

MAROSZ, Magdalena, Preservation of What has Become Known as “Acid Paper”. *Atlanti*, Vol. 19, Trieste 2009, pp. 105-115.

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Most files created in the 20th century were written on the so-called “acid paper”. For archivists today it is a great problem related to the storage, preservation, protection, rendering for access and exhibition of files. We can say that it is the question of preservation of all these files for future generations. On 17th November 1999, Polish government introduced the Long-term Governmental Programme for the years 2000-2008, “Acid paper. Mass-scale preservation of the endangered Polish library and archival collections”. Many library and archival institutions engaged in the preparation of the Programme. They decided cooperate in counteracting the effects of acid degradation of paper. The completion of the programme is a good opportunity for its evaluation and for answering the question if the so-called mass conservation (that is deacidification and digitisation) of archival materials has achieved its aims.

MAROSZ, Magdalena, Conservazione della così detta “carta acida”. *Atlanti*, Vol. 19, Trieste 2009, pp. 105-115.

La maggior parte dei documenti creati nel XX secolo è stata scritta sulla cosiddetta “carta acida” (avente un pH inferiore a 7). Per gli archivisti oggi è un grande problema, collegato al deposito, alla conservazione, alla protezione, all’accesso e mostra dei file. Possiamo dire che questo è il problema della conservazione di tutti questi file per le generazioni future. Il 17 novembre 1999 il governo polacco ha introdotto il Programma governativo a lungo termine per gli anni 2000-2008 “Carta acida. Conservazione massiva delle

Paper production

For hundreds of years, paper has been produced in Europe, and has quickly become the basic material for writing. The technology for its production, however, has changed throughout the centuries. The changes which resulted from the need to improve production led to the appearance of new qualities of paper. Since the 15th century, that is from the invention of printing in Europe, the demand for paper grew considerably and in 1799 Luis Nicolas Robert invented a paper making machine. Machine production of paper started in England as early as 1803, which in turn caused the gradual diminishing in the production of handwoven paper.

Paper is produced by depositing plant fibers (whose main ingredient is cellulose) in suspension, onto a finely woven metal mesh. In Poland paper was produced from linen rags up until the middle of the 19th century, while in the more industrially developed countries new raw materials were being used already at the beginning of the 19th century. The machine invented by Luis Nicolas Robert produced a ribbon of paper and its use spread relatively quickly. As mentioned above, it was as early as in 1803 that paper was produced with the use of this machine and between 1803 and 1823, 38 such machines were built. This led to the gradual diminishing in the production of handwoven paper. In the 1840s, Friedrich Gottlob Keller discovered a use for wood pulp; after many trials a method of extracting cellulose en masse was developed, which in turn was used for the mass production of paper. Wood pulp has remained the dominant raw material in the production of paper until today. Technology using acid as a part of production spread from about 1850. In paper produced in such a way, acids break down the tough cellulose chains, but subsequently also facilitate in the further deterioration of the mechanical qualities of the paper and so on to the weakening of the structure of the leaves of paper.

The method of handwoven paper production was widely used until the 19th century: then in Europe the demand for paper rose steeply, so a technology was needed which would enable its much quicker production.

A comparison made between both types of paper (handwoven

rag paper and paper produced from wood pulp) is much in favour of the old paper, produced up until the beginning of the 19th century. The rag pulp, mashed and ground down in various ways throughout the centuries, does not need any refining additives and produces a pulp with longer fibers, which even after several hundreds of years still attests to the fact that the paper retains its colour, is strong and ages very slowly. The papers made of wood pulp become yellow, fragile and crumble in one's hands.

The accelerated ageing process of wood paper has its cause first of all in the different methods of production. Until the 17th century the process of making single paper sheets remained the same: firstly rags were sorted and white ones separated as they were used for the production of more refined kinds of paper; then the rags were cut and underwent a rotting process to make them softer. The material prepared in this way was in turn mashed mechanically using special machines. The fibres remained in suspension while a fine rectangular wire mesh was dipped into the mixture and taken out, trapping the fibres in a layer, while the water seeped away. No slurry or bonding agents were added at this stage but animal glue was used in the last part of paper production in order to limit its absorption and give it smoothness and rigidity. The first change in the technology of paper production took place between 1650 and 1675, when aluminium sulphate started to be added at the of gluing stage, which caused an increase in paper acidity and diminished its mechanical resistance. A further change occurred to increase efficiency with the introduction in 1680 of grinding machines. The pulp was mashed very quickly, but as a side effect the fibre length diminished, which led to a decrease in the mechanical resistance of the paper. Another technological change was the introduction of bleaching soiled or coloured rags with chlorine (in 1771). The chlorine, which was impossible to remove completely, caused quicker acidification of paper. The introduction at the beginning of the 19th century of paper making machines along with enormous changes in the printing industry plus the advances in technology of obtaining wood pulp and the development of technology of gluing the paper en masse with the use of resin alum glue in an acid environment, all contributed negatively to the condition and longevity of paper.

All of the above mentioned technological changes resulted in the fact that since the middle of the 19th century manufacture of paper has been from wood pulp which is short-fibred and apart from cellulose contains lignin and hemicellulose (fast acting acid substances) and bonding using resin alum glue. This way of paper production has survived with smaller modifications until our times and it is only within the recent several dozen years or so, that the production of a durable typing or printing paper has been talked about.

19th century paper tends to yellow and crack and develop characteristic brownish spots (foxing). The reason why they appear is not yet completely understood, but it has been established that in the places affected there appears an oxidizing of iron particles (most probably because of grinding the pulp in metal mills) and certain species of microorganisms. These spots have the capacity of migrating through consecutive adjoining sheets¹.

raccolte bibliotecarie ed archivistiche polacche in pericolo". Molte istituzioni bibliotecarie ed archivistiche si sono impegnate nella preparazione del Programma. Esse hanno deciso di cooperare per neutralizzare gli effetti del degrado della carta acida. Il completamento del programma è una buona opportunità per la sua valutazione e per poter rispondere alla domanda se la cosiddetta conservazione massiva del materiale archivistico (ossia de acidificazione e digitalizzazione) ha raggiunto i propri scopi..

MAROSZ, Magdalena, Varovanje dokumentov na kislem papirju. Atlanti, Zv. 19, Trst 2009, str. 105-115.

Veliko dokumentov, ki so nastali v XX. stoletju, se nahaja na kislem papirju, kar predstavlja današnjim arhivistom probleme pri shranjevanju, varovanju, zaščiti, sposojanju in razstavljanju arhivskega in dokumentarnega gradiva. Kisel papir nedvomno predstavlja bodoči problem, s katerim se bodo srečali tudi arhivisti v prihodnosti. V letu 1999 je poljska vlada predstavila program o varovanju dokumentov na kislem papirju v arhivih in knjižnicah v letih od 2000-2008. Uporaba tega programa bo nedvomno dobra priložnost za vrednotenje dokumentacije in odgovor na probleme, ki jih prinaša t. im. masovna zaščita (t.j. programi razkisanja in digitalizacije) dokumentarnega gradiva.

1. Agata Lipińska, *Ochrona książki przed zniszczeniem - rady dla bibliofilów*, część II, w «Świat druku», X(2002) (Book Protection against Damage – Advice for Bibliophiles, part II, in «The World of Print», X(2002)); <http://www.bj.uj.edu.pl/KP/index.php> (12.01.2009); http://pl.wikipedia.org/wiki/Papier#Historia_papieru_on_.C5.9Bwiecie (15.07.2009); <http://www.animathec.com/BJ/index.php> (17.07.2009).

SUMMARY

The research, conducted jointly by the representatives of the state archives and libraries within the framework of the Long-term Governmental Programme "Acid Paper", not only confirmed what had already been obvious previously, namely that the archival and library collections created in the 19th and 20th centuries, written or printed on the acid paper made of wood pulp, in which accelerated ageing processes take place, are especially endangered by damage. They also clearly showed the scale of this phenomenon, which we had not quite realised. The Long-term Governmental Programme "Acid Paper". Mass-scale conservation and preservation of the endangered Polish library and archival collections' also brought great financial support for libraries and archives, which enabled the creation of professional workshops of mass deacidification and also conducting on a large scale the microfilming and digitisation of the endangered collections. Presently, we can certainly say that thanks to the Programme and the use of the technologies of mass deacidification, the process of mass disintegration of files and books in Polish archives and libraries will be halted gradually. However, despite the mass-scale deacidification already conducted for several years (the first workshop in libraries – the Paper Clinic of the Jagiellonian Library was started in 2005 and the first workshop in the

The process of self-degradation of cellulose²

Cellulose is a natural polymer, consisting of chains of up to a dozen or so thousand of units of D-glucose (in cotton about 15.000, in wood 8.000-10.000, in paper about 5000). Linear chains of cellulose combine to create microfibrils, which in turn create thicker fibres - fibrils. The microfibrils contain highly ordered crystalline fragments bonded by chains of an irregular structure. The crystalline structures play the role of knots in a net and it is owing to them that paper is rigid. The chains of polymer which connect the knots of crystalline cellulose give the structure of paper appropriate flexibility.

Degradation of paper may be caused by several factors. The factors relating to the question of the acidification of paper are acid hydrolysis and oxidation.

Acid hydrolysis - chains of cellulose break down under the influence of water (hydrolysis). This process in normal circumstances is extremely slow, but is accelerated considerably in an acid environment. Acids of particular character are introduced into the structure of paper at the stages of bleaching or gluing. The method of adding bonding agents to the paper mass with the use of resin alum glue leaves aluminium sulphate as an end product. As a result of the reaction between aluminium sulphate with water contained in the paper, acid groups appear. The presence of these groups of acids on the surface of cellulose catalyses the reaction of hydrolysis. The nature of catalytic reactions is such that the catalyst itself is not expended within them. And this also explains why the process of acid hydrolysis is not halted as a result of the using up of the acid substances it is caused by. The breaking of chains of cellulose results in two phenomena:

- shortening of an average chain length, so the resistance to breaking is diminished,
- on two ends of the broken polymer chain there are active groups which easily join the neighbouring cellulose chains, thus increasing the web character of the structure which in turn increases its rigidity and brittleness.

The first of the processes described above is irreversible - the broken cellulose chains cannot be joined together again. The increase of the web like character of the structure is partly reversible: e.g. treating the paper with pure water makes the paper swell and leads to some breaking apart of the bonds which are responsible for the too great rigidity and thus the paper becomes less brittle.

Apart from the acid substances introduced into the paper during its production, pollution of the atmosphere is dangerous for paper as well. Presently, in big cities the nitric and sulphur oxides which are present in the air are absorbed by paper, and in the reaction with the water contained within the paper acids are created, which catalyse the disintegration of cellulose.

Oxidation - the speed of paper degradation due to oxidation in room temperature is little in comparison with the disintegration

2. <http://www.animatoc.com/BJ/index.php> (17.07.2009).

under the influence of acidic hydrolysis. The lignin present in the structure of paper made of wood is much more susceptible to oxidation with the oxide from the air than cellulose is. The products of lignin oxidation give the paper a yellowish colour, but its oxidation does not change the mechanical qualities of the paper. Thus the yellow colour of the paper in the majority of old prints does not have to mean poor durability. Other external factors which accelerate the process of paper oxidation are ozone and light.

Preservation and protection of archival materials on acid paper

Already at the turn of the 19th century it was observed that mechanically made paper made from wood pulp with the use of resin alum glue did not match the durability of the papers produced with the use of old technologies. Librarians and archivists started complaining about the low quality of paper and its susceptibility to mechanical damage. At present the situation is alarming, as 19th and 20th century files and especially book collections are practically crumbling away.

Awareness of the lack of durability of the paper produced with the use of acid technologies is not a new phenomenon. In 1903 there appeared the first work which described the gradual disintegration of paper, which takes place when the paper is moistened with a diluted acid. Shortly afterwards it was proved that the low durability of paper results from the presence of aluminium sulfate in its structure. In 1925, in the National Office of Standards in Washington, work was started on the question of paper durability and a method of artificially ageing paper has been developed and used in research until today. In Poland, in 1936 Bonawentura Lenart presented the excellent idea that a part of an edition of a book should be printed on a high quality, durable paper and only such 'monumental' copies should be made available to libraries. Unfortunately, this project was never realised³.

For several dozens of years systems of mass deacidification of library and archival collections have been put forward but none of the proposed methods have proved ideal.

The factors affecting paper degradation can generally be divided into two groups:

- external factors:
 - conditions of storage
 - environmental factors such as temperature, relative humidity of the air, light, air and dust pollution, biological factors
 - catastrophes and accidents resulting in damage
 - human factors (mechanical pollution, conservation errors)

archives was started at the Archive of Contemporary Files in 2006), there are still some problems which remain unsolved. As for the library collections in 2007, Tomasz Koziol from the Institute of Paper and Leather Conservation of the Mikołaj Kopernik University in Toruń, published interesting remarks concerning the problems which follow from the mass deacidification of books¹. Unfortunately, so far none of the conservators working in the state archives engaged in the mass deacidification have attempted to prepare remarks or summaries discussing, apart from the unquestionable profits, also some dangers for the files resulting from the en masse methods of conservation. Let us then attempt an assessment of the efficiency of mass deacidification of archival collections not in general, but in relation to the presently conducted activities in Polish archives. As mentioned above, the factors influencing paper disintegration are, apart from its acidification, also among others factors the conditions of preservation, environmental factors (temperature, relative air humidity, light, atmosphere and dust pollution, biological factors). It is thus doubtless that the ensuring of optimal conditions for the preservation of files limits the impact of these factors. What should be especially important is the ensuring of the best storage conditions for the files which have undergone the process of deacidification, as this process does not reverse but only stops the process of paper disintegration, a process which given unfavourable conditions of pre-

3. <http://www.animatex.com/BJ/index.php> (17.07.2009).

servation will proceed anew. It is a pity, then, that while planning activities and expenditures of the Programme 'Acid Paper', no necessary care was taken to ensure better storage conditions for the files which have undergone deacidification. The situation in this field in the state archives in Poland is not the best. We do not have any building built with the view of being an archive building, all archival buildings being adapted and conditions prevailing in parts of them are far from satisfactory. The research on the state of preservation of archival collections from the 19th and 20th centuries ensure us that the use of mass deacidification of files is for the collections of the state archives indispensable. And despite the fact that there is no ideal deacidification method, it was impossible to delay the decision about the choice of method and appliance. Conservators point to the fact that each method of mass deacidification gives some side-effects, but it seems that they are unavoidable². Let us mention here the side effects which seem unavoidable in the case of mass deacidification of files: the lack of equal deacidification of paper, the too scarce alkali reserve, swelling of sheets, the possibility of only superficial deacidification of cardboards³. In the case of the state archives, it is a pity that it was decided to choose solely one mass method, which serves the deacidification of loose sheets, forgetting that the archives also keep glued books and stitched books. In the plans towards the end of the Programme, however, it was

- internal factors

- corrosion of inks
- chemical degradation of paper⁴

It is doubtless true that ensuring the optimal conditions of preservation of archival and library collections eliminates the above-mentioned dangers. The greatest difficulty, however, in the preservation of collections on paper is posed by the factors resulting from bad quality of paper and its excessive acidification.

With archival collections, both the assessment of damage and the most effective means to counteract problems are hindered because of the specific character of objects within an archival collection: they vary greatly, while library collections are relatively homogeneous.

Even a rough inspection of archival collections assures us that the great majority of documents from the 19th and 20th centuries are those created on acid paper. The most common results of paper degradation are yellowing and brittleness of the paper and subsequent numerous mechanical damages which follow from the above, such as losses, tears, cracks - which appear especially at the edges of sheets. These damages to archival collections enforce the provision of appropriate conditions of storage, making items available for actual use and also for potential conservation (especially deacidification), as well as for the process of digitisation and microfilming. An especially important element of preservation of archival materials created on acid paper is not only their mass deacidification, but also making copies (digital copies, microfilms) in order to make available the materials in archival reading rooms in this form. We should also not forget that, unlike as in library collections, archival materials usually appear as one, unique copy and this is why it is especially important to preserve the original of a document in the best possible condition for the longest possible time. An additional problem is, again unlike as in library collections, that the majority of archival materials do not possess their original covers, which makes them even more susceptible to damage. In order to better protect them, appropriate boxes, folders, or dust jackets made of acid free materials should be used⁵.

The Long-term Governmental Programme for the years 2000-2008. 'Acid paper, en masse preservation of endangered Polish library and archival collections'⁶

In January 1998 representatives of scholarly, archival and library groups submitted to the Prime Minister of the Polish government a 'Petition for the need to save Polish cultural heritage in the library and archival collections of the 19th and 20th centuries. In an answer to this Petition, the government established the Long-term Governmental Programme for the years 2000-2008, 'Acid paper. Mass-scale preservation of endangered Polish library and archival collections'. The National Library, The Head Direction of the State Archives and the Jagiellonian Library with the participation of representatives of scholarly circles of the Jagiellonian University, the

4. *Zasady postępowania z materiałami archiwalnymi. Ochrona zasobu archiwalnego*, opr. M. Borowski, A. Czajka, A. Michaś, Warszawa 2006, s. 31; (*Principles of Dealing with Archival Materials. Protection of Archival Collection*, ed. M. Borowski, A. Czajka, A. Michaś, Warsaw 2006, p. 31);

<http://www.bj.uj.edu.pl/KP/index.htm> (12.01.2009);

http://www.bj.uj.edu.pl/akt/wy/06_05_kl_pap.htm (12.01.2009).

5. http://www.animathec.com/BJ/IMGB/4_klinikapapieru_zbiory_zagrozenia.pdf (12.01.2009)

6. A shortened version of the text of the Programme was published in «Przegląd Rządowy (Governmental Review)», nr 2(2000), pp. 67-81; see also: A. Barański, J. Grochowski, K. Zamorski, *Kalendarium i założenia realizacyjne wieloletniego programu rządowego na lata 2000-2008*, in «Notes Konserwatorski», nr 4(2000) (*Chronology and Realisational Assumptions of the Long-term Governmental Programme for the Years 2000-2008*, in «Conservator's Notebook», nr 4(2000)); <http://www.bn.org.pl/inne/wpr/kwasny.html> (17.07.2009); <http://www.animathec.com/BJ/index.php> (17.07.2009); <http://www.archiwa.gov.pl/lang-pl/konserwacja/uczestniczymy-w-projektach/243-program-kwany-papier.html> (17.07.2009).

Mikołaj Kopernik University in Toruń and the Institute of Cellulose and Paper were the authors and initiators of the programme. On 24 July 2007 the Government updated the The Long-term Programme for the years 2007-2008. The basic aim of the programme was to be a thorough study of the technologies of mass deacidification, finding the exact costs of the measures to take and commence the deacidification process of collections in Polish libraries and archives. At present, following the measures undertaken by the archival and library circles, the programme has been prolonged until 2012.

Originally, the following aims were identified in the programme:

- Full and complete establishment of the scope of the dangers faced, with the ranking of library and archival collections according to their level of endangerment and according to the geographic and administrative division of the country.
- Undertaking decisive preventive steps limiting, and in the case of some activities, excluding completely, the influx of acidified materials to library and archival collections.
- Creating in Poland a network of installations of mass deacidification and the strengthening of 19th and 20th century fragile paper - the network which would co operate with appliances for the mass microfilming of endangered collections.

As a result of the updating of the programme in 2007, the aims were defined in the following way:

- A.1 Assessment of the state of preservation and a thorough determining of the dangers threatening Polish library and archival collections from the 19th and 20th centuries
- A.2 Research into microbiological effects and conservation methods for the mass protection of library and archival collections from the 19th and 20th centuries
- B.1 Limitation on the provision of acid paper as a medium of information, especially the information accumulated presently in libraries and archives; its replacement with durable paper and in necessary cases with archival paper.
- B.2 Substantial and formal preparation through the legislature, concerning the rules and regulations on the use of acid-free paper. Monitoring of the application of the law.
- C.1 Creation of a network of centres equipped with appliances for microfilming and initiating an action of protective microfilming of the endangered 19th and 20th century library and archival collections, selected for this purpose during the realisation of aims A and B
- C.2 Purchase of a network of installations enabling en masse deacidification and strengthening of books and archival materials.

Realisation of the Long-term Governmental Programme "Acid paper" in the state archives.

The Head Direction of the State Archives is one of the initiators of the Programme, which assumes 38 detailed tasks comprising,

decided to purchase deacidification kits for the deacidification of stitched books and books produced by hand. It also seems that during the making of the choice of deacidification method used in the state archives, the costs connected with the process used were not fully analysed and the fact that in the budgets of the state archives – after the completion of the the Programme "Acid Paper" – it will be difficult to find finances for the purchase of indispensable reagents and for the further employment of people working in the workshops of mass deacidification⁴.

1. T. Koziolec, *Uwagi na temat masowego odkwaszania zbiorów bibliotecznych (Remarks on the Mass-scale Deacidification of Library Collections)*, in «Biuletyn Informacyjny Konserwatorów Dziej Sztuki», vol. 18(2007), nr 1-4, pp. 58-65.

2. See: T. Koziolec, *Uwagi (Remarks)...*, pp. 62-63.

3. Ibidem.

4. Deacidification and conservation within the Programme is conducted by 4 workshops with 32 employees.

among others: research on the phenomenon of acid paper, the building of a specialised centre for research on the reasons for paper disintegration, at the faculty of Chemistry at the Jagiellonian University; the building and exploitation of installations of mass deacidification in libraries and archives and the modernisation of a network of workshops for microfilming of archival materials. Within the framework of the Programme, between 2002 and 2005, the state archives in collaboration with the National Library realised a research project 'Assessment of the state of preservation and a full determining of the risks facing Polish library and archival collections from the 19th and 20th centuries'⁷. The research comprised:

- assessment of the state of preservation of the 19th and 20th century book collections in five large libraries
- assessment of the state of preservation of the 19th and 20th century paper archival materials in three archives
- assessment of the different levels of acidification of publications from the same edition, kept in seventeen different Polish cities
- cataloguing of the threats to the archival and library collections.

The research confirmed strong acidification of the archival and library collections in Poland. The average paper pH in the studied archival materials amounted to 4.4, in books - 4.65. The lowest pH was 2.4, the highest - 9.2. It was concluded that 90% of book collections from the studied period needed deacidifying and 100% of archival materials. An interesting fact was discovered, namely that the strongest acidification appears in the collections kept in the South-West of Poland (Zielona Góra, Wrocław, Kraków)⁸.

The results of the statistical research also enabled the assessment of the needs of state archives and libraries in the field of conservation and microfilming of the the 19th and 20th century collections.

For the purpose of the present article, I am going to discuss two of the four subjects of the research project 'Assessment of the state of preservation and a full determining of the dangers threatening Polish library and archival collections from the 19th and 20th centuries' in more detail, namely:

- assessment of the state of preservation of the 19th and 20th century paper archival materials in three archives
- cataloguing of the dangers threatening the archival and library collections.

The state of preservation of archival materials from the 19th and 20th century⁹

The survey was conducted following a modified Stanford method¹⁰, using a broadened assessment for acidity levels, appraisal of the fibrous state of the papers and the assessment of the biological state of the documents. The survey covered altogether 14 000 running metres of files.

7. Full information on the project, see: *Stan zachowania polskich zbiorów bibliotecznych i archiwalnych z XIX i XX wieku*, pr. zbiorowa pod red. B. Drewniewskiej-Idziak, Warszawa 2006, (*The State of preservation of Polish library and Archival Collections from the 19th and 20th centuries*, collective work ed. By B. Drewniewskiej-Idziak, Warsaw 2006,) and also <http://www.archiwa.gov.pl/images/stories/file/pdf/ulotka.pdf> (17.07.2009).

8. *Stan zachowania (The State of preservation)...*, pp. 5-6.

9. *Stan zachowania (The State of preservation)...*, pp. 23-35.

10. The Stanford method is a statistical way of the assessment of the state of preservation of book collections. From the collection meant for the survey, a representative sample of 384 books is selected and assessed according to the strictly defined principles. The assessment concerns the state of preservation of paper sheets, the state of the book block and of the cover. In the case of archival materials the assessment concerned the state of preservation of the edges of the sheet, the level of yellowing, possible presence of tears and a hand test for folding - six times folding of one corner of the sheet and an attempt to stretch it slightly. See: *Stan zachowania (The State of preservation)...*, p. 23.

As a result of the research, it was established that the group of files in good condition (group 1) comprised 48.1 % of the studied collection; the group of files which needed some intervention such as mending (group 2) - 27.1 %, and the group of files in poor condition, for which it was legitimate to exclude from making available for use (group 3) - 24.8 %. Simultaneously, excessive mechanical weakness was shown by 22 % of the studied files.

Proportionally to the amount of the studied archival materials, it means that almost $\frac{1}{4}$ of the files kept at the state archives in Poland should be excluded from being made available for use and about $\frac{1}{5}$ should undergo intervention such as strengthening.

In the summing-up of the research it was concluded that the paper documents from the 19th and 20th centuries in Polish archives were highly acidified and in great part they need deacidifying. We should remember that the documents from the end of the 20th century, created on paper of a much better quality, have not been placed in the state archives yet.

It was also concluded that the influence of the level of acidification of the studied papers on their various properties: the state of their preservation, the weakening of structure of structure and the level of yellowing turned out to be less conspicuous in the case of archival collections than in the case of the library collections¹¹.

Cataloguing of the dangers to the 19th and 20th century archival and library collections¹².

The cataloguing was made on the basis of a questionnaire sent to 235 institutions: 61 archives and 174 libraries. 39 archives and 90 libraries sent a filled in questionnaire back. It contained 62 questions grouped into 14 following chapters:

1. characteristics of the collection
2. technical state of buildings
3. storerooms equipment
4. climatic conditions
5. lighting
6. safety of the collection
7. chemical threats
8. biological threats and damage
9. chemical and mechanical damage of the collection
10. protection of the collection through transition onto other media
11. catastrophes
12. damage in the collection due to catastrophes and failures
13. services for the protection of the collection
14. data of the person filling in the questionnaire¹³

The analysis of the results of the survey has shown how big the needs within the field of the appropriate protection of the archival and library collections are, both as far as the prevention activity and mass conservation (disinfection, lamination, liofilisation, deacidification, strengthening of the structure of paper), or the protection in

11. *Stan zachowania (The State of preservation)...*, p. 32.

12. *Stan zachowania (The State of preservation)...*, pp. 63-75.

13. *Stan zachowania (The State of preservation)...*, pp. 63-64.

the form of reprography (digitisation, microfilming).

The survey also enabled a rough assessment of the volume of archival and library collections which should undergo deacidification: these are at least 220 000 running metres of files and 43 000 000 volumes in library collections. These figures pose a great challenge for archivists and librarians¹⁴.

Furthermore, the research conducted between 2002 and 2005 clearly also showed that the problem of acidification of files from the 19th and 20th century poses a great challenge for the state archives. First of all, the research turned our attention to the growing need for the preservation of acidified files. It was recognized that the most effective method in the fight with the growing disintegration of the collections would be the creation of a network of workshops for the mass deacidification of files.

Thus, the greatest investment realised in the state archives in Poland within the framework of the Long-term Governmental Programme 'Acid paper' was in providing the buildings for four workshops of mass deacidification and conservation of archival materials, which started in 2005.

The following workshops were created: the Workshop of Mass Deacidification in Milanówek, which is a part of the Central Laboratory of Archival Materials Conservation, the Workshop of Mass Conservation at the Archive of Contemporary Files in Warsaw, the Workshop of Mass Deacidification at the State Archive in Gdańsk (a branch in Gdynia), the Workshop of Mass Deacidification at the State Archive in Katowice¹⁵.

The workshops were located in such a way that they could work for all state archives within the division of Poland into Northern Poland (Gdynia), Central Poland (Warsaw and Milanówek), and Southern Poland (Katowice).

The workshops use the technology of mass deacidification with magnesium hydroxide in a water bath, provided by the German firm Neschen. Between 2005 and 2006 four C900 machines for mass deacidification of individual sheets and the equipment for hand deacidification of large-format objects were purchased. The deacidifying solution used in the C900 technology creates on the surface of the paper an alkaline reserve, and owing to the addition of methyl cellulose strengthens the paper. The fixing agents and lowered temperature of the process protect inks against washing away in the water during the deacidification. After the deacidification, if necessary, the archival materials are preserved by the use of suitable large-scale methods or traditional, hand-made methods¹⁶.

It was also necessary to elaborate the appropriate procedures, defining the way that documents should circulate, the system of work, the way of documenting of the conservation steps taken, as well as to train employees.

Deacidification and strengthening of paper - within the framework of the Programme "Acid Paper" - is closely connected with the making of microfilm and digital copies. In the case of highly acidified archival materials and because of its brittleness, the making and

14. *Stan zachowania (The State of preservation)...*, p. 72.

15. <http://www.archiwa.gov.pl/images/stories/file/pdf/ulotka.pdf> (17.07.2009), s. 8.

16. <http://www.archiwa.gov.pl/images/stories/file/pdf/ulotka.pdf> (17.07.2009), s. 7.

rendering for use of protective copies is the only way of protection against mechanical damage.

Between 2004 and 2006 the realisation of tasks following from the Programme included the modernisation of reprographic workshops - parts of the Centre of Reprography and Digitisation of the Archive of Mechanical Documentation (presently the National Digital Archive) and the microfilm workshop of the State Archive in Krakow. The following appliances were purchased then: microfilm and hybrid cameras (enabling both microfilming and scanning) from the firm of Zeutschel, microfilm scanners, scanners for bound archival materials, microfilm scanners, tables for the inspection and assembly of microfilms, equipped with ultrasonic veneering press for the tape¹⁷.

The finances of the Programme devoted for the tasks connected with deacidification of archival materials between 2000 and 2008 were the following:

- deacidification and strengthening of archival materials - 9 000 000 PLN
- building/modernising of rooms and the purchase of the installations for deacidification - 9 550 000 PLN

Additional financing from archives' budgets:

- building/modernising of rooms of the deacidification workshop - 140 000 PLN
- supplementing of conservator's equipment - 543 000 PLN¹⁸

The data prepared in May 2008¹⁹ give the number that 815 386 sheets of A4 format were deacidified at the state archives. It also gives the average daily efficiency of the workshops of mass deacidification, working at the state archives - for the workshops working in the one-shift system it is 1200-1400 sheets, for those working in the two-shift system 2000 sheets, which gives an average from 25 000 to 45 000 sheets of A4 format deacidified per month in individual workshops.

Bibliography

1. A. Barański, D. Dutka, R. Dziembaj, A. Konieczna-Molenda, J.M. Łagan, *Effect of Relative Humidity on the Degradation Rate of Cellulose. The Methodology Studies*, in «Restaurator», vol. 25(2004).
2. A. Barański, J. Grochowski, K. Zamorski, *Kalendarium i założenia realizacyjne wieloletniego programu rządowego na lata 2000-2008*, in «Notes Konserwatorski», no 4(2000).
3. A. Barański, A. Konieczna-Molenda, J.M. Łagan, L.M. Proniewicz, *Catastrophic Roomtemperature Degradation of Cellulose*, in «Restaurator», vol. 24(2003).
4. A. Barański, J.M. Łagan, T. Łojewski, *Acid Catalysed Degradation, in Aging and Stabilisation of Paper*, ed. M. Strlič, Ljubljana, 2005.
5. A. Bąkowska, *Linia masowego odkwaszania arkuszy w Bibliotece Narodowej*, in «Biuletyn Informacyjny Biblioteki Narodowej», vol. 3(174), 2005.
6. E. Bielińska, A. Czajka, *Kwaśny papier w archiwach państwowych*, <http://20090209.archiwa.gov.pl/repository//clka/Kwasny.pdf>

17. <http://www.archiwa.gov.pl/images/stories/file/pdf/ulotka.pdf> (17.07.2009), s. 4.

18. E. Bielińska, A. Czajka, *Kwaśny papier w archiwach państwowych (Acid Paper in State Archives)*, internet presentation prepared in 2008 pp. 3-4, on: <http://20090209.archiwa.gov.pl/repository//clka/Kwasny.pdf> (17.07.2009).

19. *ibidem*, s. 23-24.

7. A. Bluher, B. Vogelsander, *Mass Deacidification of Paper*, in «Chimia», vol. 55(2001), n. 11.
8. J. Dąbrowski, *Degradacja włókien roślinnych w papierze o odczynie kwaśnym lub zasadowym*, in «Notes Konserwatorski», vol. 8(2004).
9. J. Dąbrowski, *Jak długo może trwać papier?*, in «Notes Konserwatorski», vol. 10(2006).
10. J. Havermans, *Effects of Air Pollutants on the Accelerated Ageing of Cellulose-based materials*, in «Restaurator», vol. 16(1995), n. 4.
11. <http://www.animatec.com/BJ>
12. <http://www.archiwa.gov.pl/images/stories/file/pdf/ulotka.pdf>
13. <http://www.archiwa.gov.pl/lang-pl/konserwacja/uczestniczymy-w-projekta-ch/243-program-kwany-papier.html>
14. <http://www.bj.uj.edu.pl/KP>
15. <http://www.bn.org.pl/inne/wpr/kwasny.html>
16. <http://www.science4heritage.org/survenir>
17. http://pl.wikipedia.org/wiki/Papier#Historia_papieru_na_C5.9Bwiece
18. E. Jabłońska, A.B. Strzelczyk, *Czynniki niszczące zbiory biblioteczne i archiwalne*, in «Notes Konserwatorski», vol. 11(2007).
19. T. Kozielec, *Uwagi na temat masowego odkwaszania zbiorów bibliotecznych*, in «Biuletyn Informacyjny Konserwatorów Dzieł Sztuki», vol. 18(2007), n. 1-4.
20. A. Lipińska, *Ochrona książki przed zniszczeniem - rady dla bibliofilów*, część II, in «Świat druku», X(2002).
21. T. Łojewski, *Kwaśny papier - chemiczna katastrofa w bibliotekach*, in «Przegląd papierniczy», vol. 4(716), 2004.
22. T. Łojewski, T. Sawoszczuk, *Technologie odkwaszania arkuszy i książek w Polsce*, in *Zachowajmy przeszłość dla przyszłości. Nowoczesne technologie konserwacji zbiorów bibliotecznych*, Warszawa 2007.
23. *Stan zachowania polskich zbiorów bibliotecznych i archiwalnych z XIX i XX wieku*, collective work ed. B. Drewniewskiej-Idziak, Warszawa 2006.
24. E. Stefańczyk, M. Woźniak, *Perspektywy zastosowania technologii C 900 do odkwaszania archiwalnych zasobów arkuszowych w Bibliotece Narodowej*, in «Notes Konserwatorski», vol. 10(2006).
25. *Zasady postępowania z materiałami archiwalnymi. Ochrona zasobu archiwalnego*, ed. M. Borowski, A. Czajka, A. Michaś, Warszawa 2006.

