TECHNOLOGY OFFER

"Washing machine for books" – Mass-Deacidification of Archival Materials

This technology offers a novel method and technical device to conveniently prevent cultural assets from destruction on a large scale. This so-called "book washing machine" uses a method based on a non-aqueous chemical process at elevated pressure using multifunctional alkaline composite nanoparticles or pure alkaline compounds and nitrogen gas or supercritical CO_2 for deacidification of diverse archival materials. It is used for low-cost restoration of old books, paper documents, paper money, and other biopolymer-based items stored in archives and libraries.

BACKGROUND

For paper, which represents the largest share of world-wide cellulose-based material of world heritage value, the decomposition or degradation, due to acid-catalyzed hydrolysis predominantly caused by the well-established application of alum in previous periods, leads to an irreversible depolymerization of cellulose chains by breaking the hemi-acetal bonds between different constituents of cellulose molecules (glucose monomers), thus accounting for a substantial loss of mechanical strength. The acid hydrolysis of cellulose occurring during the aging process accounts for 95% of all damages, and is considered the major cause for the degradation of cellulosic materials. Therefore, understanding the degradation process (increased acidity, ink corrosion, yellowing, embrittlement, microbial degradation) is the basis for the development of efficient preservation treatments. To circumvent the above-mentioned problems, several paper deacidification processes were developed and improved in the past decades, but still the issues related to the complete removal of acidity and to bring an adequate alkaline reserve in the papers, together with enrichment of mechanical strength has not been reached so far.

TECHNOLOGY

The invention is based on non-aqueous chemical process and treatment at elevated pressure using alkaline compounds as composite nanoparticles and amines and nitrogen gas or super critical CO_2, for the mass scale deacidification of archival materials (paper and books). This method consists of two steps:

(1) Manufacturing of hydrophobically modified alkaline composite nanoparticles from cellulose derivatives and alkaline metal oxide nanoparticles or pure alkaline compounds based on silicon oligomers or alkyl amines.

(2) Neutralization of acids in archival materials using non-polar organic solvents or supercritical CO_2 (exhibiting interfacial surface tension lower than 20 mN/m) acting as a carrier system for alkaline composite nanoparticles or pure alkaline compounds obtained from step 1 under elevated pressure.

ADVANTAGES

- Both deacidification processes are economic, efficient and provide a homogenous distribution of nanoparticles / cationic compounds both in the interior and on the surfaces of paper.
- This novel approach eliminates the acid-catalyzed hydrolysis of cellulose macromolecules by neutralization of acidity present in archival material, creates an alkaline reserve (1-2 wt.-%) that is sufficient to neutralize the acid to be generated during further aging, and increases mechanical strength by 40-50 % without removing the ink or changing the transparency of paper samples.
- Although results are currently based on $Ca(OH)_2$-HEC or –MC functionalized particles, this method can be extended to other metal oxide nanoparticles like $CaCO_3$, $MgCO_3$, $Ba(OH)_2$ and hydrophilic polymers such as carboxymethyl cellulose (CMC) and ethyl cellulose (EC) and other cellulose derivatives and their combinations.

APPLICATIONS

Restoration of old books, paper documents, bank notes, and other biopolymer-based items.

WISSENS/ TRANSFER/ SÜD/

www.wtz-sued.at

KEYWORDS:
Deacidification
Nanoparticles
Non-aqueous
Chemical process
Restoration
Rescue
Preservation
Archival material
Books
Paper

INVENTORS:
RIBITSCH, VOLKER
KARGL, RUPERT
TAMILSELVAN, MOHAN
AMORNKITBAMRUNG, LUNJAKORN

COOPERATION OPTIONS:
LICENSE AGREEMENT
R&D AGREEMENT

DEVELOPMENT STATUS:
PROOF OF CONCEPT

STATUS OF PATENTS:
EUROPEAN PATENT EP3072933
GRANTED ON 05/05/2021
VALIDATED IN AT, CH, DE, GB, IE, IT, PL, SI, FR

REFERENCE NUMBER
2014_12

CONTACT:

Gernot Faustmann
University of Graz
Research Management
Technology Transfer
Universitaetsplatz 3
8010 Graz
T: +43 316 380 3994
gernot.faustmann@uni-graz.at
www.uni-graz.at

UNI GRAZ