A NOTE ON THE USE OF MAGNESIUM BICARBONATE IN HYDROGEN PEROXIDE SOLUTIONS

Hydrogen peroxide has been regarded as the safest oxidizing bleach because it does not leave behind chemical residues such as chlorine, and is believed to break down into water and oxygen which can volatilize out of paper. With this in mind the paper conservation staff at the National Gallery has used it in cases where discoloration on paper was disturbing and it appeared that only an oxidizing agent could bleach it. When we use hydrogen peroxide as a bleaching agent (or to convert darkened lead whites), we dilute reagent grade 30% hydrogen peroxide to the desired strength of ca. 1-3% with a saturated solution of magnesium bicarbonate. The resulting pH is around 8.0. If a more alkaline solution is desired, ammonium hydroxide can be added to raise the pH to 9.0.

Where possible we first try to diminish the stain by applying magnesium bicarbonate prior to bleaching, allowing it to dry and then rinsing with alkalized deionized water. This process often solubilizes some discoloration. According to Gilbert, Pavlovova and Rapson [1], magnesium bicarbonate also sequesters metallic ions that catalyze cellulose degradation by hydrogen peroxide. Moreover, we prefer using magnesium bicarbonate to other chemicals in our bleaching solution because it has a history of use in conservation treatments. We prepare a fresh solution of hydrogen peroxide at least once an hour. We have noticed more rapid evolution of oxygen bubbles in solutions several hours old, and by using fresh solutions we feel more certain that peroxide, rather than nascent oxygen, is the active bleaching agent.

In the way we have used hydrogen peroxide we have not experienced the problem of color reversion reported by other conservators. We have, however, noted a residual bleaching action that continues for hours. This makes us suspect that the bleach does not disappear from the paper as readily as is often thought, or that some other bleaching entity may be produced. Consequently, in using hydrogen peroxide as a bleach we attempt to bleach stains partially, expecting some further brightening. Following peroxide treatment we rinse as thoroughly as possible with deionized alkalized water.

I have made some informal tests using magnesium bicarbonate as the alkalizing agent for hydrogen peroxide solutions and exposing strips of newsprint treated with these solutions to filtered north light for almost two years. Two solution batches were applied to

---

[1] Gilbert, Pavlovova, and Rapson, "Mechanism of Magnesium Retardation of Cellulose Degradation During Oxygen Bleaching", Tappi. 56, 6. (June 1973.), 95 ff.

the paper strips: one freshly made and one two hours old. Treatment solutions consisted of:

1. saturated $Mg(HCO_3)_2$
2. H_2O_2 diluted to 3% with deionized water
3. H_2O_2 diluted to 3% with deionized water, pH raised to 9 with NH_4OH
4. H_2O_2 diluted to 3% with saturated $Mg(HCO_3)_2$
5. H_2O_2 diluted to 3% with saturated $Mg(HCO_3)_2$, pH raised to 9 with NH_4OH

One consistent observation was that magnesium bicarbonate greatly reduced the darkening of the newsprint when exposed to light. Where magnesium bicarbonate was absent from the test solution, fairly uniform darkening occurred both in the treated and untreated portions of the newsprint strips. The use of hydrogen peroxide in the solutions did not result in darkening of the paper.

In conclusion, we can see some protective action by the magnesium bicarbonate both with and without hydrogen peroxide present. Similarly we see no increased darkening from peroxide treatments.

Nancy E. Ash
National Gallery of Art
October 1983