

## THE KNIHA PROJECT IN SLOVAKIA

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### 1. Introduction

The Kniha<sup>SK</sup> project is aimed at supporting education, research and industry in the field of Conservation Science, Technology and Industry (CSTI) in Slovakia. There are an adequate number of highly-qualified human resources which is the basic requirement for CSTI development in the country. The project is a consequence of the programme statement of the Slovak Government, and has been elaborated by the Consortium of the Slovak University of Technology, Slovak National Library, Slovak National Archive, Slovak Academy of Sciences and the private sector. The project Kniha<sup>SK</sup> should lead to establishment and development of a modern conservation industry in the field of preservation of millions of books and documents in Slovakia in the first decades of the 21<sup>st</sup> century. According to the project scheme, it will be oriented also to the field of protection of other information carriers - wood, textile, inorganic and metal materials, as well as preservation of other historical artefacts and monuments.

### 2. Results

The most substantial results of the Project Kniha<sup>SK</sup> were accomplished:

1. Consortium Kniha<sup>SK</sup> is presently the owner and a co-owner of know-how, of 33 patents, licences and trademarks. The solutions of the project problems were published in 257 publications<sup>1-7</sup> of which 77 in current contents and peer-reviewed journals and 16 in scientific monographs and book publications.

2. The number and interest of high school and university students in chemistry and preservation technology of cultural heritage has increased, including the interest of higher university education, research and modern technologies of analysis and preservation; 2 PhD - dissertation theses were successfully defended, 76 diploma, bachelor and student science theses elaborated.

3. The shared space of world-wide and new own knowledge, intranet communication system and virtual work space for researchers of the project, which can be found at <http://kniha.chtf.stuba.sk/dav>, as well as the shared potential of instruments and devices available for education and research of protection of cultural heritage was enlarged and improved. The information on the shared potential of instruments and equipments is now available for the Consortium Kniha<sup>SK</sup> members as multimedia DVD catalogue; the new internet portal informing about aims and continuous results of the project Kniha<sup>SK</sup> was created and can be found at <http://www.knihask.eu>.

5. A system of sorting books was improved. Guidelines for description of the state of documents in stores of libraries and archives in SR were prepared. Conditions for evaluation of the state and for sorting of the other (non-paper) traditional material carriers of information and objects of cultural heritage were established as well.

One of the goals of the Kniha<sup>SK</sup> project lies in the elaboration of a multi-criteria system of evaluation of the efficiency and quality of deacidification processes and related equipment, and in selection of technologies intended for further development in Slovakia in the nearest period.

The evaluation system of the Consortium Kniha<sup>SK</sup> takes into account the needs of Slovakia in the field of promoting own university education, research, technological development and culture. Up to now, the evaluation has been applied to test mainly wood-containing types of paper, the type most sensitive to ageing and important paper type for the Slovakian collections.

### 3. Evaluation Criteria

The following criteria stem from a multi-criteria evaluation systems of Kniha<sup>SK</sup> and Library of Congress:<sup>8</sup>

#### 3.1. Innovation Potential

The selected technology platforms must possess good innovating potential for the continuing university research and technological development (RTD), higher education in Slovakia or in cooperation, and continuing employment rise of highly-qualified human resources in the RTD and innovative new industries in the Slovak Republic and in collaborative RTD with EU partners. This implies for the CSTI area, the protection of cultural and natural heritage, renewable resources as well as new industries areas.

#### 3.2. Efficacy in Term of Increased Mechanical Permanence and Lifetime Prolongation

This criterion, proposed by the Library of Congress (LoC, USA, 1994), reads as follows: "efficacy of deacidification process on tested paper, which is expressed as the rate at which paper loses strength upon accelerated ageing (e.g. at 90 °C / 50 RH for up to 30 days), it shall be decreased by at least a factor of 3.0, when the logarithm of the folding endurance is plotted against time in days. The permanence of

the treated paper shall be increased by a factor of 300%, the books should keep their utility properties 3 - times longer".

### 3.3. pH and Alkaline Reserve, their Stability

### 3.4. Price of Technology and Deacidification

### 3.5. Risk Assessment:

- Damage of documents.
- Explosion hazard.
- Fire hazard.
- Health hazard.
- Environmental hazard.
- Chemical hazard.

## 4. Results of Comparative Evaluation

The first part of the comparative evaluation has been completed based on wood-containing test paper and test books evaluation. The objective testing and evaluation of stabilised paper, documents and conservation technologies, along with the development and improvements of new non-destructive, micro-chemical, micro-sampling and quasi-non-destructive methods and validation of the testing methods is the continuing activity of the Consortium Kniha<sup>SK</sup> in the Slovak Republic.

### 4.1. Innovation Potential.

Based on the multi-criteria evaluation system, in particular on the criterion of "innovation potential", the best option for continuous research, development and university education in Slovakia is the HMDO (ZFB/Nitrochemie) and air (Libertec/SoBu) platforms. Stemming from the inherently free nature of the university research, no platforms, companies or cooperation activities requiring or trying to retard or forbid to publish the research results and/or to exploit them in university educational activities, can be accepted.

### 4.2. The Efficacy

The efficacy in term of increased stability of mechanical properties and life-time prolongation requirement as adopted by the Kniha<sup>SK</sup> consortium and the project proposed by the LoC, Washington, has been best met by the processes implemented the HMDO (Nitrochemie, Wimmis; Battelle, Eschborn; ZFB, Leipzig) and air (SoBu, FÜRth) platforms.

The wood-containing test paper composed of 55% of mechanical bleached groundwood, 20% of bleached kraft pulp, 15% scrap fibres and 10% clay, with surface pH = 5.6 was subjected to testing; model test books were prepared from the paper and treated at the Battelle, Eschborn; ZFB, Leipzig; Nitrochemie, Wimmis; UPC, Barcelona; Preservation Academy, Leipzig (PAL); SOBU, Fürth. Sheets of wood-containing paper were sent to Neschen, Bückeberg; and Preservation Technologies (PTI), Heerhugowaard.

The ageing was carried out with samples encapsulated in a PET-Al-PE foil bags at  $96 \pm 2$  °C with an exception of Bookkeeper process (PTI, Heerhugowaard) using dry ageing process of loose sheets of the test paper at 105 °C. Mechanical, optical and chemical properties were measured, published in internal research reports of the Consortium. The results obtained at the testing laboratory IPST, Atlanta for the Bookkeeper deacidification process,<sup>8</sup> were accepted as provided.

A part of the results presenting the mechanical folding endurance permanence evaluation is shown in Figure 1. The order of deacidification processes quality was made based on Consortium Kniha<sup>SK</sup>, Bratislava, and LoC, Washington methods. The requirement: the coefficient of lifetime prolongation  $S_{t,\alpha}$  must reach the value of 3 as a minimum.

Requirements concerning pH and alkaline reserve were met at all evaluated processes, but some of them, e.g. PAL-CSC process failed at both the pH stability and the alkaline reserve stability during accelerated ageing in closed vessels.

Based on the criterion of price, air based technology is the most cost-efficient.

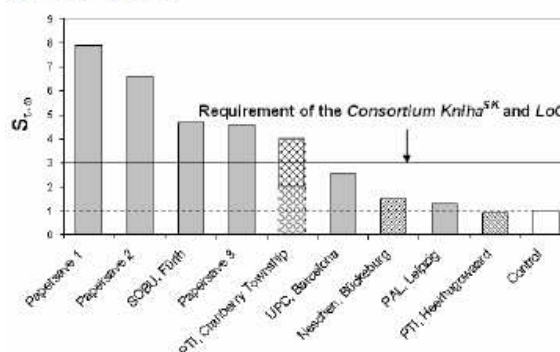


Figure 1: Comparative evaluation of deacidification efficacy based on the 1<sup>st</sup> criterion of the Consortium and Testing Lab Kniha<sup>SK</sup>, Bel Novamann International, Bratislava and the Library of Congress, Washington.<sup>8</sup>

$S_{t,\alpha}$  - coefficient of ageing time change; the index  $S_{t,\alpha}$  is related to a non-modified, non-deacidified control sample having  $S_{t,\alpha} = 1$ .

- Processes evaluated in the Consortium Kniha<sup>SK</sup> Testing Lab, the test books of A5 format (wood-containing paper, 55% of mechanical bleached groundwood, 20% of bleached kraft pulp, 15% scrap fibres and 10% clay, surface pH = 5.6), ageing conditions: accelerated ageing in closed bags from composite foil (PET-Al-PE),  $98 \pm 2$  °C, 15 days.<sup>9-11</sup>
- Ditto, the test sheets of A5 format, accelerated ageing, 105 °C.<sup>12</sup>
- Process evaluated in the Consortium Kniha<sup>SK</sup> Testing Lab, the test sheets of A5 format (wood-containing paper, 55% of mechanical bleached groundwood, 20% of bleached kraft pulp, 15% scrap fibres and 10% clay, surface pH = 5.6), ageing conditions: accelerated ageing in closed bags (PET-Al-PE),  $98 \pm 2$  °C, 15 days.<sup>10</sup>
- Process evaluated at the IPST, Atlanta and at the LoC,<sup>8</sup> various kinds of test sheets (pH = 5.7 - 9.42), accelerated ageing at 90 °C and 50% RH during 30 days.

Control - untreated paper of the same type as the treated/ deacidified one.

### 4.3. Risk Assessment.

It is known that the older water-based deacidification processes Neschen, Bückeberg, or Vienna process cause the most severe deformation, buckling, cockling of paper and

mainly the deformations of book cover, either evaluated subjectively, or using objective laser methods, and therefore they are not suitable for book deacidification. On the other hand water enables the deepest diffusion of water-soluble deacidifying agents into the cell walls and molecular structure of lignocellulosics. The deformation in other processes is either negligible or small.

Considering the criterion fire and explosion hazard, the safest options are the air platforms (SoBu / Libertec/ Bückeberg), followed by techniques employing freons and halogenated hydrocarbons (UPC Barcelona; PAL, Leipzig; Bookkeeper, PTI, Cranberry Township and Heerhugowaard) and ending with the most dangerous techniques with regard to fire and explosion hazard, HMDO (ZFB, Leipzig; Nitrochemie, Wimmis; Battelle, Eschborn) due to the large volumes of the liquid HMDO per 1 kg of processed documents, with high flammability and the flash point 1 °C.

The processes exploiting water and air are characterised by low health and chemical risks or none.

These air and water based technologies are also the most ecological with the lowest environmental risk. Higher environmental risk is attributed to procedures supporting the increase of production, and utilisation of freons or other halogenated hydrocarbons (as compared by the Global Potential Warming (GPW) indicator), or organic solvents.

Based on the unbiased multi-criteria evaluation, HMDO and air based stabilizing technologies are at the time being the most suitable procedures, both having currently their specific advantages and drawbacks, as well as sound potential for the future development, creating good conditions for the further development of the university education and RTD in the country in the conservation science and technology area.

## 5. Acknowledgement

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