

Practical Investigations and Applications on the Conservation of the Special Collections from the Library of “Ștefan cel Mare” National College, Suceava. Investigations and Treatments

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In this article, the authors present the results obtained by specialized expertise, on the basis of the scientific arguments resulting from the examination of the documents, as well as of the pre-digitization interventions for the preservation of the special collections from the Library of “Ștefan cel Mare” National College, Suceava, in order to digitize them. The authors consider that this scientific approach is necessary for the development of the practical concept of pre-digitization as a working tool for the digitisable documents in the special collections belonging to the Library of “Ștefan cel Mare” National College, Suceava, for their introduction in the cultural and scientific flow. In the literature on the protection of documents, pre-digitization represents the set of investigations and preventive-curative interventions performed in library environments, especially in the morphological structure of documents, in order to investigate, stop and eradicate the complex of identified degradation factors, of physical, mechanical, chemical and biological etiology. In the case of the Library of “Ștefan cel Mare” National College, Suceava, pre-digitization is the essential stage of preparation of the documents, in order to carry out digitization operations under appropriate conditions.

Keywords: *pre-digitization; mobile cultural heritage; preservation; special collections; school library; documents*

1. Importance of the theme. Arguments. Motivation

Libraries, museums and archives holding special collections of documents are legally obliged to ensure proper storage, preservation and consultation-research of the documents of great interest to the public. There are known several libraries that hold “under lock and key” special collections too little known but of a great historical, cultural or scientific value. Keeping these values “under lock and key” is a bad practice commonly found in libraries, whereby the managing librarian, directly responsible for the integrity and security of valuable documents, blocks the researcher's access to the documentary source.

Considering the special value of the documents that are part of the special collections, the concerns of the manager, the old book specialist and the library conservator (in libraries where there are permanent concerns for the protection of special collections) to borrow documents valuable for

consultation in the reading rooms of the institution under the direct supervision of specialists are however normal. Beyond assuming these concerns about ensuring the security and integrity of documents, we ask ourselves: *How the patrimonial info-documentary values can become known? Only through exhibitions or some thematic presentations?* The results are known: there are libraries with special collections that are not enough researched or which want as these values to remain unknown.

The real reasons are:

- the professional training of (pseudo) library managers in the field of modern libraries is modest;
- fear of the unknown: some educators and / or culture educators continue to fear that these values, once known, can be taken at any time for the establishment of a new cultural establishment of regional or national interest;
- the lack of funding sources for Expertise Studies, prepared by an expert accredited by the Ministry of Culture, in order to establish the patrimony category for the old printed and manuscript by the Ranking Procedure on the basis of a report as an expertise;
- lack of library space and facilities for special collections requiring generous locations with microclimatic stability and appropriate storage, conservation and consultation modules.

Starting from the realities encountered in most libraries that hold special collections, it is considered as necessary and appropriate the elaboration and implementation of a set of measures of a scientific, legal, administrative, financial, fiscal and technical nature to ensure the identification, research, inventory, ranking, preservation, security, maintenance, restoration and, last but not least, the digitization of these values (Deac et al. 2017).

2. Advantages and disadvantages of digitizing valuable documents from libraries, museums and archives

The preservation of valuable documents in electronic format has definite advantages for the important libraries and archives in Romania, which have impressive special collections:

- making digital substitutes and putting them in circulation, the holding institutions preserve their original documents, prolonging their physical and informational integrity;
- preserving the original and its protection from various forms of degradation, as well as the risk of its removal or substitution with a surrogate on paper;
- by digitization, for the heritage books are created special preservation conditions in individual conservation modules, thus prolonging the existence of the cultural values on paper support;
- digitization is carried out with a scientific interest, in order to capitalize on the scientific content of the documents, by facilitating users' access to information;
- digitization offers the access possibility to a large number of users to unique or special collections that can usually be viewed by one person at once; it is the most attractive practical application of the digitization project, since the access to digital copies of the original materials by a large audience brings a great service to the library and equally to the users of the institution.

The main disadvantages of the digitization process are:

- it changes the original layout of the page and generates certain character recognition errors, which involves text (re-reading) check-up and correction, often a difficult and tedious operation;
- it does not recognize characters from non-Latin alphabets as well as some diacritical marks in the manuscripts;

- digitization projects are very expensive; the need for specialized personnel and state-of-the-art technical infrastructure often involves the highest costs in the project, which cannot be covered only by the charges imposed to the users;
- digitization is not a stable preservation mode; the only long-term information storage media accepted by the specialists is the quality paper or microfilm.

In conclusion, before starting a digitization project for valuable library documents, you need to know the answers to a series of questions that should clarify the whole approach:

- What does the institution (library, museum, archive) gain by digitizing the special collections?
- Have any analyzes been made on the impact of the digitization project of the special collections according to the structure, value and conservation status of the info-documentary collections?
- Were the analyses conducted by conservative specialists in accredited laboratories for investigations and interventions?
- How will the digitization project be covered on the core activities of the institution?
- What are the costs, or the degree of supportability generated by the digitization project?
- What will be the impact of the digitization project on the public?
- Is there a legislative, regulatory and normative framework to serve as a basis for creating some management and compliance tools with the legal aspects of digitization: visibility, interoperability, integrity, authenticity and sustainability of information?
- What are the methods for verifying the effectiveness of the digitization project?
- Has the digitization project been successful?

2.1 Arguments and motivation of the scientific approach

The present material contains a summary of the activities undertaken at the Library of “Ștefan cel Mare” National College in Suceava, in order to investigate the multifactorial degradation complex identified on 74 stock units (S.U.) belonging to the special fund of the college library and performing interventions under the specific conditions of this library.

The symptomatology of the degradation complex of the special collections represented a first stage of the assessment of the conservation status, according to which we gradually established the intervention program: the products used for each category of degradation; the dose used; the technical modalities for applying the treatment; optimal microclimate factors (temperature, relative humidity, intensity and nature of the light source); technical modalities of *in situ* intervention on the document: on the external contact surfaces of the document, smoothing of the covers by brushing and fine diffusion of nanoparticles, thermotherapy etc.

Regarding the evolution of the microclimate physical parameters in the library's storage rooms (especially relative temperature and humidity), the college board provided the funding for the procurement and installation of relative temperature and humidity monitoring equipment for values below 48% of RH, so that the recorded values are appropriate for the preservation of the special collections: 22-23°C ambient temperature and 50-52% RH. The light source, as well as its intensity, corresponds to the rules required for the preservation of special collections.

A library where, rarely in the network of pre-university libraries and not only, the librarian Corina Dominte, a PhD student at “Ștefan cel Mare” University of Suceava, also acquired the superior quality of conservator by attending and completing a two-year specialty course. This professional symbiosis that appeared in a short time between the teams from Oradea - the Conservation-Research Laboratory at “Gheorghe Șincai” County Library, represented by Vasile Deac, and the Library of the University of Oradea, represented by Ionela Burz can be explained only this way.

This collaboration started with an internship of about 15 days (18.06-5.07.2018) of Dr. Vasile Deac, an expert in the preservation of library collections, at the Library of “Ștefan cel Mare” National College, Suceava, for carrying out investigations and interventions on the special collections stock. Based on these investigations, on the state of conservation of collections and sanitation of deposits and access paths, the treatments indicated to neutralize the most important degradation factors and the consolidation of information carrier paper were developed and applied. The curative and preventive interventions concerning the conservation status of the special collections, carried out together with Corina Dominte (PhD student), taking advantage of her conservator professional quality, represented an interesting scientific approach as a professional duality and optimal as the rigor and finality of the operations specific to the info-documentary conservation activity.

2.2 “Norman Manea” Library of “Ștefan cel Mare” National College, Suceava

Historical landmarks

The evolution of the “Norman Manea” Library in time merges with that of the first upper secondary school in Southern Bucovina - Griechisch-orientalische kaiserliche-königliche Obergymnasium in Suczawa, today's “Ștefan cel Mare” National College. Classical high school with teaching in German, founded by imperial decree (1860), the institution was supported by the Church Fund of Bucovina. In 1881, the classes with full tuition in Romanian were set up at the lower secondary school, in 1900 the high school being divided into two sections (Romanian and German). The last German class was abolished in 1923. The existence of the Romanian parallel classes is due to the Romanian professors who have produced manuals according to the Austrian curriculum for all disciplines, promoting the history, the Romanian language and culture (Programm... 1863). The monument building was built in 1895 and placed on the list of historical monuments in 2015.

The foundations of the library of books in Romanian at the Suceava gymnasium were made by Constantin Morariu-Andrievisci, the first Romanian teacher of the high school (1860-1869) and the first author of textbooks. Originally established for the specialized department, the library with books in Romanian functioned initially clandestinely in the gymnasium in Suceava, being assaulted by the teenagers thirsty of knowledge, despite the ban and the severe penalties imposed by the German-orientation director Johann Limberger (Cernat&Lazarovici 2006).

During the Austrian period, a library core was established and consolidated. The first book purchase for the library was recorded in the institution's first yearbook (1863). Among the 33 titles purchased, the literary criticism of the German classics, Greek and Latin writers, atlases, periodicals and school textbooks were predominant (Programm... 1863). In 1884, citizens of Suceava and students of the gymnasium, as a sign of profound appreciation shown to the institution, enriched the book fund of the teachers' library with 210 titles. Of the six volumes of patrimonial value, three have been preserved until today: Ioan Bobb, *Dicționarul românesc, latinesc și unguresc* (1822, 1823, Cluj), *Dictionnaire italien-français-espagnol* (1671, Geneva), Joannis Alexi, *Gramatica daco-romana sive valachica* (1826, Vienna).

The publishing editions of the Sucevean high school library were a tedious process. If in 1871 the library reported a total of 4,507 volumes, of which 259 volumes were of Romanian literature before the war the high school had a library with over 11,000 titles. The funds for the purchase of the books had different sources: the church fund with an annual average of about 250 florins (until 1918), the School Casket (100 florins, the annual average), the “Romanian School” Society (250 florins on average annual). Important donations came from authorities, teachers and high school

students.

Witness to a turbulent history, the existence of the high school library was marked by the crucial events unfolding during the two major world conflagrations. Between June 21, 1916 and February 2, 1918, the building was requisitioned for the Soviet army and turned into a military hospital, then in the barracks (December 1916); the Russian soldiers devastated the museums and the library, when returning from the refuge, the teaching staff found chaos (Burduhos 1922).

The interwar period was a post-war rebuilding and re-consolidation period of the library. It is noted the particularly valuable donation of the scholar Ilie Toroutiu, a graduate of the high school, the 1911 generation. The 1,568 volumes and booklets donated by Ilie Toroutiu in 1935 greatly enriched the dowry of the high school library. On October 14, 1947, the library reported a total of 11,550 volumes, of which 8,570 volumes in the teachers' library (Liceul "Ștefan cel Mare" Suceava 1947).

The outbreak of the war also affected the good course of Suceava's education. Between June 12 and November 15, 1941, the high school building was occupied by the Surgical Military Hospital no. 613 (Liceul "Ștefan cel Mare" Suceava 1941). Teachers went to retreat in Slatina-Olt, taking the most valuable assets of the school. Due to the lack of means of transport, almost the entire library remained unevacuated; only the yearbooks of high school for the years 1886-1939 and 94 of the "oldest and rare and irreplaceable books" in the teachers' library reached Slatina (Liceul "Ștefan cel Mare" Suceava 1941).

The saving of the high school heritage in Suceava during the war is due to physical education teacher Aurelian Buleandra who took care of its preservation. Part of the books were built in the cellar of the monument building, others were housed in private dwellings in the locality. Thus, with the whole warfare, when the the teaching staff returned on the 2nd of May 1945, the high school site was found intact and "only a few gaps in teaching material, furniture and library" (Liceul "Ștefan cel Mare" Suceava 1947).

Saved from the purges of the 1950s by the care of warm-hearted people, with vast culture and skills in books, the old book fund, affected by moisture and mold, was maintained, preserved and seated on the shelf. If in 1966, after the reorganization of the library, the number of publications was 18,956 volumes, of which 9,456 volumes in the documentary fund, at the end of the third semester of 1977, the library held 27,857 volumes.

The post-December 1989 period included an extensive restructuring and reorganization of the library, imposed by the rehabilitation works of the monument building (2001-2005). The books in the documentary fund and those in the usual fund were deposited during the work in the gym hall of the building, increasing its wearing coefficient. The return of the bibliophile and modern book fund in the new space was completed in December 2007. On December, 31, 2007, the school library had 48,376 volumes. Beginning with 2009, the purchases of budgeted documents have been fluctuating due to the cessation of the allocation of financial resources from the state budget to school libraries amid the crisis. In the period 2008-2016, the library's increase was of 3,878 volumes.

If in 1914, before the Russian occupation, when it was really possible to speak of an own library, the number of publications reached about 13,000 volumes, today it counts over 52,000 volumes, of

which 9,601 are bibliophile valuables, bibliographic rarities, documents with “ex libris” or with autographed dedications.

Special collections

The bibliophilic valuables, which are treasured up by the Library of “Ștefan cel Mare” National College, Suceava, refer to the beginnings of typographical art through the year of its appearance. The collection of old Romanian and foreign books includes printed publications between 1581-1831. The library of the college holds three volumes of old Romanian books and seven volumes of old foreign books from donations: Joannis Alexi, *Gramatica daco-romana sive valachica* (1826, Vienna); Veniamin Costache, *Funie întreită* (1831, Iași); Cicero, *Ad Atticum. Libri XVI* (1581, Strasbourg) - the oldest printed book in the special collections of the high school library; Francois Viète, *Opera mathematica* (1646); Christophor Forstner, *Ad Libros Annalium C. Cornelii Taciti. Notae Politicae* (1661, 1662, Frankfurt); Joh. Freinshemio, *Supplementa Liviana* (1662, Strasbourg & Frankfurt); Jean Antoine de Tournes and Samuel de Tournes, *Tesoro de las tres lenguas* (1671, Geneva); Carl Christian Erhard Schmid, *Moralphilosophie* (1793, Jena).

The collection of old periodicals includes titles such as: *Magazin istoric pentru Dacia* (1845-1847), *Foaia Soțietății pentru Literatura și Cultura Română în Bucovina* (1865-1869, Cernăuți), *Familia* (1869-1878, Pesta), *Convorbiri literare* (1870-1941, Iași-Bucharest), *Arhiva pentru filologie și istorie* (1869, Blaj), *Analele Societății Academice Române* (1869-1940, Bucharest), *Albina Pindului* (1868, Bucharest), *Columna lui Traian* (1876, Bucharest), *Candela* (1882-1930, Cernăuți), *Almanachulu societății academice Social-Literare “România Jună”* (1883, 1888, Vienna), *Gazeta matematică* (1897-1911, Bucharest), etc.

The value of the publications in the collections of the high school library is also conferred by the autographs of numerous personalities of the Romanian cultural life: Simion Florea Marian, Alexandru Bocăneț, Vasile Grecu, Victor Morariu, Leca Morariu, Ion Nistor, Eusebie Popovici, Ilie Torouțiu, George Voevidca etc..

3. Materials and methods of investigation, intervention and applied research

Table 1 highlights the main products used in the pre-digitization treatments by preserving and restoring the info-documentary collections in libraries, museums and archives.

Their destination, methods and principles of intervention, as well as the proven effectiveness in the preservation of info-documentary collections from libraries, archives and museums were considered. This chapter is the first step in developing technologies, depending on the products and technical devices of intervention, for technologies that work in preserving, restoring and sanitizing the collections and places from libraries, museums or archives. As such, the products and technical provisions outlined in Table 1 may set up intervention sheets for conservation and / or restoration treatments and provide the basis for the costs of the treatments, depending on the cyclical evolution of degradations.

Table 1. *Materials, bio-chemical products and their destination. Methods and principles of intervention and applied research in the conservation and sanitation of library collections and locations*

Crt. no.	Materials and products used	Purpose	Methods and principles of intervention	Efficiency achieved in conservation and sanitation treatments
1.	<i>Nanoparticles of magnesium oxide</i>	Neutralization of paper collections acidity	Minimally invasive wet methods: spraying or brushing	Very good efficiency in neutralizing the acidity of special collections (between 1.5 and 3 pH-metric units)
2.	<i>Nanoparticles of calcium oxide</i>	Neutralizing the acidity of collections on paper	Minimally invasive wet methods: spraying or brushing	Good efficiency in neutralizing the acidity of special collections (between 1 and 2 pH-metric units). When overdosage, after drying, white spots of different sizes are formed
3.	<i>Isopropyl alcohol</i>	Decontamination treatments of library collections with active biodegradation symptoms	Mixed with products used to neutralize paper acidity	Good efficiency in the decontamination of degraded collections with cellulite fungi/ cellulosic fungi and/or pathogenic bacteria
4.	<i>Klucel G</i> -hydroxypropylcellulose non-ionic, water-soluble and in most polar organic solvents, reversible in water after drying	The product is used for fixing colors, including pastels, and especially as a hardening agent for the preparation of alcoholic or hydroalcoholic gels in a concentration of 3-5.5%	Wet methods: brushing for color fixation, including pastels, black and white or color photographs	Very good efficiency in the preservation-restoration treatments of special collections, being used as a hardening agent for the preparation of alcoholic or hydroalcoholic gels
5.	<i>Tylose MH 300 P</i> -methylhydroxyethyl cellulose soluble in cold water and insoluble in hot water and organic solvents	The aqueous solutions have a neutral pH and are therefore they are successfully used as an emulsifying agent to cure and preserve photographs or to bond the textiles	Wet methods: brushing over the entire contact surface; if necessary, a new brushing operation is performed to achieve the treatment	Very good efficiency in photo preservation or restoration
6.	<i>Carboxymethylcellulose -CMC AB57</i>	Water-soluble sodium salt with which it forms a high-density mixture with very good retention properties; it is insoluble in organic solvents	Wet methods: brushing on the paper contact surfaces	The product is used for the preservation and restoration of paper-based collections, for the cleaning of inorganic or organic surfaces, which give them fixotropic and thickening properties
7.	<i>Synthetic saliva CTS (SSC)</i>	Synthetic saliva CTS (SSC) is an aqueous solution of mucin protein and sodium chelate and triammonium citrate, which reproduce the detergent and emulsifying characteristics of natural saliva	Wet methods: cleaning on document pages using wet napkins with synthetic saliva solution. It can be used for light cleansing, removal of dust or enzymatic gels. In exceptional cases, SSC carries in the emulsion fragments of materials, partially hydrolysed by the action of the enzyme	Synthetic saliva CTS is used in preparatory preservation and / or restoration treatments for light document cleaning. Since the combination of lyophilized mucin in the citrate solution, the mucin properties have been gradually denatured with significant losses

In the procedures for preservation and restoration of info-documentary collections, two stages are required: *preventive interventions* and *curative interventions*. More details have been presented in the section *Scientific results. Scientific analyzes*. Regarding the structure of Table 1 and its usefulness in developing non-invasive intervention technologies, the authors consider that all the analytical elements included in Table 1 (materials and products used, their destination in the preservation and restoration of bibliophile collections, the methods and principles of intervention with the products highlighted for the preservation of collections and their efficiency in the application of these products), the following clarifications are brought:

- for the use of a product or some product combinations (of those specified in the table or purchased from other commercial sources) it is imperative that the use of laboratory-tested technical formulas is applied according to the following objective factors: the state of conservation of the collections, the factors of degradation identified and their nature, the factors of toxic aggression, the impact of the product on the health of the operators and users, the experience, the professional level of conservator's training, the technical endowment in the undertaken interventions (locations that are set-up, aerated and sanitized, with microclimatic stability) etc.;
- all the used products and combinations of products must protect the paper support which is an information carrier and, equally, the information itself;
- . from the point of view of the post-treatment reactions, after the drying of the paper support treated with the preservative, it is necessary to ensure the restoration of the chemical indices (neutralization of the paper acidity - $\text{pH} > 7$);
- certified conservators will safely manipulate and use the materials and products intended for conservation-restoration treatments, avoiding toxic products for users of documents in libraries, museums and archives.

4. Scientific results. Scientific analyzes

The Library of “Ștefan cel Mare” National College in Suceava is one of the most interesting library institutions in the pre-university system in Romania, which currently has a very rich documentary fund. It hoards over 52,000 volumes (S.U.), of which 9601 S.U. are bibliophile valuables and rarities, documents with *ex-libris* or autograph dedications.

Compared to 1914, before the Russian occupation, when it was really possible to speak of the presence of an independent library, the publications amounting to about 13,000 volumes, the current fund of documents in the library is about four times bigger. It is concluded that this library can aspire through its glorious secular past, to a great present, and especially to a future of its own.

The analysis of the state of preservation of the special collections at “Ștefan cel Mare” National College in Suceava implies the knowledge and understanding of the history of this cultural institution, affected by moments of crisis during the two world wars.



We must be forever grateful to those who have risked their lives to save the special collections - the cultural and scientific wealth of the school, the Bucovina spirituality and the entire Romanian space; to thank those who, with great caress and passion, managed to save the cultural dignity of the library during the two world wars and after the change of the political regime, giving it a cultural, educational and scientific role that was passed on to future generations.

Regarding the state of preservation of the collections of the library, several technical aspects have been highlighted, which contribute to the creation of a healthy environment for the preservation, preservation and exploitation by research of the special collections in the library:

- the library is located on the ground floor, with NE positioning, towards the inner courtyard;
- aeration is done in the morning, for about two hours, to remove the hydrogen peroxides resulting in the spaces accessible to people;
- storage and preservation facilities of the collections are metal shelves;
- special linoleum flooring;
- library is equipped with a fire alarm system and an anti-burglary alarm system.

Analyzing the dynamics of the physical microclimate factors in the library location (external factors involved in preserving the library collections) according to the multi-annual values, the following microclimatic aspects were highlighted:

- minimum multi-annual winter temperature varies between 17⁰C and 20⁰C;
- multi-annual maximum temperature in summer varies between 24⁰C and 25⁰C;
- multi-annual relative humidity values in winter show a minimum of about 20% R.H., or a high multi-annual value during summer ranging from 53% to 67% R.H.

In order to correct low relative humidity values, especially during the cold season, the library purchased B 250-type humidifiers, with electronic display and water evaporation disc, operating in three stages: silently at low speed; the second stage - at maximum speed for rapid humidification; automatically, the third stage, whereby the humidifier selects its humidification mode according to the humidity requirements of the atmosphere at the library locations.

4.1 Principles of interventions on the conservation of the investigated info-documentary collections

These principles were the basis for the preparation and carrying out of the treatments of the 74 S.U., as follows:

- principle of authenticity - preservation of the original elements;
- principle of patina preservation - preservation of the original patina (the old aspect of the conserved info-documentary product);
- principle of minimal intervention - avoiding radical measures in conducting interventions;
- principle of perfectly documented additions and reinforcements;
- principle of reversibility and compatibility - in the treatments for preservation of the collections of the Library of "Ștefan cel Mare" National College, Suceava, reversible products were used, which, after a certain number of years and under special conditions of preservation, can be dissolved in deionized water, with neutral pH to develop and apply a more effective treatment for document preservation for a longer period of time.

**4.2 Principles and techniques of minimally invasive treatment used
in modern conservation and restoration interventions
on info-documentary collections in libraries, archives and museums**

Conservation and/or restoration treatments of paper-based info-documentary collections should initially involve individual/document risk assessment and minimally invasive treatment depending on the present category of risk and its severity. The condition for the elimination (annihilation, healing) of the degradation symptoms of library documents in the early stages of development is the preservation of the organic integrity of the treated document. *The minimally invasive intervention concept can be called, by forcing the note, a preventive preservation, which implies abandoning the classical approach focused on constructing participatory multi-product interventions that would produce the expected effects for the treated document, with greater financial efforts and the presence of some secondary participatory risks of the products (the form of reaction residues).*

Essentially, for the protection of document collections in libraries, museums and archives, the minimally invasive treatment involves early undertaken investigations that allow for the extinction of the incipient degradation factors by using a minimally invasive treatment method. It is understood that the treatments included in this system are especially indicative of the early stages of degradation of collections, when the intervention scheme is much simplified and the financial effort is diminished.

Under extreme conditions and situations, when the level of multifactorial degradation of collections exceeds the early stages of prevention (alarm), there is a need to develop and carry out curative eradication treatments which, with all the financial effort required for the procurement and application of intervention products, as well as of the risks involved in multi-product treatment formulas must be outlined and applied as a matter of urgency. Serious intervention means for the protection of info-documentary collections from libraries, archives and museums occur under various difficult-to-anticipate conditions, but they must be managed to the extent that documents are saved with maximum efficiency: unpolluted technical solutions, reduced as number and quantity, as it is possible. As such, the minimally invasive treatment applied in these situations consists of a minimum of technical solutions applied to stagnate and extinguish the multifactorial complex of document degradation.

**4.3 Investigations regarding the state of preservation of the collections
in the Library of “Ștefan cel Mare” National College, Suceava**

Table 2. *Acidity of the sample collection (74 S.U.)*

Specification	Paper acidity values grouped by analytical standard (analytical groups)				
	≤ 4	4.1-5	5.1-6	6.1 -7	≥ 7
Number of investigated library documents / analytical groups	6 S.U.	15 S.U.	35 S.U.	18 S.U.	-
Post-operative results (after treatments)	0 S.U.	0 S.U.	0 S.U.	0 S.U.	74 S.U.

Analyzes of pre- and post-treatment paper acidity were performed by using special laboratory magnifiers and investigations of chemical degradation symptoms. From the analysis of Table 2 it was found that the 74 documents investigated showed very acidic or acidic values, which required the elaboration and application of a minimally invasive intervention system consisting of two stages as follows:

- **Wet cleaning treatment with Saliva CTS/SSC** (aqueous solution of a mucin protein and sodium chelates and triammonium citrate; wet cleaning method on document pages with wet napkins (removal of dust or enzyme gels);
- **Composite treatment with 3-5% magnesium oxide nanoparticles (3-5% calcium oxide) diluted in 2% isopropyl alcohol and deionized water**, after dilution and homogenization, are sprayed on the inner and outer components of the treated documents with beneficial effects: neutralizing the acidity of document pages; their decontamination; removal of chemical reaction products.

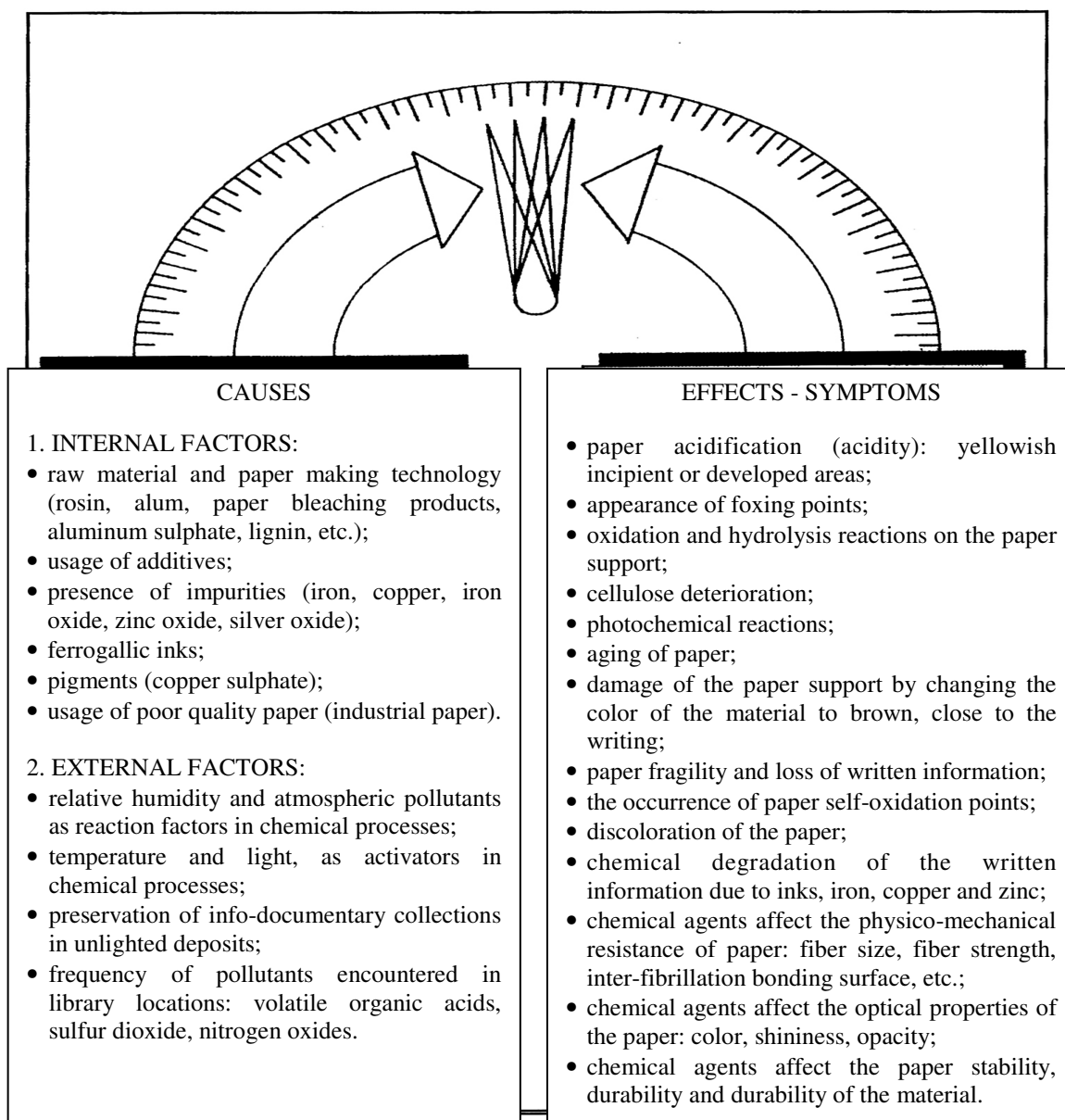


Figure 1. Factorial study by cause-effect balance in the presentation of chemical etiology degradations of documents in libraries, archives and museums

The post-operative results (after the presented treatments) revealed paper acid neutralization effects and a pH greater than 7 in all the 74 documents investigated and treated. In Figure 1, the balance of causes-effects in the installation of chemical degradation in collections has been highlighted.

Table 3. *Symptoms of biodegradations identified on the investigated sample (74 S.U.)*

Specification	Cellulosic fungi	Pathogenic bacteria	Paper-eating insects	Rodents
Number of documents with symptoms	28 S.U.	17 S.U.	18 S.U. inactive galleries	11 S.U. symptoms-frays
Post-treatment results	0 S.U.	0 S.U.	0 S.U.	0 S.U.

The special collections at “Ștefan cel Mare” National College Library in Suceava show active and/or passive (biased) biodegradation symptoms and, as a percentage, the presence of cellulosic fungi and bacteria on the components of the documents, but also on other organic library environments, holds a higher load than symptoms of faunistic attack (insects and rodents), which is due to the improper conditions (insalubrious spaces) in which these collections were kept during global conflagrations. As such, it is not surprising that the document stock in this library must be investigated and handled in order to protect the documents.

Simultaneously with the specific activities on the document stock, conservative specialists trained in the field of library hygiene must intervene preventively and/or curatively for the hygiene of all library environments. Aspects of technical facilities for monitoring physical microclimate parameters, fire detection and extinction facilities and other technical risk hardening facilities are permanent areas that support the normal development of all activities related to documents from libraries, archives and museums.

In terms of treatment with magnesium oxide or calcium oxide nanoparticles, it develops a method of treating, chemical preservation/restoration and biological disinfection of the surface of degraded historical paper (as demonstrated by laboratory determinations), by using nanoparticle suspensions in hydroxyapatite alcoholic solution (2% isopropyl alcohol diluted in deionized water at pH > 8). This treatment involves making connections between pulverized nanoparticles and cellulose fibers in degraded paper, enhancing paper strength and consistency, inducing the biological disinfection of paper, correcting paper acidity. All steps involving the manipulation of powdered nanoparticles must be done with great care by the conservator; in manipulation of magnesium oxide nanoparticles, the operator must use special protective equipment.

In summary, we presented the intervention scheme for the decontamination and deacidification of collections with biodegradation symptoms:

- **Wet cleaning treatment with saliva CTS/SSC, aqueous solution of a Mucin protein, in combination with 2% isopropyl alcohol and bidistilled water.** Wet cleaning and deep decontamination treatment on the structure of historical paper with the help of napkins moistured in the solution. This first step of the intervention is to sanitize the treated document by eliminating the physical-chemical-mechanical reaction fractions, while triggering microbiological decontamination surface reactions.
- **Wet composite treatment with 5% magnesium oxide nanoparticles, diluted in 4% isopropyl alcohol and deionized water.** After dilution and homogenization, the contents were

sprayed on the inner and outer components of the investigated document. Post-treatment analyzes performed with special magnifiers within the first three days after treatment have revealed the inactivation capabilities of aspergillus-penicillium fungi, as well as a remarkable contribution to *pH correction on papers*.

- **Treatment for preventing *Anobium punctatum* infection present in the holes in wooden coverings.** Intervention with PER-XIL 10 insecticide by injecting into each orifice and filling the orifices treated with insecticide glomeruli to close these holes.

Investigations carried out three days after the treatment showed that for the decontamination of the collections, these nanoparticle and isopropyl alcohol treatments promote the disinfection of the contaminated documents (Table 3).

Investigations of the active biological structures of the *Anobium punctatum* insect in the attack galleries revealed a necrosis of the biological material (ponta), and the glomerulus insecticide had a repellent effect of rejection on the rodents. In Figure 1, the factorial study was presented by the cause-effect balance in the presentation of the fungal etiology degradations (cellulosic and pathogen fungi) of the documents in libraries, museums and archives. In Figure 2, the size of a population of biodegradable agents, depending on the connections between abiotic and biotic growth factors and inhibitory factors were presented. Their knowledge can provide useful information in the intervention processes in the size of a population by activating inhibitory factors.



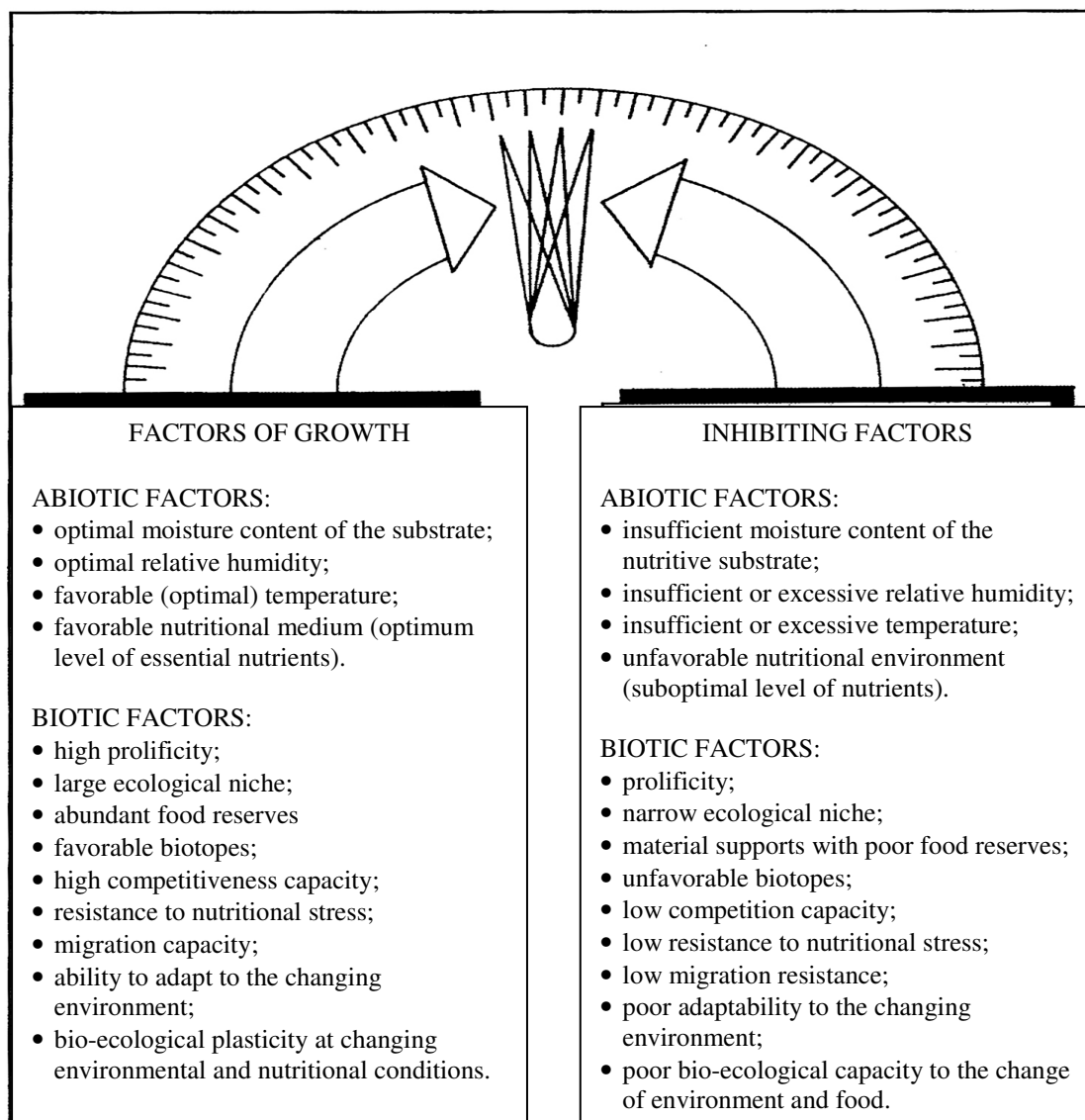


Figure 2. The size of a population is the result of the action of factors that favorably influence the size of the population (growth factors) and of unfavorable factors (environmental resistance). Fundamental study for the evolution of biological factors in libraries, archives and museums (cellulosic and pathogenic fungi and bacteria, bibliophage and xylophage insects, rodents)

Table 4. Sample 74 S.U. - physical degradation symptoms (documents affected by excessive moisture)

Specification	Incipient symptoms with excessive moisture (10% of the document's body)	Symptoms developed with excessive moisture (> 20% of the document's body)	Compact document due to the permanent excessive moisture	Documents affected by excessive moisture, but dried - morphologically sensitized pages - the internal structure of the affected paper
Number of documents with symptoms	0 S.U.	0 S.U.	0 S.U.	74 S.U.
After intervention - treatments of hardening	0 S.U.	0 S.U.	0 S.U.	0 S.U.

From the analysis of Table 4, it was found that the sample of investigated documents presented pages affected at different stages of excessive moisture, which in time had dried but which remained with the internal structure of the affected paper, morphological sensitivity highlighted in the handling of the pages. Therefore, when developing minimally invasive treatments, restoring paper hardening, decontamination and correction indices were considered. The structure of the intervention program was outlined below.

- **Wet cleaning treatment with saliva CTS/SSC with soaked napkins.** Expected effect: removing previous sources of chemical reactions and products, restoring paper by eliminating folds.
- **Wet chemical treatment for paper hardening, restoration of physical-chemical indices, correction of paper acidity, decontamination of affected papers, protection of color photographs.** Use of 2% magnesium oxide in combination with 3% Klucel G, which is used for color fixation, including pastels and especially as a hardening agent for the preparation of alcoholic or hydroalcoholic gels. In the case of spores of cellulosic fungi, it is recommended to use isopropyl alcohol in a quantitative ratio fairly to those produced from the intervention recipe. In Figure 3, activation factors and inhibitory factors are noted in the incidence of physical factors.

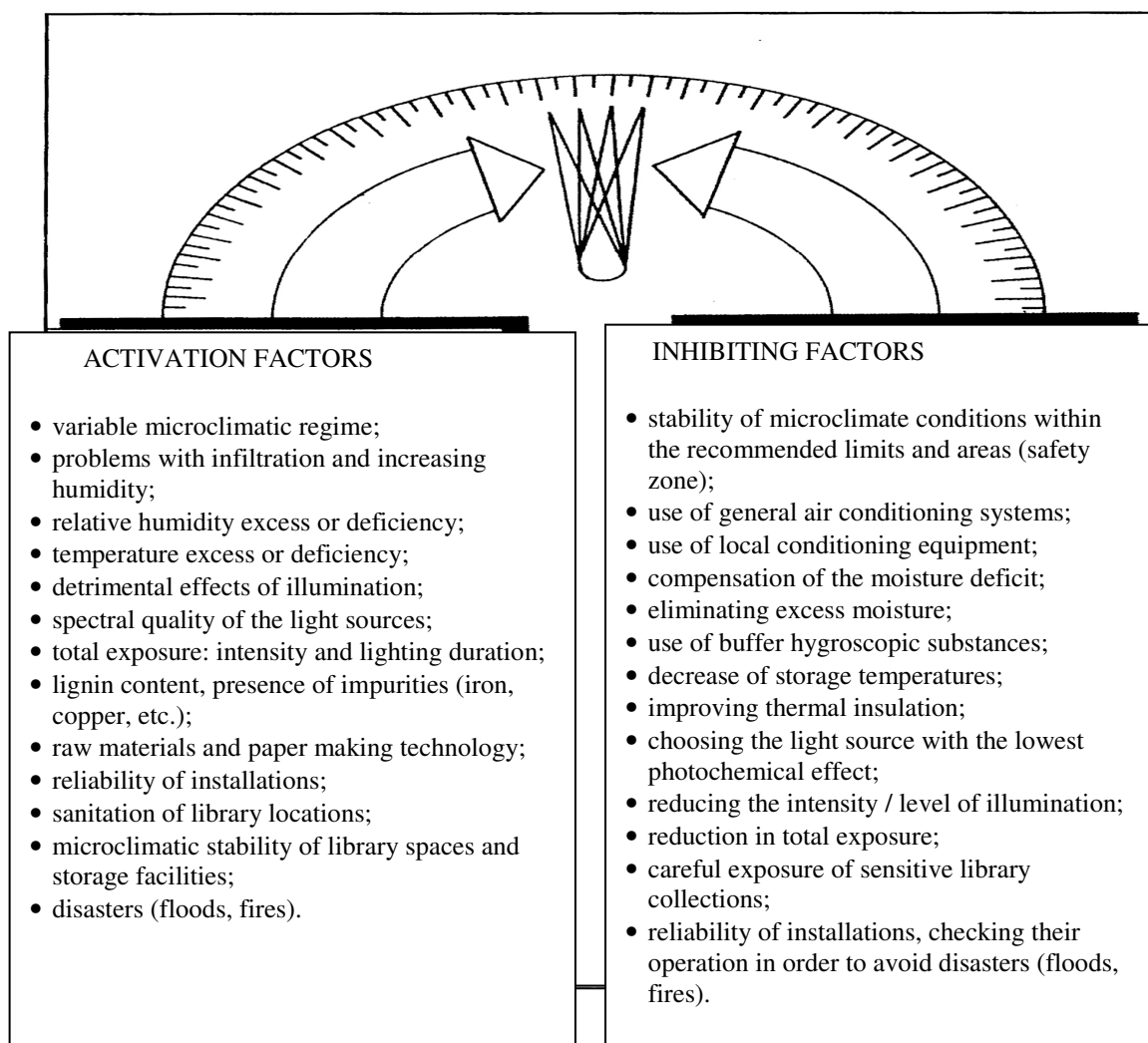


Figure 3. *Incidence of physical factors in installing and developing degradations of library collections, depending on the outcome of the action of favorable and unfavorable factors*

Table 5. *Sample 74 S.U. - symptoms of mechanical degradation (ruptures, detachments, tears, separation, forced folding, deformations, cracks, etc.)*

Specification	≤10% of the document's body: incipient symptoms of mechanical degradation	11-30% of the document's body: developed symptoms of mechanical degradation	≥31% of the document's body: very advanced mechanical degradation symptoms
Number of documents with mechanical symptoms	23 S.U.	45 S.U.	6 S.U.
After performing restoration interventions	0 S.U.	0 S.U.	0 S.U.

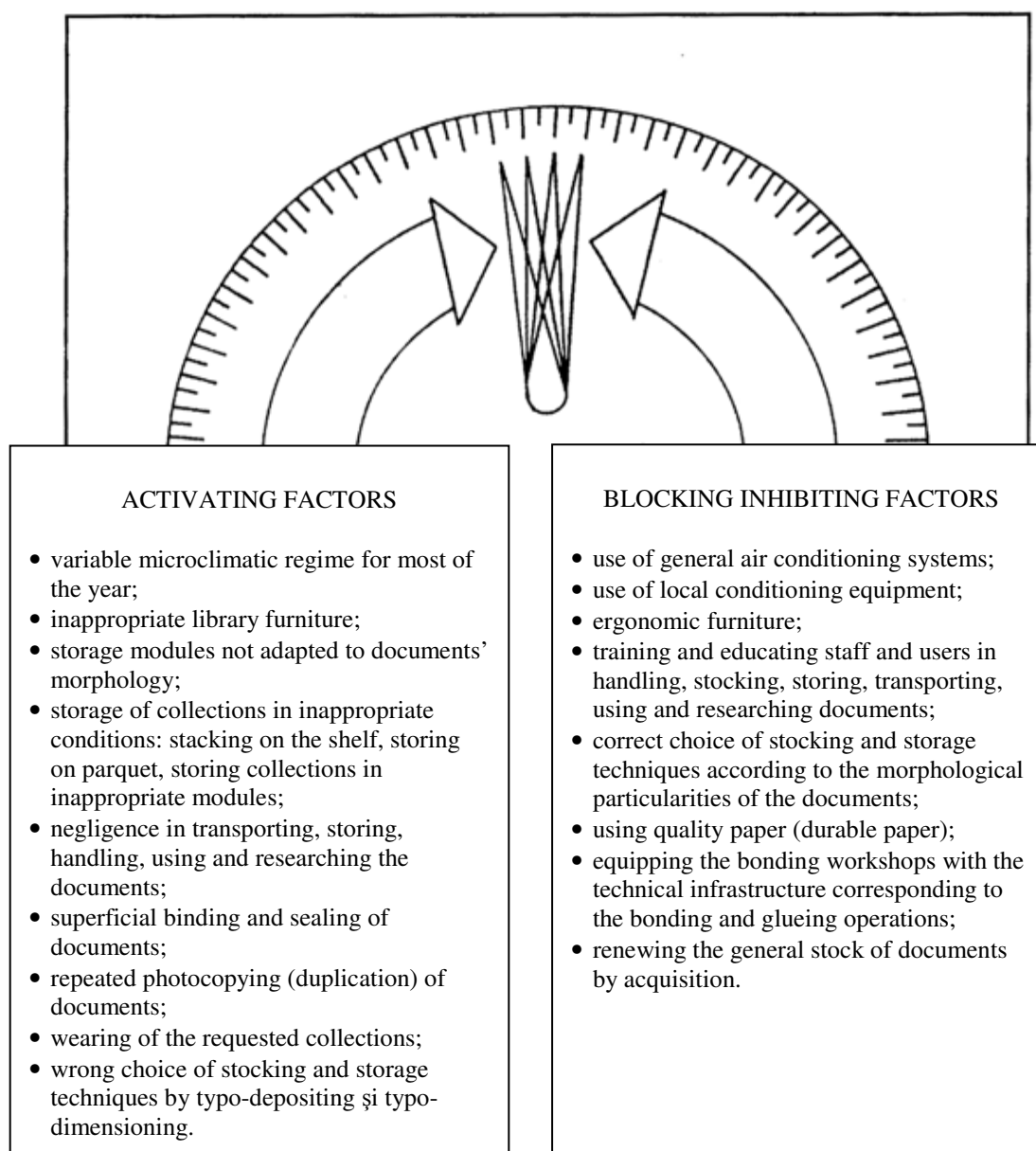


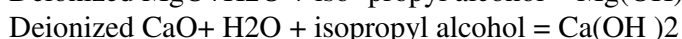
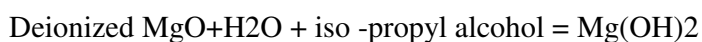
Figure 4. *Incidence of mechanical factors in the installation and development of library collections degradations, depending on the outcome of the actions of favorable and unfavorable factors*

5. Conclusions and recommendations

Acidity determinations performed on the investigated documents before performing magnesium hydroxide nanoparticle treatments revealed very acidic pH values ranging from 4 to 6.

The synthesis of Mg(OH)₂ și Ca(OH)₂ nanoparticles was done at S.C. NORDIC INVEST S.R.L. CLUJ -NAPOCA, using MgO and CaO reagents. The oxides were obtained from calcium carbonates and magnesium carbonates, which were milled through a special mill to obtain nanoparticles below 100 μm. In the final stages, the carbonates were calcined at 1000 °C.

In order to obtain magnesium or calcium hydroxides, the following hydrolysis reactions took place in the conservation laboratory at the "Gheorghe Șincai" Bihor County Library, Oradea, by maintaining the reaction products in a thermostatic oven adjusted to 80 °C for about 30 minutes:



pH determinations in liquid solutions were performed with Checker-type pH-meter, Hanna production, with electronic display, and paper pH determinations were made by surface measurements using the Noronix-type T1140 pH meter; post-treatment pH values ranged from 7-7.8.

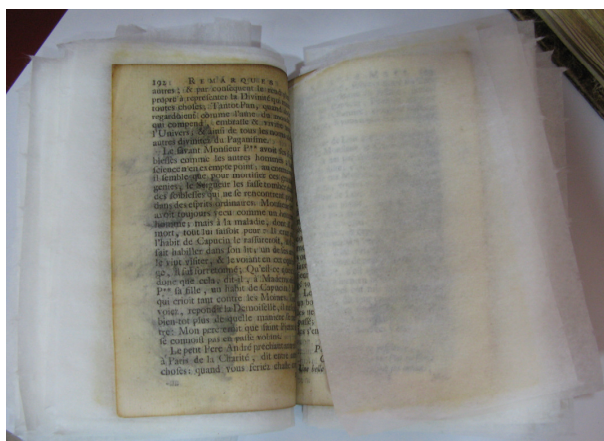
The case study conducted at the library of "Ștefan cel Mare" National College, Suceava regarding the elaboration and application of synthesis techniques and the application of alkaline hydroxide nanoparticles in order to neutralize paper acidity and bring the pH to a neutral level, highlighted the following aspects:

- hydroxides of magnesium and calcium are highly effective chemical deacidification agents in the collections, having a good physico-chemical compatibility with the support, and after the neutralization reaction of the acidic paper forms, carbonates are formed which are alkaline paper protective layers with no unwanted negative effects;
- magnesium or calcium hydroxide nanoparticles, mixed with isopropyl alcohol, are a chemical composition accepted in the practice of the conservation and restoration of library collections, with the following beneficial effects: reduce paper acidity and decontaminate documents affected by microbiological degradation;
- the collections of documents investigated and treated exhibited an active aspergillus-penicillin microbial load or latent biological stages;
- the identification of the microorganisms present in the collection of documents examined before and after the interventions with isopropyl alcohol and deionized water-hydroxyapatite nanoparticulate in hydroalcoholic suspension (HA Nano) was performed using the taxonomic identification system with special filter paper;
- manually spraying the composition of magnesium or calcium hydroxides in a mixture with isopropyl alcohol and deionized water is the optimal solution for the neutralization of acids and decontamination of the mycotic complex specific to historical documents;
- the fungal (fungi) reduction percentage was calculated according to the number and extent of stains (colonies) produced by microorganisms before performing the treatments by spraying the magnesium oxide nanoparticles on the control document and after the interventions. Depending on the number and area of biologically inactivated stains (colonies) by the application of hydroxyapatite magnesium oxide, the minimum biological activation concentration of the solution may be established on the historical paper;
- determinations of the aeromicroflora's mycotic complex present in the library media by controlled exposures, but also with microorganisms from the biochemical dust taken from the analyzed documents, were germinated in Petri dishes with Gelose and Sabourand media. After 10 days of incubation in the library premises and oscillating temperatures 23-28°C, germinable spores and then colonies appeared.

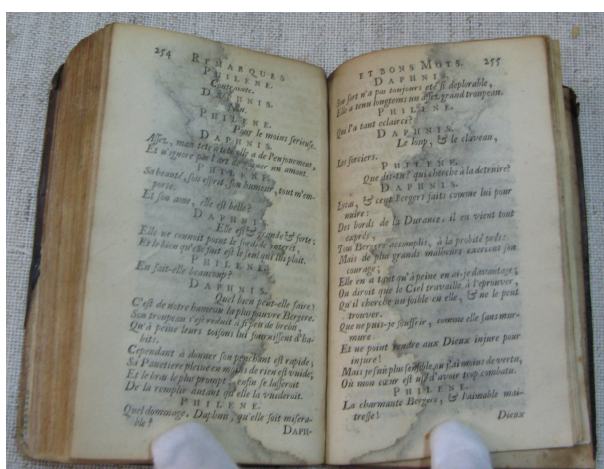
ANNEXES



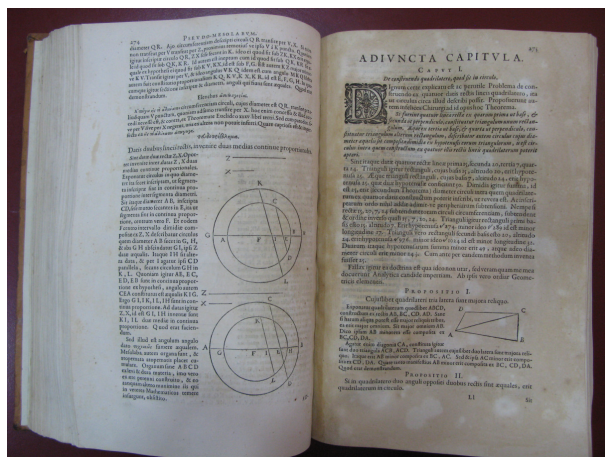
1a. Before treatment: symptoms of chemical degradation



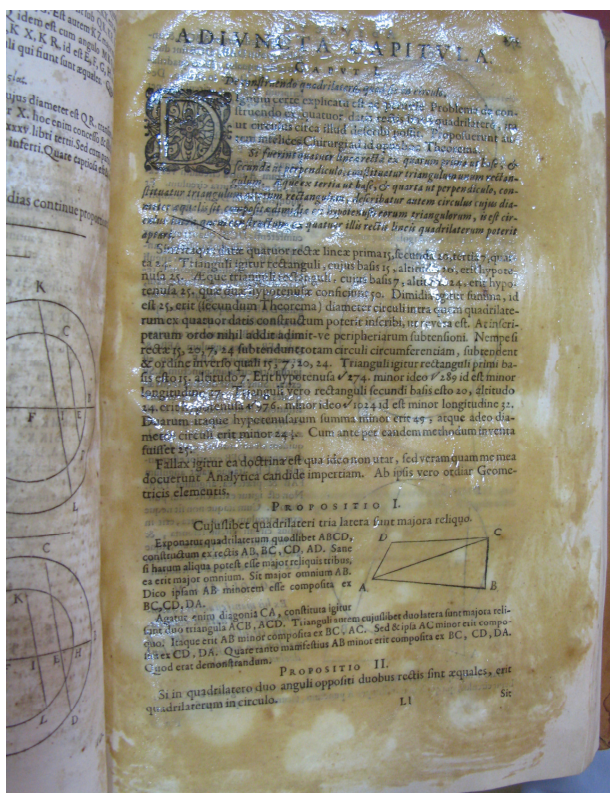
1b. During treatment: wrapping with napkins embedded with synthesized nanoparticles of Mg (OH) 2, suspended



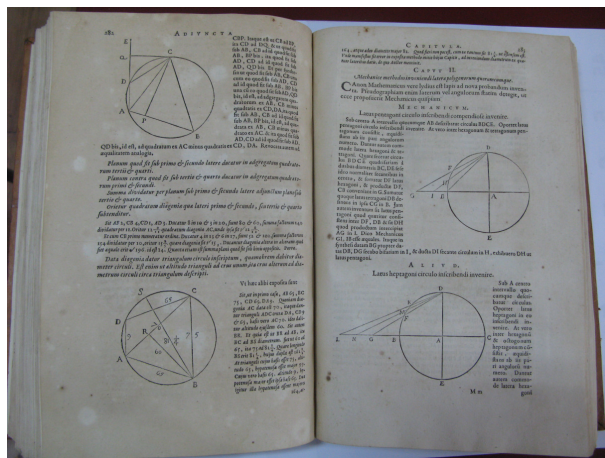
1c. Final form of the treated document: neutralized chemical degradation



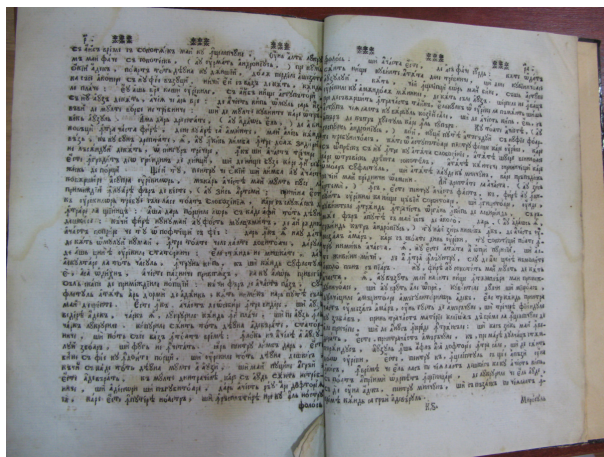
2a. Before treatment: symptoms of chemical degradation of pages; the presence of attacking spots (yellow color)



2b. During treatment: wet treatments performed with synthesized nanoparticles of Mg(OH)₂, suspended particles in isopropyl alcohol and bidistilled water



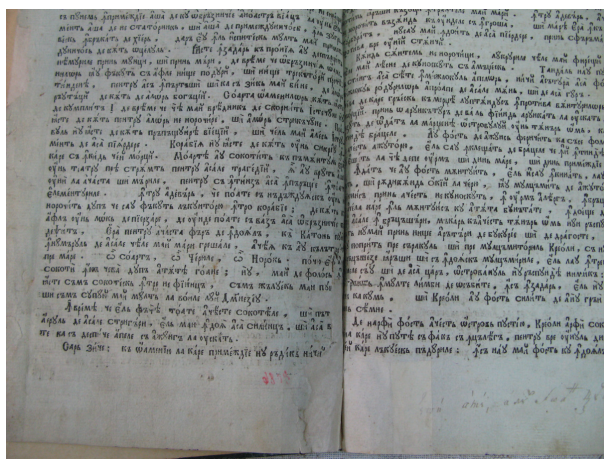
2c. Post-treatment image of the document: very good efficiency of the treatment



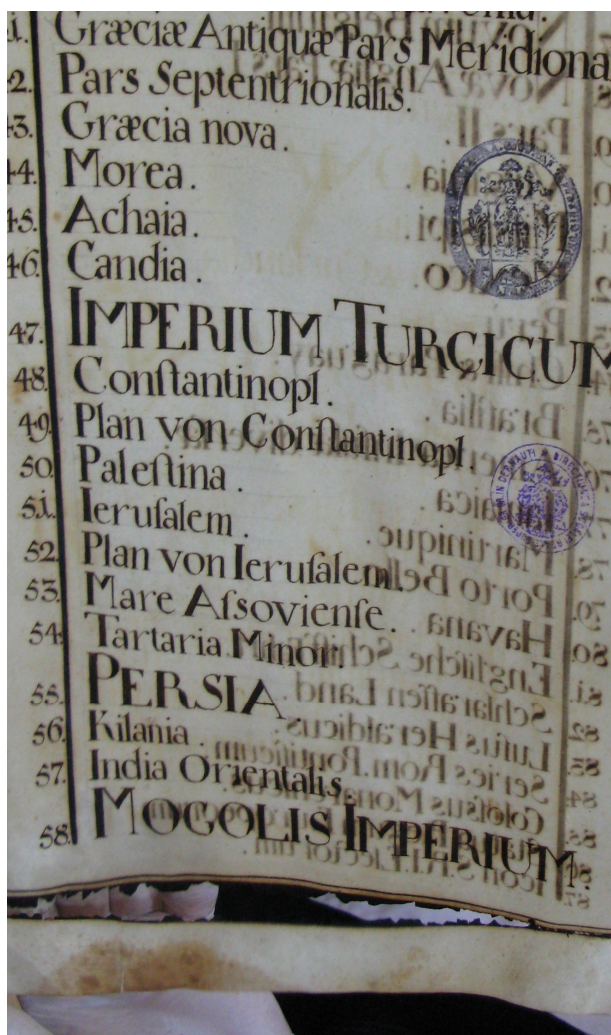
3a. Before treatment: specific symptoms of multifactual (chemical and physical) degradation in the upper third of the document affecting the paper and text



3b. Appearance of the first recovery symptoms by neutralizing the hydrogen ions in the paper structure; wet treatments performed with synthesized nanoparticles of Mg(OH)₂, suspended particles in isopropyl alcohol and bidistilled water



3c. A suggestive picture of the effectiveness of the treatment used for morphological intervention



4a. Before and during treatment: acid ferrogalic ink penetrated the paper in the text area; wet treatment performed with synthesized nanoparticles of Mg (OH)₂, suspended particles in isopropyl alcohol and bidistilled water; paper and text consolidation with (CMC) 16 and Japanese paper



4b. During treatment: wet treatment of hydrogen ions for neutralizing the paper structure with synthesized nanoparticles of Mg (OH)₂, suspended particles in isopropyl alcohol and bidistilled water and 3% Klucel G for color fixation and as hardening agent

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