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INVESTIGATION OF THE INFLUENCE OF WATER TREATMENT IN BOOK CONSERVATION PROCESSES ON THE COLOUR CHARACTERISTICS OF PAPERS

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Introduction

The conservation and restoration of books, documents and manuscripts is aimed at prolonging the life of our written cultural heritage, mainly written on paper, leather and parchment. The main aim of conservation is to preserve the integrity of the object and to prolong its life.

In the present experiment, a study was conducted to evaluate the effect of water treatment in the conservation treatment of books on the colorimetric characteristics of paper. Unrestored books were selected from the archive of the Bulgarian National Library "St. St. Cyril and Methodius", and the study was conducted in the restoration center of the library. Water treatment of all pages of the book have been done and the colorimetric characteristics before and after water treatment have been measured with a spectrophotometer.

Color difference - ΔE, lightness difference - ΔL and hue difference - Δh, between samples before and after water treatment have been calculated. From the obtained results, the effects and changes of the all investigated colorimetric parameters were determined. These results are important from a practical and scientific point of view. The results could be used as valuable information for restoration centers worldwide.

Problem Description

The main goals of the experiment are to evaluate the effect of water treatment in the conservation treatment of books on the colorimetric characteristics of paper of old manuscripts.

The processes of changing the color characteristics in the water treatment process in the conservation treatment were investigated and their quantification was done by determining the two most commonly used color difference formulas, CIE ΔE*ab and CIE ΔE2000.

For a more detailed analysis of color changes expressed as ΔE, all three coordinates in CIE* Lch were examined separately each by other to determine the effect of water treatment in conservation process for each of coordinate changes.

Methods

For the present experiment, a book entitled "Companion Talks on the Service of a Junior Officer" dated 1898 from the archives of the National Library of St. St. Cyril and Methodius. It is valuable and not restored. Twelve sheets of the book were selected. Two different fields were selected on each of pages without printing on them. Field 1 being the lightest area of the paper and Field 2 being the darkest area of the paper (zone with advanced oxidation).

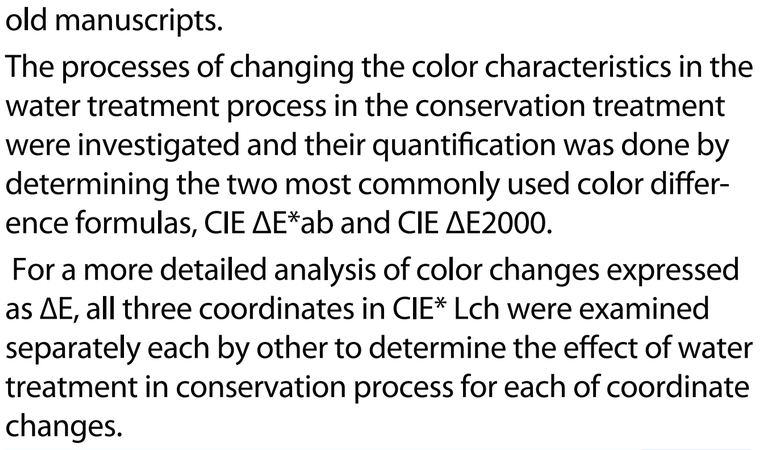

Figure 1
Sheet 1 and 2 of the book and selected fields

Results

Figure 2 shows the influence of the color difference (CIE ΔE*ab) and (CIE ΔE2000) before and after water treatment of the twelve pages of the book for the advanced oxidation zone - Field 2 (darkest zone).
Figure 3 shows the color differences in the lightest area of paper (Field 1) with less degree of oxidation

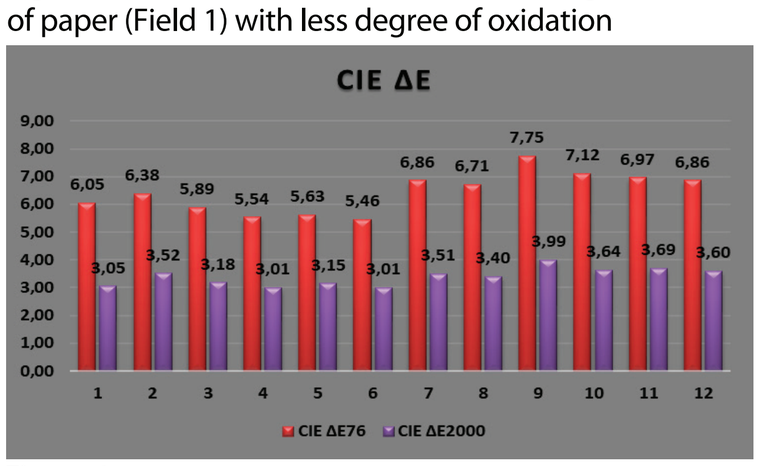

Figure 2
*Effect of color difference (CIE ΔE*ab) and (CIE ΔE*2000) before treatment and after water treatment of selected fields of paper sheets for the darkest area (advanced oxidation zones)*

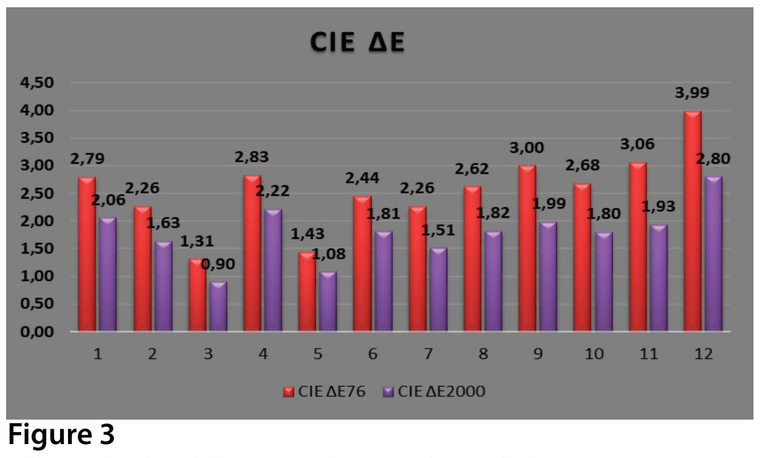

Figure 3
*Effect of color difference (CIE ΔE*ab) and (CIE ΔE*2000) before treatment and after water treatment of selected fields of paper sheets for the lightest area*

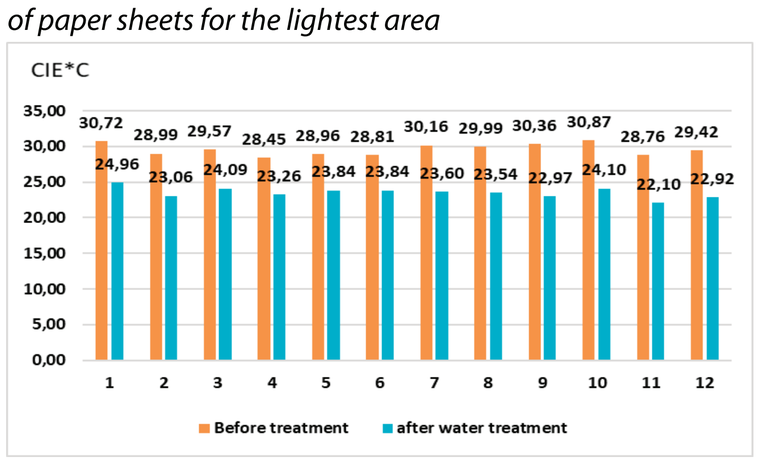

Figure 4
*Study of the change in saturation (CIE*C) of the book pages before and after water treatment for the darkest and more oxidized areas of paper*

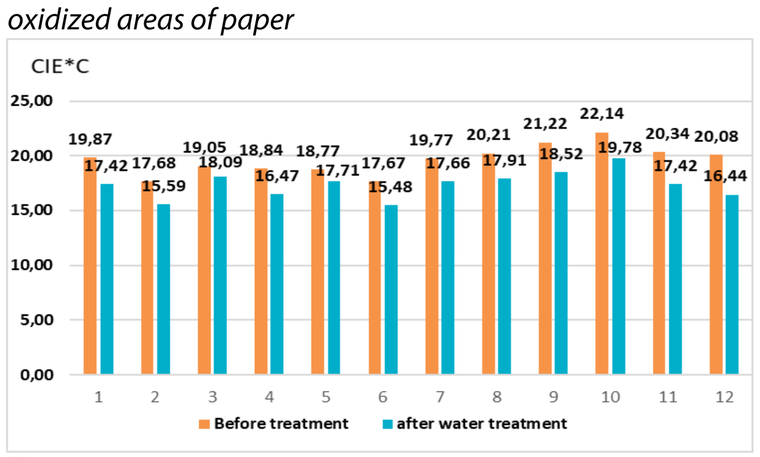

Figure 5
*Study of the change in saturation (CIE*C) of the book pages before treatment and after water treatment for the lightest area*

Discussion / Conclusion

From the study made of the color characteristics of the book before and after water treatment of the paper, it was found that the conservation treatment gives a serious effect on the areas with advanced oxidation. The lightest areas of the papers (those least affected by the aging process) are very slightly affected by the conservation processes and practically change color characteristics in relatively small dimensions.

From the calculation made of the color difference (ΔE*ab and ΔE2000) between before treatment and after water treatment of selected fields from the pages of the book, it was found that the highest values were obtained in the fields with advanced oxidation.

- The change in ΔE2000 (before and after water treatment) for the lightest selected area of the pages reached 2.60, and for fields with advanced oxidation of the paper (the darkest area) to 3.99, indicating that there is a noticeable difference expressed by the more sophisticated color difference formula - ΔE2000.

The biggest changes of the color characteristics - lightness (CIE* L), saturation (CIE* c), color tone (CIE*h), are in the fields with advanced oxidation.

Based on the results obtained, it was found that the water treatment processes mostly affect the saturation (CIE* c), less affects on hue (CIE*h) and lesser extent the lightness (CIE* L) of paper.

-There is slight change in the lightness of the paper for both light and darker areas which is almost imperceptible and is in range of 0,1 to 1 unit of CIE L. The water treatment in conservation processes very slightly decreases the lightness of paper.

-There is a significant change in the saturation of the paper (CIE*C) of the selected fields of the book pages in the area of advanced oxidation of the paper (darkest area) after water treatment. The water treatment reduces the saturation of oxidized paper by 6-7 units of CIE C. This change in the saturation values visually feels like a decrease in the intensity of the yellow-brown color of the oxidized paper after the water treatment process is done, which improves the good visual feeling when reading the book. The obtained results show, that after the water treatment, the saturation of the darker and lighter areas of the paper become closer in value because the darker yellow spots on the paper fade and become closer in color to the lighter and less affected by oxidation sections of the paper.

-The change in color hue as a result of the water treatment is approx. 3-4 units for the dark oxidized fields, and 1-3 units for the light parts of the paper. These changes in color tone are not visually very significant because the color saturation is not too high, especially for lighter fields of paper.

From a scientific and applied point of view, the obtained results are important, as they provide valuable information on the effect of water treatment on the color characteristics of paper in the book conservation process. The study also proves that despite the advent of electronic media, paper remains the main material for storing and transmitting information. Therefore, in the future, care for the storage, conservation and restoration of written materials will remain the main priority of libraries, museums, archives, and private collections.