SurveNIR Project – Development of a Non-Destructive Tool for Paper Characterisation Based on NIR spectroscopy

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Abstract

Assessment of the state of archival, museum and library collection is a task of high priority. Depending on the type and size of the collection, surveying may also be one of the most demanding tasks in terms of the necessary resources.

The aim of the 6th Framework EC co-funded SurveNIR project is to develop a near-infrared-spectroscopic instrument with software incorporating multivariate chemometric analysis of the spectra. By relating the spectral information to classical chemical and mechanical testing, the end users will be provided with an objective survey tool allowing reagent-less multi-component low-cost analysis of items. The instrument prototype has already been produced, while the software is under development. The tool will be tested in seven collections, thus validating the developed approach.

Introduction

Paper-based documents have long been, and still are, the most important witness to human activity. Fortunately, paper is a long-lived material provided that the production technology favours its stability and provided that it is stored in a favourable environment. However, most of the paper produced between 1850 and 1990 is likely not to survive more than a century or two, due to the inherent acidity auto-catalysing the degradation of paper.

Traditionally, the preservation state of a paper-based collection is assessed visually, and simple physical and chemical tests are performed, such as the folding test [1] or determination of pH of paper using pH-indicator pens. Some of the survey tests are also highly individual [2]. Although these traditional methods are invasive or destructive they were often necessary in order to reveal the condition of a collection, the general conservation needs and in order to plan preservation activities. NIR spectroscopy in combination with chemometric data evaluation was already used for evaluation of cellulose degradation during accelerated ageing experiments [3]. The intention of the SurveNIR project is to provide museums, libraries and archival collections with a non-destructive chemical-free low-cost surveying tool that would provide more in-depth information as the traditional methods but would also be user-friendly and would not require extensive technical knowledge of the surveyor [4].

Materials & Methods

As a part of the new instrument (Figure 1), software will be developed, which will incorporate chemometric data evaluation. Chemometry will allow the analysis of a large amount of information – represented by the large number of reflection NIR spectra taken in a collection.

Results

Basing on a set of more than a thousand of real samples, the chemometric software, now in the development phase, will enable us to model paper properties on the basis of near infrared spectra. It is planned that the new instrument will be used to evaluate paper pH, degree of polymerization (molecular weight of cellulose in paper), mechanical properties (tensile strength and zero span), presence of lignin, etc. These data are needed to plan conservation procedures and examples of successful modelling of chemical properties from NIR spectra will be shown on the poster.

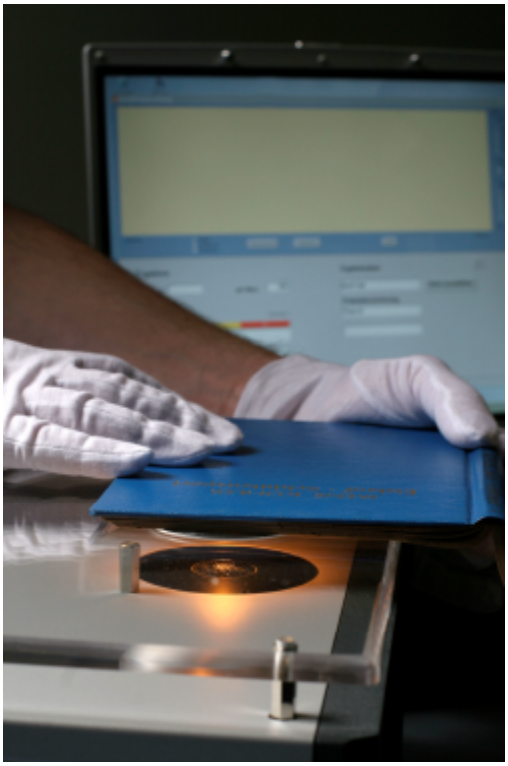

Fig. 1; The SurveNIR instrument for non-destructive evaluation of paper chemical and mechanical properties and for collection surveying, based on chemometric evaluation of NIR spectra.

Case studies in seven collections from European countries in three different types of paper-based collections – museum, library and archive – will be performed to validate the approach.

References

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