

NIR SPECTROSCOPY AND CHEMOMETRICS FOR NON-DESTRUCTIVE CHARACTERISATION OF HISTORICAL PAPER

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In museums, archives and libraries, the application of analytical techniques in the absence of chemicals or solvents is preferred. The time of analysis should be short, as occasionally a considerable number of items are surveyed to establish the state of preservation of a collection. If possible, the instrument should be easy to use by non-professionals.

While the use of mid-IR spectroscopy in material analysis is widespread, near-IR spectroscopy is gaining in importance. However, real (aged) paper is often too complex to allow for an exact analytical interpretation of spectra. In order to extract complex spectral information, chemometric analysis of data is a widespread approach, which can be successful if care is taken to avoid misleading or overly optimistic results. Partial least squares (PLS) allows for correlation of spectral and chemical information. We report on the development of a multi-analytical non-destructive approach to historical paper analysis using NIR spectroscopy with chemometric data evaluation. Based on the chemical and spectroscopic analysis of more than 1500 historical samples from AD 1650 onward, we developed a method, which enables us to characterize historical paper in view of gelatine content, ash content, aluminium content, lignin content, pH, degree of polymerization of cellulose and other properties. A lightweight and portable instrument has been developed and designed in cooperation with conservators and curators.

Since the described approach is non-destructive, it can be used for analysis of even the most valuable paper objects. In addition, the analysis of an individual object can be performed in a matter of seconds, thus enabling us to survey whole collections effectively.