

Jasna Malešič, Damir Globočnik, Petra Zaviršek

PRESERVATION OF LOJZE DOLINAR'S SKETCHES (ca. 1950–1970)

Zusammenfassung

Der Nachlass von Lojze Dolinar, einem Hauptrepräsentanten slowenischer Bildhauerkunst des 20. Jahrhunderts, umfasst auch Arbeiten auf Papier, deren Hauptmotiv die menschliche Figur ist. Dieser Beitrag befasst sich mit der kunsthistorischen Analyse der Artefakte, die allerdings durch den Zustand der Arbeiten nach Restaurierung in

ein Dilemma gerät. Obgleich ein etabliertes Verfahren die Langzeitstabilität säurehaltiger Papiere verbessert, kann die Entsäuerung auch zu nachteiligen Effekten führen. Aus diesem Grund wurde eine Studie bezüglich der Farbveränderung an Testpapieren durchgeführt. Anhand dieser Testergebnisse wurden für 68 großformatige Zeichnungen Entscheidungen für eine Reihe von Konservierungsmaßnahmen erstellt.

Keywords: Lojze Dolinar, deacidification, works of art, paper, sketches, drawings

Introduction

In 2014, sixty-eight of Lojze Dolinar's sketches, stored at the Gorenjska Museum, were delivered for conservation-restoration to the National and University Library (NUL) Centre for Preservation and Conservation of Library Materials.

The sketches, produced by Dolinar in the 1950s and '60s were drawn on low-quality paper.

Starting in the mid-19th century, wood replaced rags as the raw material for paper manufacture. Wood is processed into paper by mechanical or chemical pulping, which produces paper with shorter fibres. Mechanical pulping produces ground wood pulp paper with the shortest fibre length and does not remove lignin from wood,

which promotes acid hydrolysis, darkening, staining of nearby materials and deterioration. Lignin is a naturally occurring substance in wood that darkens and breaks down into acidic byproducts as it ages. In addition, wood pulp papers from before the 1980s tend to be acidic due to aluminosizing, that can lead to brittleness and discolouration of the paper.¹ Ground wood pulp paper is acidic and rapidly becomes brittle. Such paper has a relatively short life expectancy and is used for newspapers, pulp novels, etc.²

1 Library of congress, The Deterioration and Preservation of Paper: Some Essential Facts <https://www.loc.gov/preservation/care/deterioratebrochure.html> [accessed 15 May 2019].

2 National park service, How to preserve acidic wood pulp paper, in: *Conserve O gram*, 19/24 (2001) <<https://www.nps.gov/museum/publications/conserveo-gram/19-24.pdf>> [accessed 15 May 2019].

In order to preserve information on wood pulp papers, rehousing in high quality materials as well as reformatting (micro-filming or digitization) are advised. In addition, low temperature, relative humidity, and light will extend the life expectancy of the documents.

Conservation treatments, such as deacidification, can be performed on significant original documents, which must be kept due to their value. Deacidification is a process of treating paper documents to neutralize their acidic content, with the objective of prolonging the object's useful life.

Deacidification processes are either aqueous (using water) or non-aqueous (not using water). For deacidification purposes, most often weak bases, such as alkaline earth carbonates, hydroxides, or oxides, are used. Usually, calcium or magnesium carbonates are introduced into the paper in the form of hydrogencarbonates due to their higher solubility in water compared to the corresponding carbonates. The pH value of paper after deacidification is significant, as increased alkalinity might induce colour changes of the inks, pigments, and dyes.³ The pH value of the paper in the range of 7.5 to 9 due to the presence of CaCO₃ has been regarded favourably by conservation scientists.⁴

The aim for conservators, librarians, and curators is to prevent any damage to objects of historical value undergoing deacidification treatments. If water-based procedures are not possible or appropriate, as in the case of documents containing water-sensitive inks or dyes, non-aqueous deacidification procedures have been developed.

Non-aqueous deacidification processes use solvents or gases to carry the alkaline buffering agent. They are well suited to treating books and other bound

materials because the gas or solvent is able to penetrate deep into the crevices and close spaces of books and treat the material evenly. The Bookkeeper deacidification process,⁵ which is available and applied worldwide, uses a dispersion of submicron particles of magnesium oxide in inert liquid. It is also available as a spray product to treat single items in paper conservation workshops.

However, deacidification sprays can cause some side effects on wood pulp paper. Problems, such as darkening of some wood pulp papers, colour changes of colour media and supports, staining on some types of papers and leathers, residue build-up on paper, cockling and buckling of some papers and running of some media, such as inks, pigments, and watercolours can occur after spraying of objects.⁶

Over the past two decades, nanotechnologies have been increasingly introduced for the deacidification of paper artefacts. Nano- and micron-sized calcium hydroxide particles in alcohol media were introduced by Giorgi et al.⁷ as an effective agent for deacidification of library and archival material.

This paper focuses on the art-historical analysis of the artefacts and the dilemma of interfering with the condition of the works by using conservation treatments. A study of colour changes caused by various methods of deacidification has been carried out on mock-up papers. According to the results, the decision on the range of conservation treatments for 68 large format drawings has been made.

3 A. F. CLAPP, *Curatorial care of works of art on paper: Basic procedures for paper preservation* (New York: Lyons and Burford, 1977), 26.

4 J.W. BATY, C.L. MAITLAND, W. MINTER, M.A. HUBBE, S. K. JORDAN-MOWERY, 'Deacidification for the conservation and preservation of paper-based works: a review', in: *BioResources*, 5 (2010), 1955-2023.

5 Preservation technologies, Bookkeeper <<https://ptlp.com/en/bookkeeper/overview/about-us/>> [accessed 15 May 2019].

6 National park service; The Book and Paper Group of the American Institute for Conservation of Historic and Artistic Works, in: *Paper conservation catalog. Neutralization and alkalization* (1985), 2; <<http://cool.conservation-us.org/coolaic/sg/bpg/pcc>> [Accessed 8 May 2019] G. PETHERBRIDGE, *Conservation of library and archive materials and the graphic arts* (London: The Institute of paper conservation and the Society of archivists, 1987).

7 R. GIORGI, L. DEI, M. CECCATO, C. SCETTINO, P. BAGLIONI, 'Nanotechnologies for Conservation of Cultural Heritage: Paper and Canvas Deacidification', in: *Langmuir*, 18 (2002), 8198-8203.

Sculptor Lojze Dolinar

Lojze Dolinar was born on 19 April 1893 in Ljubljana and died on 9 September 1970 in Ičići near Opatija. He is regarded as one of the leading representatives of Realism, Art Nouveau, Expressionism, New Objectivity, and Social Realism in 20th-century sculpture in Slovenia.⁸

Dolinar loved to draw. However, his drawing oeuvre is not preserved entirely. In 1944, the Germans occupied Dolinar's house in Belgrade and destroyed nearly all drafts for sculptures and other art material.

In 2000, when Dolinar's widow Branka Dolinar, née Jurić, passed away, the City of Kranj and the Museum of Gorenjska agreed that the latter would gain custody of Dolinar's artistic legacy located in his studio at Rotarjeva ulica 4 (some sculpture drafts, numerous drawings, photographs and other documentation, a specialized library, sculptural tools, furniture: a bookcase, drawer, drawing desk, etc.).

The majority of Dolinar's drawings, drafts and sketches kept in the Museum of Gorenjska in Kranj, probably originated in the 1950s and '60s. Unlike prints, they were never intended for presentation at exhibitions. While drawing or sketching, Dolinar could, therefore, use different types of paper, which was at hand, such as wrapping papers and small scraps of paper that were later glued to larger pieces of cardboard, or the backs of photographs. He would draw with pencils, ink, fountain pen and ballpoint pens of various colours. Many of these scraps of paper are damaged, yellowed and folded, with edges torn or trimmed. One can assume that Dolinar often began to form his ideas for sculpture by drawing them first. Works on paper offer valuable insight into the evolution of his sculpture ideas. Some of these drawings can be related to specific sculptural

works (small sculptures), while some have been transformed into independent drawings and prints for the exhibition in 1958. Dolinar's basic motif is a human figure, usually connected to larger figure groups. The full sculptural impression of his figure motifs, in pencil drawing, in particular, was achieved by means of shading.

The vastness of Dolinar's oeuvre is extraordinary. The catalogue of his retrospective exhibition (Museum of Modern Art in Ljubljana, 1996)⁹ lists 505 works of sculpture, and many a work from his Belgrade period was not included there. Dolinar's drawings and prints are discussed in a brief text in this catalogue.¹⁰ The list of works also includes 33 prints and seven drawings or sculpture drafts, which is only a modest selection of the vast sculptor's legacy.

The catalogue of his memorial exhibition in the Town Hall in Kranj in 2017 also includes some of Dolinar's works on paper.¹¹

Experimental:

Paper samples

The samples were produced for the needs of the project PaperTreat¹², with different compositions:

- PT1: bleached chemical pulp, 12.2% kaolin, initial pH value 4.8 ± 0.2 ;
- PT2: 80% ground wood, 20% bleached chemical pulp, 11.7% kaolin, initial pH 4.8 ± 0.2 .

Samples were immersed into 0.01 mol·L⁻¹ aqueous solution of calcium hydrogencarbonate (marked as CaCO₃) two times for 20 minutes or into various non-aqueous dispersions for two minutes and left to dry on Mylar film.

8 Biographical data from: F. ŠJANEC, *Sodobna slovenska likovna umetnost* (Maribor: Založba Obzorja, 1968), 292-302; Š. ČOPIC, *Lojze Dolinar* (Ljubljana: Partizanska knjiga, 1985); Š. ČOPIC et al., *Lojze Dolinar (1893–1970) / Retrospektivna razstava* <Ljubljana, Moderna galerija, 20. december 1996 – 12. februar 1997> (Ljubljana: Moderna galerija, 1996).

9 ČOPIC, note 8.

10 B. ILIČ KLANČNIK, 'Dolinar's drawing and printmaking', in: *Lojze Dolinar*, note 8, 39-40.

11 D. GLOBOČNIK, *Lojze Dolinar (1893–1970)*, (Kranj: Gorenjski muzej, 2017).

12 European Community, Sixth Framework Energy, Environment and Sustainable Development Programme, Contract No. SSPI-006584 (PaperTreat).

A solution of calcium hydrogencarbonate was prepared using 1.5 g of calcium carbonate in 1 L of deionized water. Carbon dioxide gas was bubbled through the suspension of calcium carbonate and water until the solution became clear.

Non-aqueous dispersions were: CaLoSil IP5 (nano $\text{Ca}(\text{OH})_2$ in 2-propanol, $3 \text{ g}\cdot\text{L}^{-1}$, marked as CS iPr, IBZ-Salzchemie GmbH & Co.KG, Halsbrücke, Germany), CaLoSil E5 (nano $\text{Ca}(\text{OH})_2$ in ethanol, $5 \text{ g}\cdot\text{L}^{-1}$, marked as CS EtOH), Bookkeeper deacidification dispersion (MgO sub-micron sized particles with the addition of a surfactant- a perfluoropolyether derivative in perfluoro-alkane, marked as BK), Preservation technologies, Cranberry Township, United States).

Accelerated degradation

The treated and the untreated samples were subjected to accelerated degradation conditions in a Vötsch VC 0020 climatic chamber under the following conditions: 80°C and 65% RH for up to 12 weeks.

pH determinations:

Surface pH determinations on original documents were determined according to a Tappi 529 om-04 standard¹³ using a flat combined electrode (Metrohm, 6.0256.100), connected to a Mettler Toledo MP 220 pH meter.

On paper samples, the pH of paper extract was performed according to the TAPPI T 509 om-02 standard,¹⁴ adapted to lower quantities of the sample in the following way: to 100 mg of sample, 7 mL of deionized water was added. pH was determined in the water extract after one hour, using a flat membrane electrode (Metrohm 6.0256.100) connected to a Mettler Toledo MP 220 pH meter.

Colour measurements

The colour of the paper was determined using a Minolta CM-3610d diffuse reflectance UV-VIS spectrophotometer, with specular

13 TAPPI 529 om-04. Surface pH measurement of paper. 2004.

14 TAPPI T 509 om-02. Hydrogen ion concentration (pH) of paper extracts (cold extraction method). 2002.



Fig. 1: Drawing (L. Dolinar, Gorenjska Museum, Kranj) with ballpoint pen with damage due to bleeding of the ink. (Photo: Milan Štupar, NUL)



Fig. 2: Damaged drawing (L. Dolinar, Gorenjska Museum, Kranj) with pencil on paper: folds, wrinkles, creases, tears, holes and losses to the paper, discolouration, clay tape, stains. (Photo: Milan Štupar, NUL)

component excluded and a D65 standard illuminant. The instrument has a $d/8^\circ$ geometry, and reflectance was measured in percentage relative to a polymeric Minolta standard. The values for the colour are expressed in the CIE 1976 LAB system.

Condition assessment of the sketches

All 68 sketches were drawn on machine-made, mostly low quality, lignin-containing paper with pencil (53 sketches), color pencils (1), ballpoint pen (2) or combination of pencil and ballpoint pen (8), combination of pencil and brush point pen (1), combination of pencil and colored pencil (2) and combination of pencil, colored pencil and

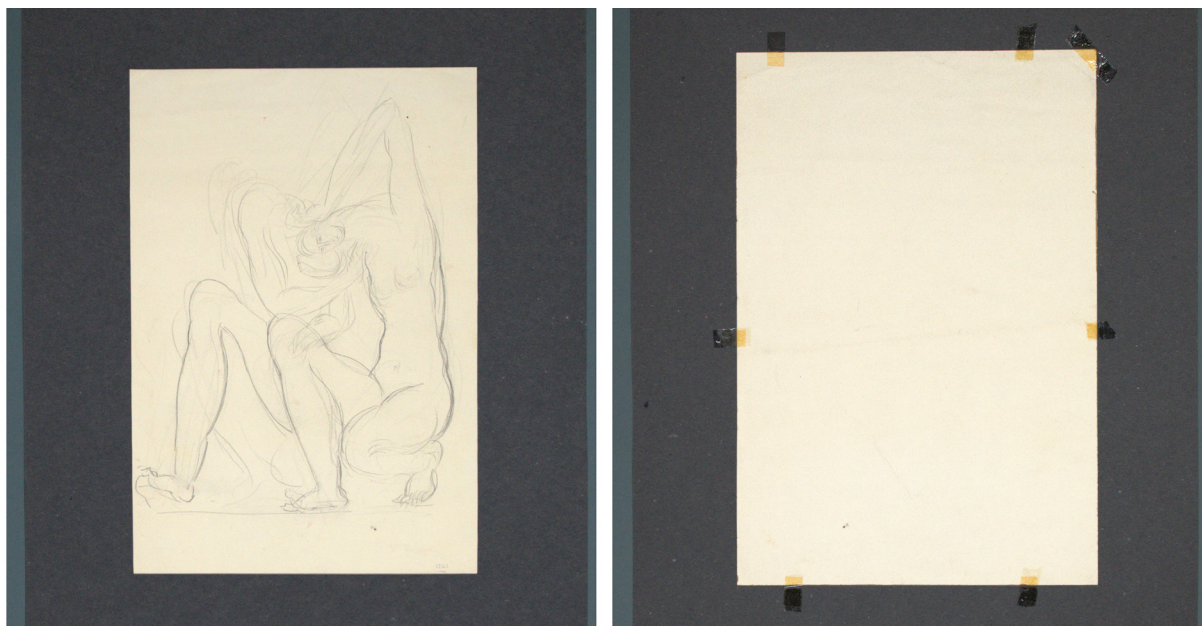


Fig. 3: Drawing with pencil on paper in mat (L. Dolinar, Gorenjska Museum, Kranj). Left: front side, right: back side (Photo: Milan Štupar, NUL)

ballpoint pen (1). The dimensions were very different; the smallest measured 29 × 33 cm, the biggest 85 × 100 cm, most of them had an irregular shape.

The condition of the colour layer was generally good; only slight bleeding of the ink could be observed on one of the sketches (Fig. 1). Due to the acid hydrolysis of paper, discolouration (66 sketches) and associated brittleness (38 sketches) were observed on most of the papers. Many sketches were stained due to foxing (25), adhesive stains (63), mostly with clay, colour stains; in one case water stains were evident and, there were rust stains on two of the sketches. All sketches were also mechanically damaged: the paper was either folded, creased, wrinkled or contained tears, holes or losses to the paper (Fig. 2).

Some of the sketches had remnants of self-adhesive tapes, mostly gummed tapes. Ten sketches were improperly mounted in *passe-partouts* using adhesive tapes and acidic materials (Fig. 3). In addition, storage materials (paper folders) were made of low-quality paper with an acidic pH value.

Determination of pH values on sketches and storage materials

On five sketches, measurements of pH values were performed. The pH values ranged from 4.3 ± 0.2 to 5.1 ± 0.2 , proving the acidity of the papers. In addition, *passe-partouts* and paper folders were measured. Average pH values of paper folders were 6.4 ± 0.1 , and 5.8 ± 0.4 of *passe-partouts*, all in acidic pH region.

pH values and colour stability of the paper samples after deacidification

One of the most important parameters for conservators are the colour changes in the paper after conservation procedures. Colour changes of the samples are undesirable if the change is large enough to a perceptible degree. The most frequent causes of perceptible colour changes are pH-induced changes, the introduction of coloured substances or substances that form coloured products after application or during artificial thermal ageing or deposits on the paper.¹⁵

¹⁵ B. REISSLAND, R. VAN GULIK, A. DE LA CHAPPELLE, 'Non-aqueous prototype treatment agents for iron-corroded papers:

To study the effect of deacidification treatment on the color stability of the paper after deacidification procedures or artificial degradation, two types of papers, one containing only bleached chemical pulp (PT1) and another containing ground wood pulp and bleached chemical pulp, were selected, treated and analysed (paper samples are marked with PT1 and PT2). The papers were deacidified with an aqueous solution of calcium hydrogencarbonate (marked as CaCO_3), Bookkeeper deacidification dispersion (BK) and CaLoSil suspensions of nano calcium hydroxide in either isopropanol (CS iPr) or ethanol (CS EtOH). At the time of conservation treatment, there was no commercially available dispersion containing nano-particles for the treatment of paper documents. In the study by Giorgi et al., it was shown that the application of nanoparticle dispersions of calcium hydroxide in a concentration of $10\text{g}\cdot\text{L}^{-1}$ to ancient acidic paper samples from the 14th, 17th, 19th, and 20th centuries provided excellent results.¹⁶ The product CaLoSiL treatment dispersion,¹⁷ containing nanoparticles of calcium hydroxide, was developed for the conservation of stone, mortar, and plaster; therefore, it was necessary to test it before it could be used on paper documents. All treatment solutions resulted in pH values between 7.2 and 8.1 ± 0.2 , with the lowest pH values obtained after deacidification with calcium hydrogencarbonate. The resulting pH values were all below pH 9, considered optimal for the stabilization of paper documents.

The colour of the samples after deacidification treatment and after accelerated degradation was determined with a diffuse reflectance spectrophotometer. Different studies have proposed different ΔE^* values (total colour difference between two



Fig. 4: Scanned images of paper samples before and after accelerated degradation for 12 weeks.

samples) that have a just noticeable difference, which is the difference perceived by the human eye. Usually, the colour difference (ΔE^*) that equals 1-1.5 is suggested.¹⁸

As evident from Figs. 4, 5, and 6, the colour of the paper changes after the conservation procedure (0 weeks of accelerated degradation) and even more after accelerated degradation. In both cases (PT 1 and PT2), the treatment with calcium hydrogencarbonate (sample CaCO_3) did not change the colour of the paper to a perceptible degree. The treatment with CS EtOH changed the colour of the paper samples to a perceptible degree ($\Delta E^* > 1.5$) on both papers. On lignin-containing sample PT 2, yellowing of the paper after application of the nano calcium hydroxide dispersions was stronger (Figs. 4 and 6) and could be noticed with the naked eye. The difference was even more noticeable after the test of spraying CaLoSil suspension on the paper, with yellow dots clearly visible on it. The results are similar to the ones obtained using an aqueous calcium hydroxide bath. The most serious drawback of the method is considered to be yellowing to lignin-containing paper, attributed to the high pH of the deacidification bath.¹⁹

After accelerated degradation, the biggest colour changes were observed on untreated papers and the smallest after treatment with calcium hydrogencarbonate solution. Bookkeeper deacidification dispersion, as well as CS EtOH, induced the biggest colour changes among deacidification

Evaluation of side effects', in: *Iron gall inks: on manufacture, characterisation, degradation, and stabilisation* (ed. by J. Kolar, M. Strlič, (Ljubljana: National and university library 2006), 215-246.

16 GIORGI, DEI, CECCATO, SCETTINO, BAGLIONI, note 7, 8198-8203.

17 IBZ-Salzchemie <<https://ibz-freiberg.de/en/products>> [accessed 15 May 2019].

18 IBZ-Salzchemie <<https://ibz-freiberg.de/en/products>> [accessed 15 May 2019]. c

19 POULOU, 'Paper conservation methods: a literature review', in: *Cellulose*, 22 (2015), 2859-2897.

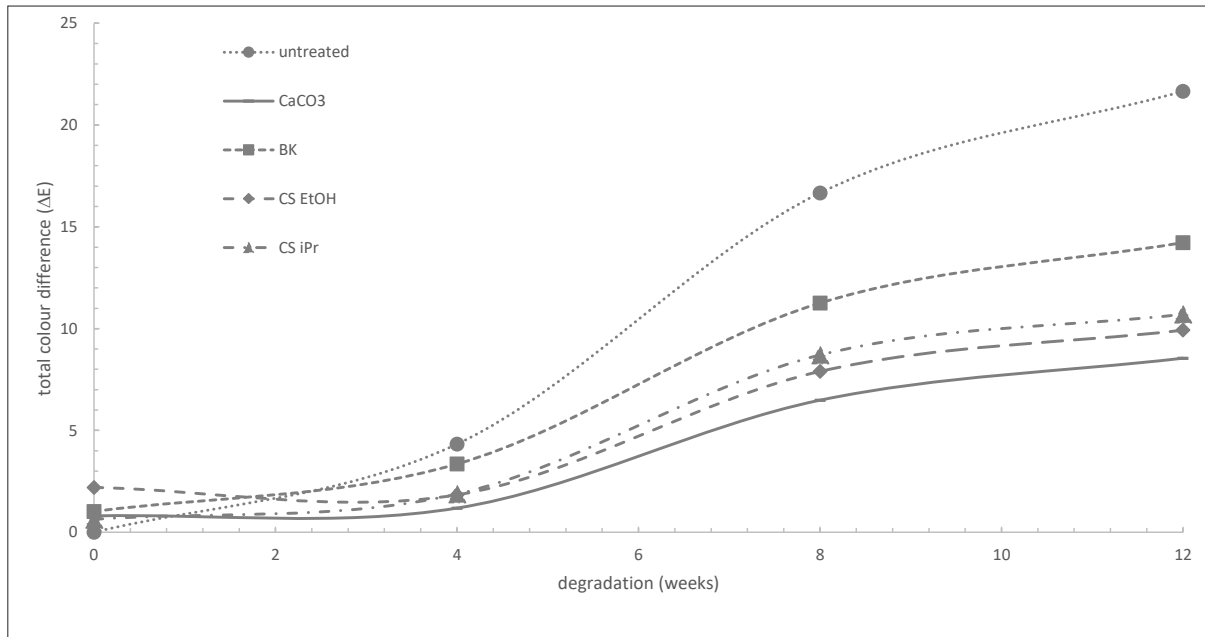


Fig. 5: Total colour difference of paper sample (PT1) after artificial thermal ageing. The average standard deviation of total colour difference determination was 0.4.

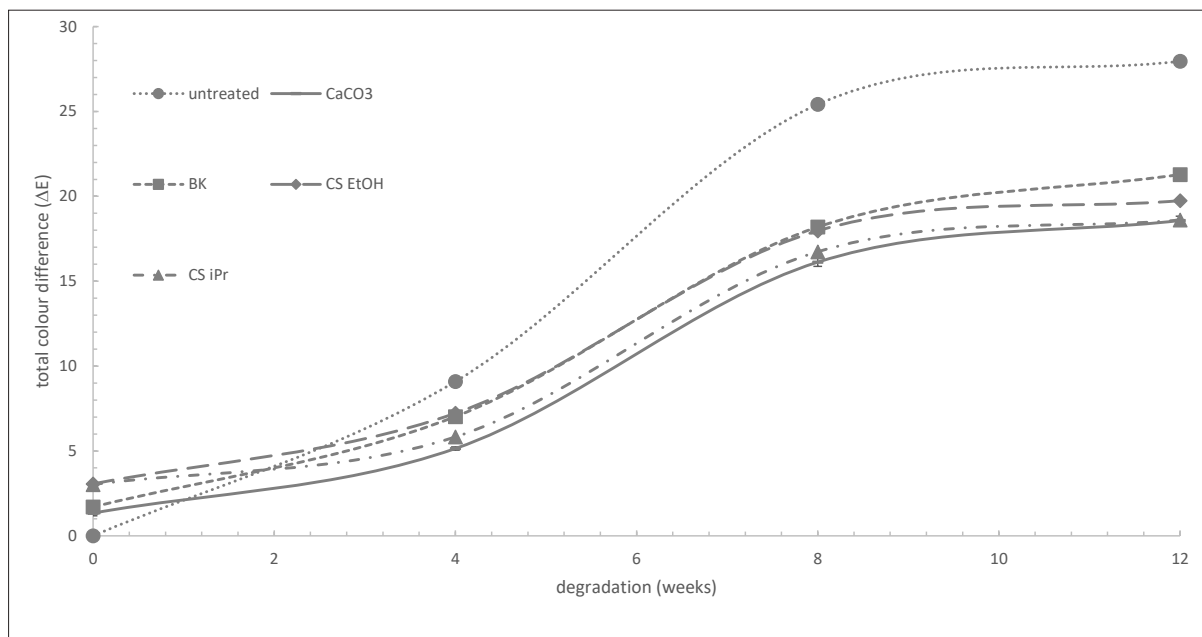


Fig. 6: Total colour difference of paper sample (PT2) after artificial thermal ageing

dispersions. The results are in accordance with literature data, as yellowing is usually attributed to the magnesium-containing deacidification agents, including Bookkeeper.²⁰

The average standard deviation of total colour difference determination was 0.4.

Conservation treatment

The consensus is that which comprises the original work of art should not be modified in any way, and the superficial

20 D. S. STAUDERMAN, I. BRÜCKLE, J. J. BISCHOFF, 'Observations on the Use of Bookkeeper Deacidification Spray for the Treatment of Individual Objects', in: *The Book and Paper Group Annual*, 15 (1996), < <http://cool.conservation-us.org/coolaic/sg/bpg/annual/v15/bp15-17.html> > [accessed 5 June 2019].



Fig. 7: Drawing (L. Dolinar, Gorenjska Museum, Kranj) before (left) and after (right) removal of passe-partouts, self-adhesive tapes, deacidification and conservation of mechanical damage. (Photo: Milan Štupar, Petra Zaviršek, NUL)

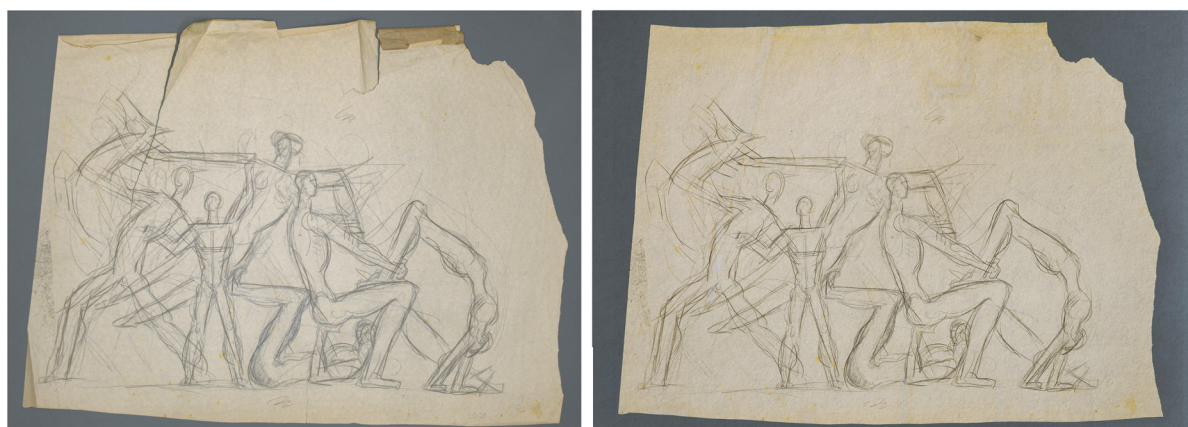


Fig. 8: Drawing (L. Dolinar, Gorenjska Museum, Kranj) before (left) and after (right) local conservation treatment. (Photo: Milan Štupar, Petra Zaviršek, NUL)

traces of natural ageing or even sometimes evidence of accident should not be suppressed. In contrast, means are sought to minimize insofar as possible other consequences of ageing, such as discolouration of paper that is evidence of chemical deterioration, whether from the poor preservation of the work or because of the quality of its support.²¹

The elimination of acidity and the introduction of protection against acidity into paper can be considered as preservative actions if the treatments do not affect the image and thus the pictorial equilibrium.²²

21 C. JAMES, 'Concerns of the curator and concerns of the conservator', in: *Old master prints and drawings. A guide to preservation and conservation*, ed. by M. B. Cohn (Amsterdam: Amsterdam University Press, 1997), 200.

22 JAMES, note 21, 202.

Based on the results of the colour stability of the samples after the application of deacidification treatments, it was decided not to use CaLoSil dispersions or Book-keeper deacidification spray, which could be sprayed on the verso of the drawing in order to avoid white deposits of magnesium oxide on the sketches. Treatment that suppressed ageing and therefore discolouration of the paper carrier was primarily the aqueous one with calcium hydrogencarbonate solution. In addition, the treatment did not cause significant colour changes directly after deacidification treatment.

Because it is most effective if applied on the paper as water bath, it could be used only without any water-sensitive media present. Therefore, solubility tests for all

present media were performed to obtain an indication of the risk of media by dissolving (bleeding) in water. Only those with stable media and not the biggest format sketches (altogether 29), which could be safely handled and supported in their wet state were deacidified.

On all drawings, dry cleaning was performed using Staedtler Mars plastic erasers, Wishab sponges, and scalpels for removing self-adhesive tapes.

Self-adhesive tapes were removed on 39 drawings. If present, gummed tapes were removed by using hot water and scalpel. The rest of the tapes were removed mechanically, using scalpel and eraser or a mixture of acetone and ethanol in a 1:1 volume ratio.

On drawings selected for deacidification, dry and wet cleaning in warm water was performed prior to deacidification. Wet cleaning was performed on nylon screens to prevent them from creasing and tearing during handling. They were subsequently deacidified by immersion (two times for 20 minutes) in 0.01 mol·L⁻¹ calcium hydrogencarbonate solution. Tears were mended while the drawings were still moist using Japanese paper (Japico, Tosa Tengujo, 7,3 g·m⁻², Japico, Kozu - Shi natur, 23 g·m⁻²). Afterwards, the sketches were left to dry slowly under pressure.

Mechanical damage was repaired using Japanese paper (Japico, Tosa Tengujo, 7,3 g·m⁻², Japico, Kozu - Shi natur, 23 g·m⁻² and wheat starch paste made with fine wheat starch and solution of calcium hydrogencarbonate. Folds and creases were (if not deacidified) locally moistened and dried under weight.

Passe-partouts were also removed from the collection, as they were of acidic board and drawings fixed inappropriately with self-adhesive tapes.

In order to preserve the drawings in their new condition for as long as possible, folders were made of museum quality paper with alkaline buffer according to ISO 18916 (Klug K017120 100 g·m⁻²). The largest drawings, too big to be stored in the museum's drawers, were put between paper sheets and rolled.

Conclusion

Before the memorial exhibition, which was held in 2017 in the Town Hall in Kranj, some of Dolinar's drawings were conserved.

As the analysis of the effect of ageing on the pictorial equilibrium is fundamental since all further potential conservation treatment depends on it, deacidification treatments were tested on mock-up papers of similar quality.

All sketches were cleaned, self-adhesive tapes were removed, and mechanical damages were repaired in order to prevent further damage during handling, storage and display, and to improve the aesthetic effect of the artwork as well. Some of the sketches were chemically stabilized. The rest will have to be treated by additional deacidification procedures, safe to be used by conservators on each specific case that has to be developed yet. In order to improve storage conditions of the artworks and preserve them for our successors, old, improper protective equipment was replaced by high quality paper enclosures.

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Jasna MALEŠIČ

National and University Library, Turjaška 1, SI - 1000 Ljubljana, Slovenia
jasna.malesic@nuk.uni-lj.si

Damir GLOBOČNIK

Gorenjski muzej, Tomšičeva 42, SI - 4000 Kranj, Slovenia
damir.globocnik@gorenjski-muzej.si

Petra ZAVIRŠEK

National and University Library, Turjaška 1, SI - 1000 Ljubljana, Slovenia
petra.zavirsek@gmail.com