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THE EFFECT OF DUST PARTICLES ON CELLULOSE DEGRADATION

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This study was focused on changes of properties of cellulose filters Whatman 41 which took place as a consequence of contamination by dust particles and artificial ageing.

The dust particles fractions PM1 and PM10 from repositories of the State Regional Archives in Třeboň and the Research Library of South Bohemia at Zlatá Koruna (Czech Republic) were collected on cellulose filters. The Whatman 41 was selected as a representative of cellulose-based paper. In parallel the same size fractions were collected on polytetrafluorethylene and quartz filters. These samples were analysed gravimetrically, by Ion Chromatography, PIXE and thermal-optical method, giving mass, ionic, elemental and organic and elemental carbon concentrations. The sampling was carried out in the spring, the summer and the autumn of 2012. The mass of the dust particles deposited on the cellulose filter fluctuated between 6.6 and 61.1 $\mu\text{g}\cdot\text{cm}^{-2}$. The samples were aged at 80 °C and a relative humidity of 65 % for 28 days. Reference samples of pure Whatman 41 filters were aged in the same way. Monitored properties of the filter paper were the total color difference, the pH value of an aqueous extract and the viscosity-average degree of polymerization of cellulose.

On the basis of the results, a defined mass of pure ammonium sulphate was deposited on Whatman 41 filters under laboratory conditions and the samples were artificially aged. In this way a relative contribution of this ubiquitous compound to the total degradative effect of the dust particles could be estimated.

It was confirmed that Whatman 41 filters can undergo substantial changes when contaminated by dust particles and artificially aged. The degree of degradation showed a positive correlation with the content of sulphate ions in the dust particles. These changes could be monitored by the decrease of DP of cellulose (Fig. 1)

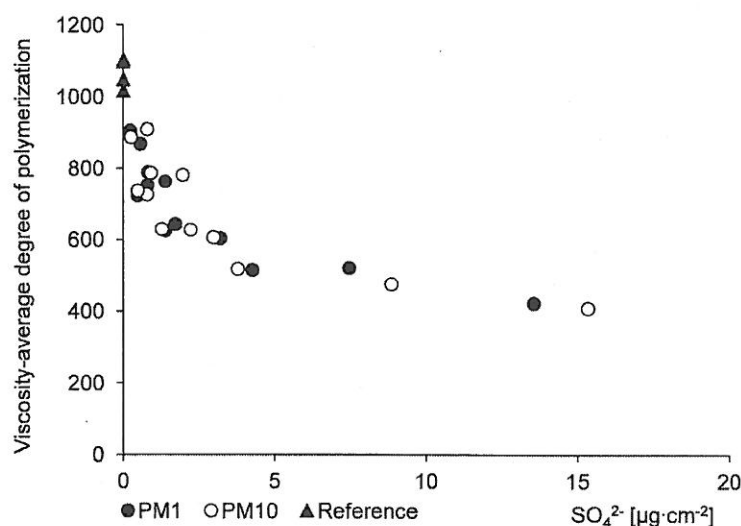


Fig. 1. Decrease of DP of cellulose in dependence on sulphate concentration for PM1 and PM10 particles.

The results of the measurement of the total color difference and the pH value of the aqueous extracts were in agreement with the results of DP measurements, although the sensitivity of those methods was lower. Considering the particle size fraction, the results obtained for PM1 and PM10 samples did not differ significantly, suggesting the decisive importance of the fine particles.

The degradative effect of the fine sulphate particles was also confirmed with the samples with the deposit of pure ammonium sulphate which showed a significant decrease of DP after artificial ageing. The question to what extent this compound can be degradative to paper under real conditions is studied at present.

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