

## Light Bleaching: Scientific Investigation of Various Effects on Different Properties of Several Old Papers

### ABSTRACT

The light bleaching is an aesthetic treatment used in the field of paper conservation. Its efficiency, measured by the increase of brightness in the paper, has been quite extensively studied but the actual chemical mechanism of light bleaching in relation to paper fibers has not been elucidated in most of the literature. In the theoretical part of this study, the author recounts the chemical reactions occurring in the paper during light exposure. In the experimental part, the effects of light bleaching were demonstrated in terms of the chemical and mechanical properties of various papers. Six different kinds of papers were chosen for the study, and characterized by means of microscopic observation and various spot testing. Then, each paper was cut into multiple samples and submitted to different treatment conditions to compare the action of each treatment on the studied properties (figs.1–2): washed in ambient light, immersed in water in the dark, exposed to high-intensity light in a dry condition, immersed in water and exposed to high-intensity light. Control and treated samples were measured for their optical properties by measuring the brightness with a spectrophotometer; the mechanical properties by testing the tensile strength (O-SPAN Test); acidity by evaluating the pH; and the condition of the fibers by measuring the degree of polymerization by viscosimetry. All these measurements and tests were repeated after artificial thermal aging to appreciate the effects on the long term as well.

On the short term effect, light bleaching in water immersion neither brightened nor darkened the lignin-containing paper even after four hours of exposure. On the other hand, it increased the brightness of all the non-lignin papers whether the paper is made of woodpulp or rag/cotton. For some paper, the bleaching treatment decreased the strength of the paper and the degree of polymerization soon after the treatment. The pH was not significantly changed by the light bleaching

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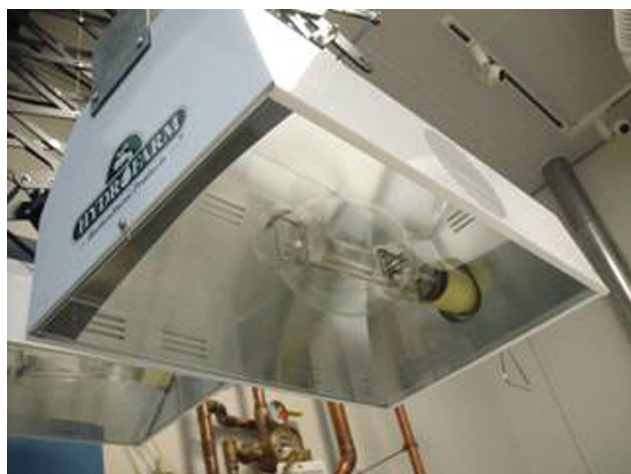


Fig. 1. Metal Halide Lamp used for indoor light bleaching

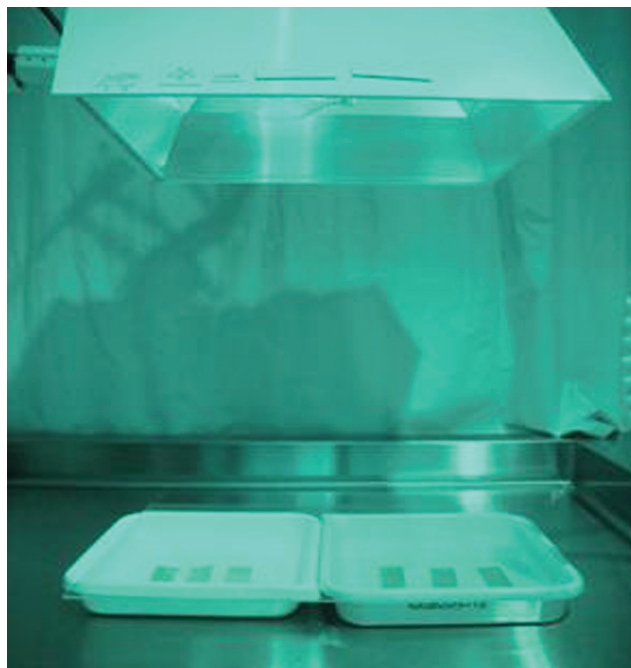


Fig. 2. Samples exposed to light during the research project

treatment. On the long term effect, rag/cotton paper showed the least color reversion compared to other kinds of paper.

In conclusion, it is obvious that most often, a simple bath or a deacidification treatment can considerably reduce the yellowing without being negative for the fibers. Even though it is difficult to make general observations since the behavior of each paper is different, it can be said that the light bleaching treatment may have negative consequences and the decision to apply it should be taken seriously with the respect of its effects and potential damages on the paper fibers. Understanding the intricacy of light bleaching and the positive and negative effects on various papers may lead conservators to implement the procedure for individualized cases. The decision making for light bleaching should be based on each conservator's ethical and technical judgment.

A full-text publication of the research project and its results is pending.

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