

ANALYSING THE SIZE OF FRAGMENTS RELEASED DURING THE WASHING OF TEXTILES USING THE LASER DIFFRACTION METHOD



ANALIZA VELIČINE FRAGMENATA OTPUŠTENIH TIJEKOM PRANJA **TEKSTILIJA PRIMJENOM METODE LASERSKE DIFRAKCIJE**

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AIM OF THIS WORK

Contribution to the problem of the release of particles during the washing process and to the methodology of analysing fragments released during the washing of polyester (PES) textiles after 5 and 10 washes.



Figure 1. Grafical abstract

- > The washing process was carried out according to HRN EN ISO 6330:2021 at a temperature of 60 °C with ECE A detergent and bath ratio of 1:7 with 4 rinsing cycles in SDL Atlas Rotawash laboratory equipment.
- > Effluent analysis was performed using standard methods to determine total solids (TS), total suspended solids (TSS) and total dissolved solids (TDS), turbidity and volume distribution of particle size using the laser diffraction method.
- \succ Gravimetric analysis was used to monitor the change in mass of the polyester textiles before and after the washing cycles.

RESULTS

- \succ The phisyco-chemical parameters of the effluents from 5 and 10 washing cycles are listed in Table 1.
- \triangleright After 10 washing cycles, an increase in the solids content and a decrease in the turbidity of the effluent can be observed.
- The mass of the PES textiles decreased from 123.08 g to 121.09 g, after 10 washing cycles, indicating that the released particles originated from the material.

	5 cycles	10 cycles
TSS (mg/L)	66.0	69.0
TS (mg/L)	678.3	682.4
TDS (mg/L)	560.2	550.1
рН	8.57	8.49
Conductivity (µS/cm)	982.8	814.3
Turbidity (NTU)	75.7	46.4
COD (mg O_2/L)	368	601

Table 1. Phisyco chemical parameters of the effluents
 from 5 and 10 washing cycles.

- \succ The particle size was measured using the laser diffraction method according to the Fraunhofer theory.
- \succ The measurement results obtained are expressed as a function of the particle size distribution - PSD curve.
- \succ The results are presented as a volume distribution (volume fraction/%) of particles of a certain size in a size interval, Figure 2.



Figure 2. Particle size distributions of washing effluents.

Computer support - KalliopeTM to determine the characteristic diameters D_{10} , D_{50} , D_{90} , mean size volume, shape factor (k), distribution width (Span) was used, Table 2.

 D_{10} 10% of the particles have a value smaller than the D_{10} value; D_{50} half of the particles in the sample have a diameter smaller than the D_{50} value; D_{90} 90% of the particles in the sample have a diameter smaller than the D_{90} value.

CONCLUSION

 \checkmark The results obtained show the influence of the washing cycles on all observed parameters of the solids content as well as on the distribution of particle sizes and their volume fraction in the effluents.

Table 2. Parameters of the PSD curve of effluents from 5 and 10 washing cycles

Parameters	D ₁₀	D ₅₀	D ₉₀	Mean	k	Span
5 cycles	6.102	18.095	34.980	20.618	1.833	1.596
10 cycles	4.805	13.716	27.580	15.962	1.833	1.661

- \checkmark Based on the results of the gravimetric analysis, it is clear that the released particles originate from the material.
- \checkmark The results originally contributed to the problem of the release of particles in the washing process and the methodology for analysing them.
- \checkmark The results obtained are used to analyse the assessment of the release of fragments during the washing of textiles containing polyester components in order to protect the environment from microplastic pollution.

REFERENCES

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