Air Pollution and Paper Deterioration
Causes and Remedies

Anna Johansson
Department of Chemistry, Göteborg University, Göteborg, Sweden, 2000

ABSTRACT

The objectives of the work described in this thesis have been to determine effects, especially synergistic effects, of air pollutants (SO_2, NO_2 and O_3) and climate on the stability of cellulose materials, in particular paper used and stored in archives and libraries. To reach these objectives, a number of paper grades were selected and reference papers were manufactured.

The role of trace amounts of SO_2, NO_2 and O_3 on the degradation processes of paper was investigated using on-line gas analysis and *in situ* Diffuse Reflectance Infrared Fourier Transform spectrometry (DRIFT) and different reaction product characterisation techniques.

Five mass deacidification processes were evaluated with respect to their capability to provide protection against further acidification of papers. These processes were the *DEZ* (DiEthylZinc) gas phase process and the solvent-based processes *Battelle* based on magnesium titanium ethoxide, *Bookkeeper* based on MgO, *FMC* based on magnesium dibutoxytriethylene glycolate, *Wei T'o* based on methoxy magnesium methyl carbonate and, the *Sablé* process, which is a modified version of the Wei T'o process and uses a mixture of carbonated magnesium methoxide and ethoxide.

It was concluded that the relative humidity plays an important role in the uptake of air pollutants. Both NO_2 and O_3 were found to increase the uptake of SO_2 on paper. The addition of O_3 increased the SO_2 uptake both at 50 and at 85% relative humidity, whereas NO_2 was only active at the higher humidity.

The results show that the deacidification processes protect paper against the attack of acid air pollutants, although there are some quantitative differences. However, it was also shown that the alkali reserve *per se* does not provide an adequate protection from oxidants on paper.

This dissertation emphasises the importance of setting maintenance plans implementing preventive measures of improving the air quality in repositories in order to secure our written cultural heritage.

Key words: paper, calcium carbonate, mass deacidification, air-pollutants, sulphur dioxide, nitrogen dioxide, ozone, deposition, deterioration, conservation, alkali reserve, in situ, DRIFT