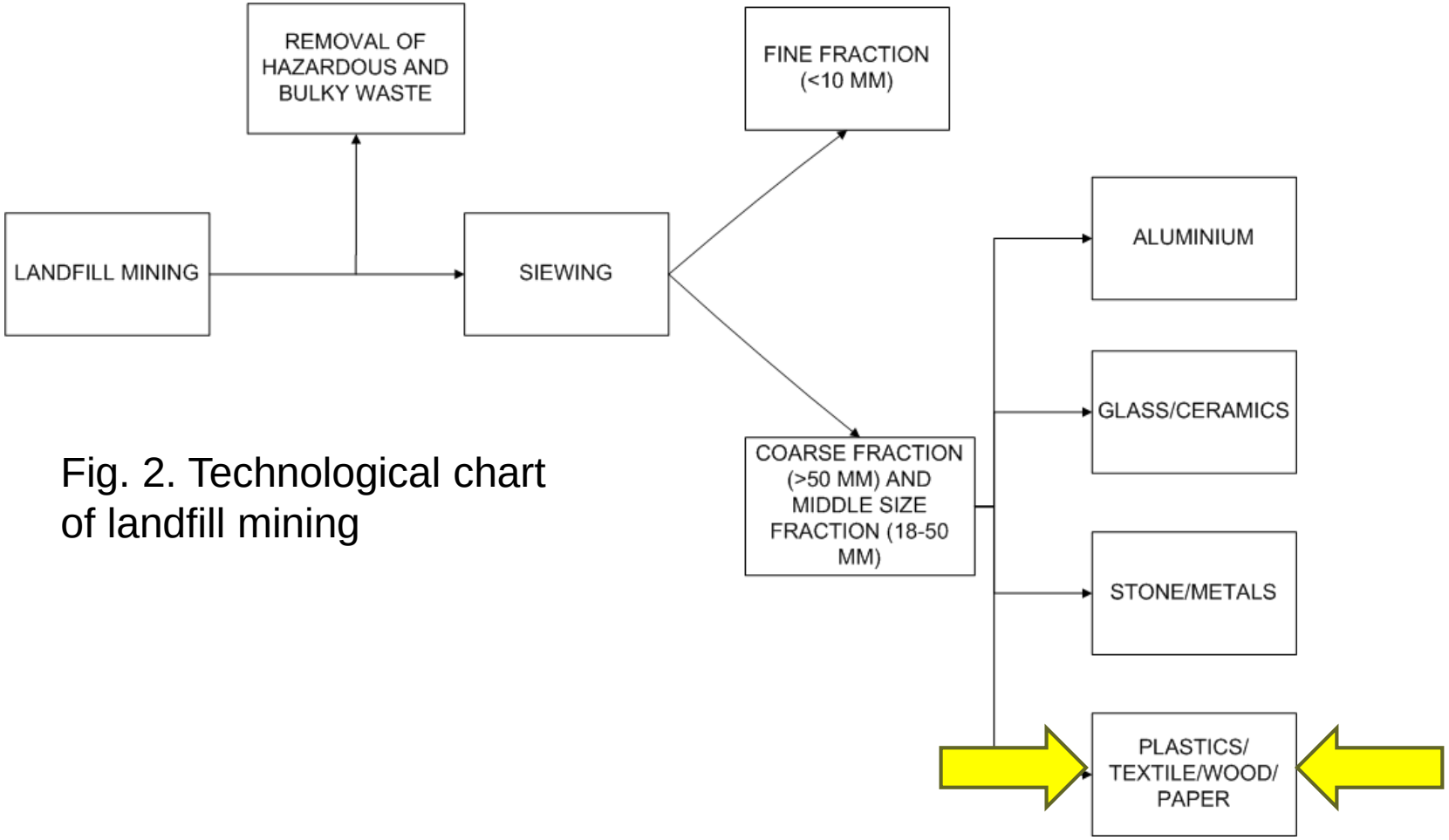


Fig. 2. Technological chart of landfill mining

METHODOLOGY

- Two fractions of excavated from landfill waste were used for experimental investigation – textile and soft plastic (Fig. 3);
- 27 samples of both textile and plastic were prepared from the excavated waste (three per meter of borehole of plastic and textile samples), each of which weighed 1 gram (weighed with 0,001 gr. accuracy);

Fig. 3. Samples of waste

RESEARCH PROCESS FLOW CHART

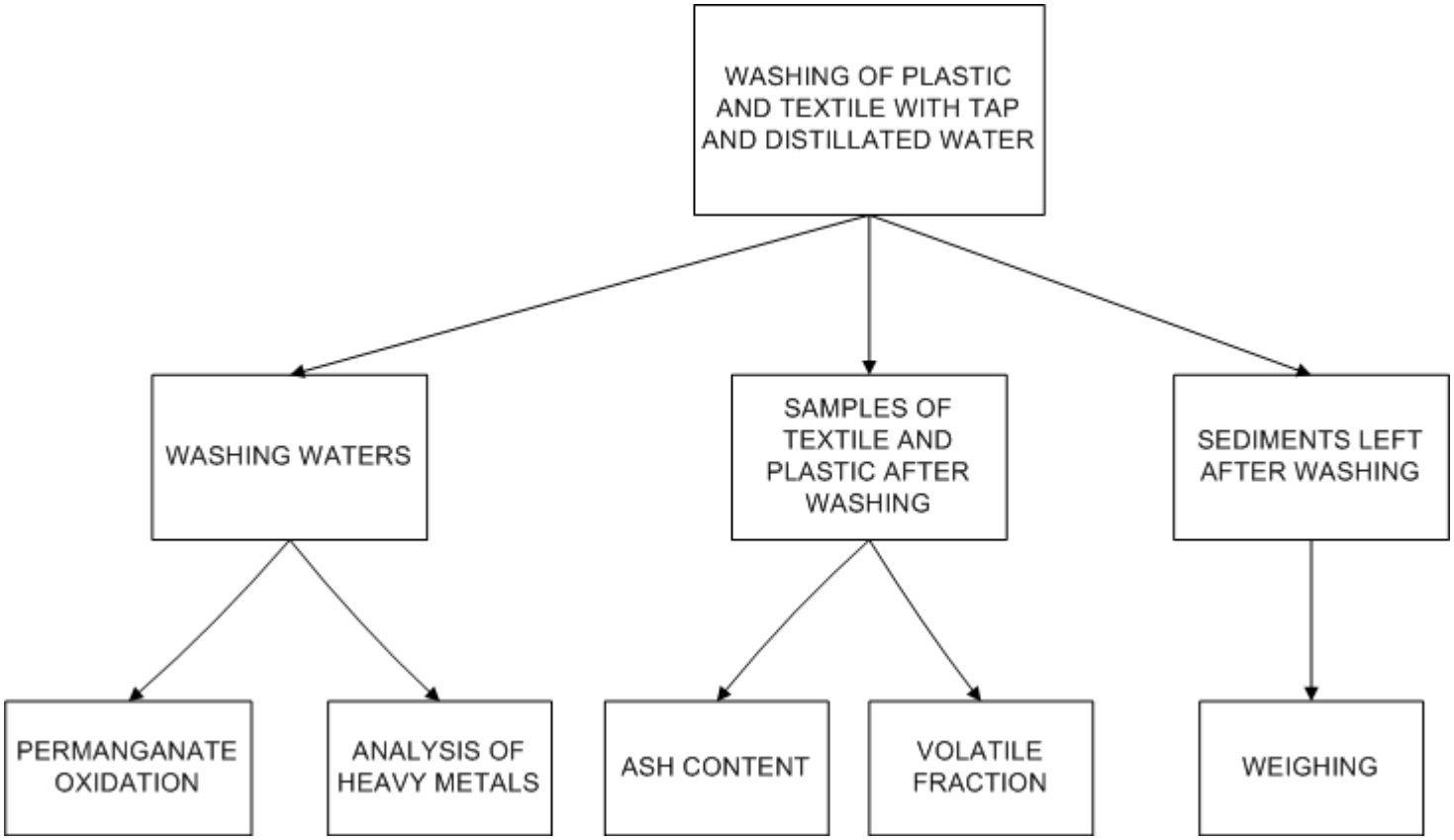


Fig. 4. Research process flow chart

ALYTUS REGIONAL LANDFILL

INVESTIGATION METHODS

Fig. 5. Drilling of boreholes

Fig. 6. Siewes used for fractioning

Fig. 7. Drilling process

WASHING OF EXCAVATED WASTE

- Samples were washed in laboratory to investigate changes of excavated waste;
- After washing small inorganic and humic part was removed from larger particles of combustible fraction, thus it was purified, in addition plastic calorific capacity increased after washing;
- Samples of excavated waste were washed with distilled and tap water, washing was repeated twice;
- Samples from all meters of 9 m depth were washed, beginning from 2nd meter.

Fig. 8. Washing of waste

PERMANGANATE OXIDATION

- Permanganate oxidation (ChDSMn) - one of the indirect methods, used for quantitative analysis of organic substances in natural waters;
- Organic matter in natural waters can be brought by streams and arise from vital performance products of variuos organisms.
- To determine total organic matter content indirect estimation techniques are used, which are based on unraveling organic materials with inorganic oxidants.
- Permanganate oxidation index results are calculated according to the formula:

$$x = \frac{(a-b)\cdot N \cdot 8 \cdot 1000}{V},$$

- Where: a - consumption of 0,01 N potassium permanganate solution volume for sample titration, ml; b - consumption of 0,01 N potassium permanganate solution volume for control sample titration, ml; N - equivalent concentration of potassium permanganate, mol/l; 8 – oxygen equivalent; V – volume of test water used during analysis, ml.

HEAVY METALS ANALYSIS

Content of heavy metals (Cu, Mn, Cu, Cd, Pb, Cu, Ni, Zn) in the washing water was determined using method of atomic absorption spectroscopy

Cu (concentrations from 0,045 to 0,206 mg/l) and Zn (concentrations from 0,113 to 0,892 mg/l) were found in all samples, Mn, Ni, Pb in some samples. Co, Cd, Cr were absent.

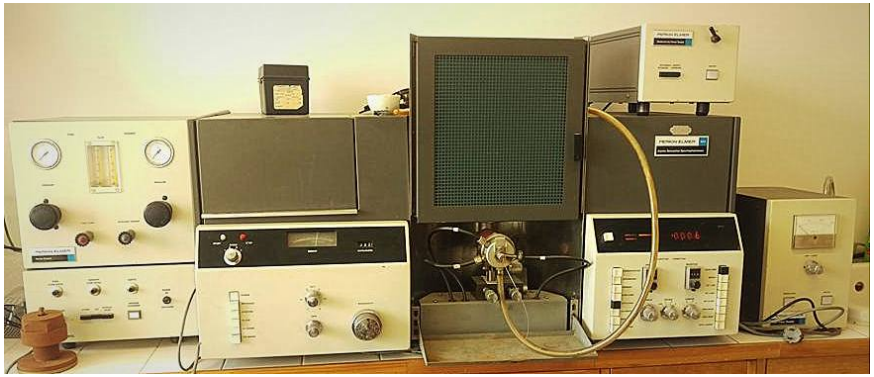
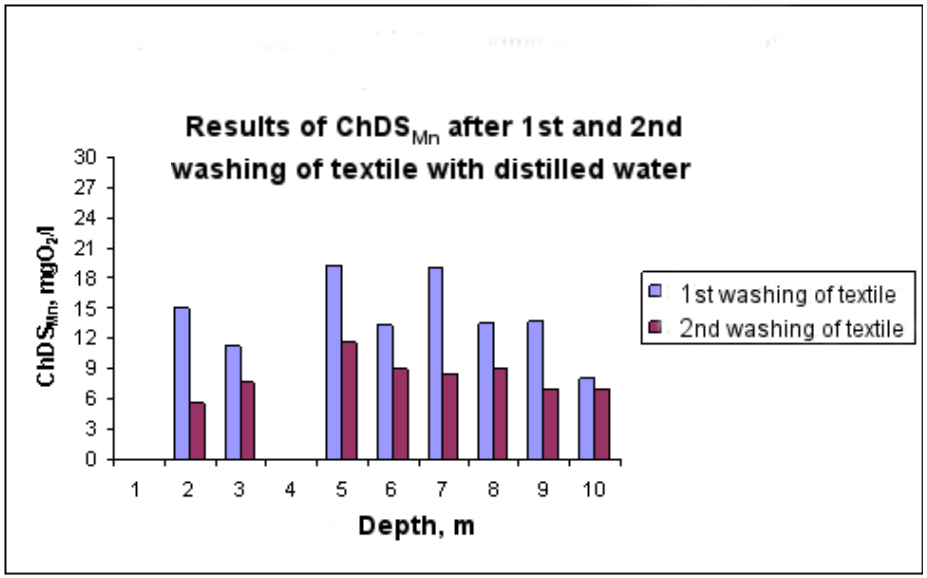


Fig. 9. Flame atomic absorption spectrometer

RESULTS OF WASHING OF TEXTILE



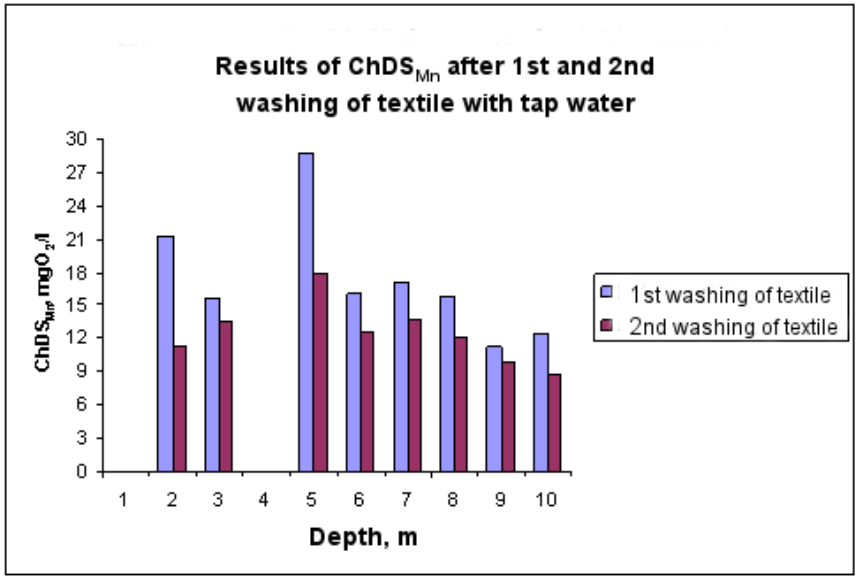


Fig. 10. Results of ChDS$_{Mn}$ analysis of textile washing waters

- After permanganate oxidation it can be noted that textile fraction the most polluted with organic residues were on the 2nd and 5th meter of borehole;
- Data shows that rainwater by flowing deeper carrying a variety of pollutants, which are absorbed by the textile waste in the first 5 meters.

RESULTS OF WASHING OF TEXTILE

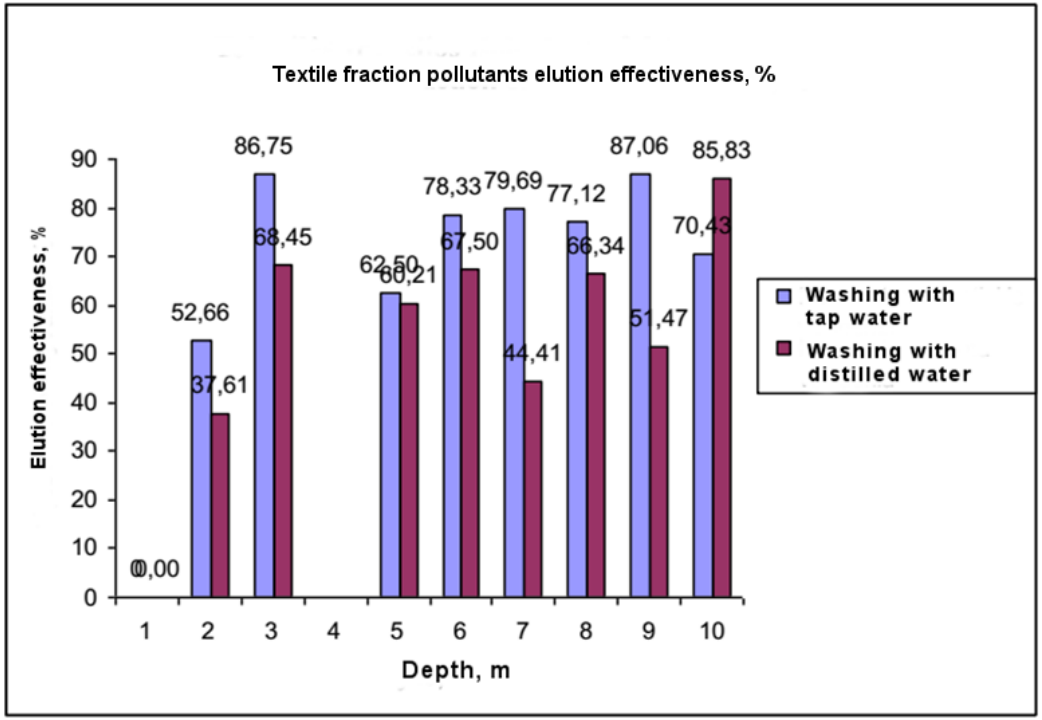


Fig. 11. Textile fraction pollutants elution effectiveness

- Efficiency of elution is significant by washing both with distilled and tap water – 57% by washing with tap water and 66% by washing with distilled water;

RESULTS OF WASHING OF PLASTIC

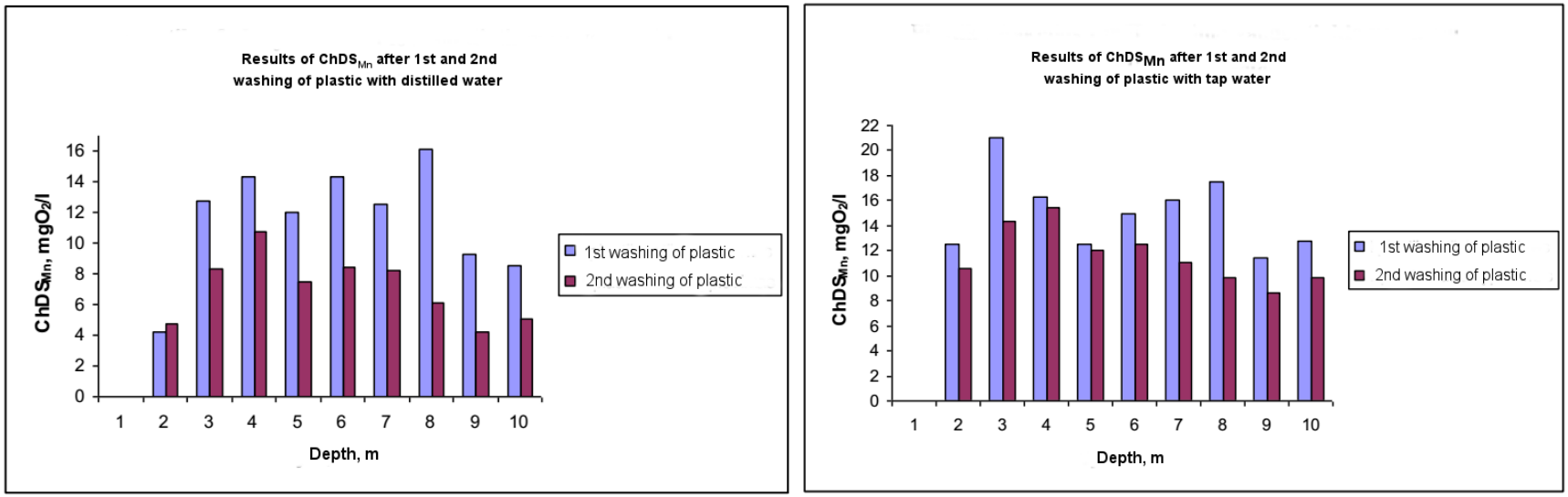


Fig. 12. Results of $ChDS_{Mn}$ analysis of plastic washing waters

- Maximum $ChDS_{Mn}$ values after analysis have been found in 3rd, 4th and 8th meters depth;
- It is clear that plastic fraction absorbing less pollution from environment due to lack of pores.

RESULTS OF WASHING OF PLASTIC

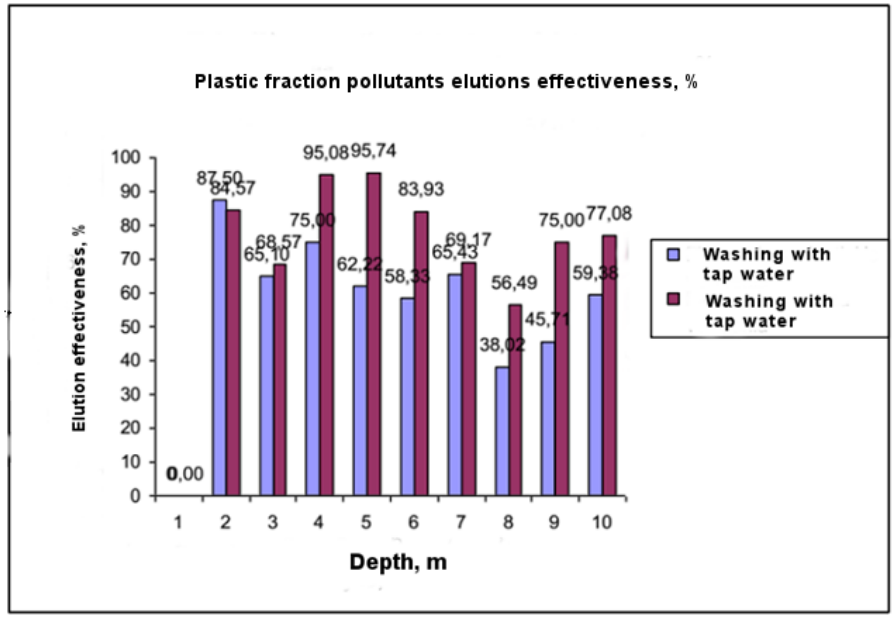


Fig. 13. Plastic fraction pollutants elution effectiveness

- Plastic elution efficiency while washing with tap water 55%, washing with distilled water – 70%;
- In this case distilled water better removed contaminants from the samples of plastic fraction.

ASH CONTENT

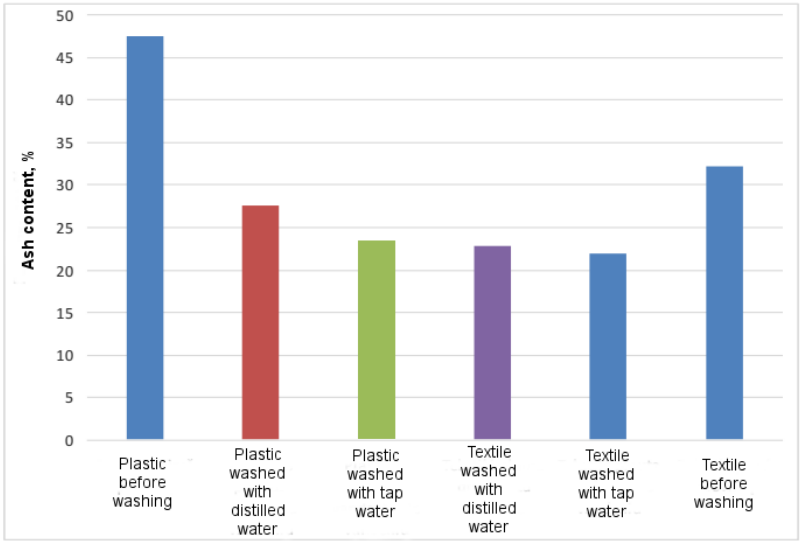


Fig. 14. Ash content of plastic and textile fractions before and after washing

- After washing waste fines and humic part from combustible waste fractions their ash content is reduced by about 5-15 per cent;
- Washing process reduces ash content of a fraction regardless of the type of water used for washing, thus improving fraction quality if it is used for fuel production.

VOLATILE FRACTION CONTENT

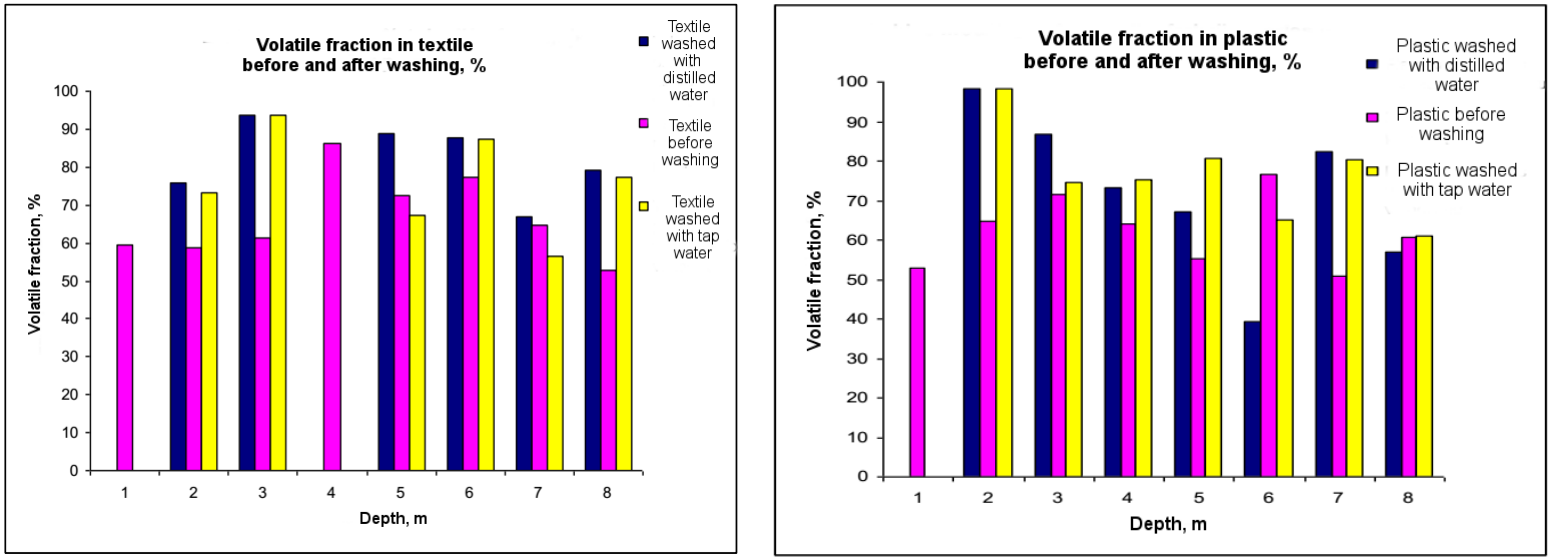


Fig. 14. Volatile fraction content of plastic and textile fractions before and after washing

- After washing volatile fraction increased about 10% in both textile and plastic fractions.

CONCLUSIONS

- After washing in laboratory textile and plastic waste fractions, using water and distilled water, organic matter and heavy metals were washed out and humus fractions of the surface portion was removed. The washing process was repeated twice, washing efficiency after second washing was determined as 60%.
- After analysis of permanganate oxidation of the washing water (leachate), the largest values of the oxidation have been found in the landfill layers between 2 and 7 m deep. Permanganate oxidation of washing plastic 19,27 mg O_2/l and textiles – 28,8 mg O_2/l have been determined. Zn and Cu were detected in all samples; Mn, Ni and Pb have been found in single samples.
- After the washing process, ash content of plastic and textile waste decreased on average about 10%. During washing process humus, which consists largely of inert material was washed out, so after washing the waste its ash content decreased.
- After washing volatile fraction increased about 10% in both textile and plastic fractions.
- The experimental results confirm the results of other researches that after washing excavated waste their energy properties improving and toxicity for the environment is reduced. However, to determine cost-effectiveness of the process detailed economic calculations are required.

THE END

Thanks for your attention