Regards to the Restoration Treatments of Manuscripts

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Summary: *The use of restoration treatments to manuscripts should be consider with special care. Particular and very aggressive process of degradation for these documents, together with differences in the paper of the document, show different results when using restoration treatments in aqueous media. Otherwise, fragility of the support can stops practical aqueous treatments without previous reinforcement. In this work we try to make a glance over several factor which we consider very important when evaluating results.*

Keywords: *Paper composition, paper degradation, processes of restoration*

1 Introduction

The concept of manuscript involves two materials, the support (paper or parchment) and the ink. Both fit the condition of preservation of the manuscript and both are important when corrosion ink processes starts. This work wants to contribute to the MIP EU project (EVK4- 2002-20010) and its aim is to comment several details which should be take into account when restoring manuscripts..

Acidity of the iron gall ink brings about important acidity in the paper. This subject has been one of the most usual factors studied, and deacidification is still now the treatment with more bibliography published. Nevertheless, other factors like oxidation of cellulose contribute too to the degradation process of corrosion. Fortunately, InkCor EU-project (EVK4-CT-2001-00049) develops treatments focused to counteract the degradation activity of metallic ions and Papylum EU-project (EVK4-2000-CT2000-00038) studies oxidation of cellulose and its chemiluminescence effect.

2 Subjects to regard

Experience tell us that several factors have to be take into account to understand results when restoration treatments are applied to manuscripts in contrast to the results obtained for the printed ones or other graphic documents. The behaviour of manuscripts during and after deacidification using aqueous or non aqueous treatments, as well as results obtained with new experimental compounds demands to consider special characteristics of the ancient hand made paper and particular reactions between metallic ions and structure of cellulose. Parameters which can influence global results when applying restoration treatments are the following:

2.1 Structure of hand made paper

The distribution of fibres in the thickness of paper is different depending on its mechanical production or its hand made production. Hand made paper has the fibres without preferential direction so they are placed in aleatory way. In contrast, mechanical production keeps the fibres mostly positioned to one direction.

2.2 Composition of fibres

Fibres used in ancient manuscripts until around 1850 are from rags made from natural plants, mostly flax and hemp. The quality of cellulose in earlier paper is very good. This quality for fibres from wood depends on the process of production used to eliminate or change the lignin with thermal, mechanical or chemical treatments. This process can degrade the physical structure of the fibre and cause oxidation of sensitive hydroxyl groups in cellulose chain. Otherwise, % of hemicelluloses from wood also contribute to the particular behaviour of these fibres when ageing.

Using usual paper reagents (Herzberg, Lofton-Merrit and others) to dye fibres is possible to identify the process applied in paper production and distinguish the “quality” of the fibre (origin, acidic or alkaline treatment).

The raw material (wood or rags) used to made paper fit different treatments to obtain fibres and this different condition of cellulose fit different answer too when applying restoration processes in manuscripts.

2.3 Additives in paper

Paper itself is a complex material because several components like glue (starch, gelatine, rosin), alkaline buffering, alum and others, influence paper ageing behaviour. Characteristics of paper changes along centuries to improve paper writing quality: craft paper process add mechanical and chemical

improvements. More changes appear when mechanical and wood paper production starts.

2.4 Moistening

Morphological dimensional structure of fibres justifies capillary sensibility for water as well as for other solvents with different polarity. Amorphous zones in the fibre are the most sensitive points when acidic (H^+) and metallic (Fe^{2+}) ions starts easily its degradation activity. Short migration capacity (1mm) of iron ion can be attributed to its relatively large size and to orbital "d" which can interact with active points of cellulose (C=O, -OH). Large migration capacity of acidic ion (H^+) and for (SO_4^{2-}) (5mm) in corroded manuscripts should be take into account in restoration processes.

2.5 Oxidation of cellulose

Degradation of manuscripts from iron gall ink corrosion causes strong oxidation of cellulose. Degree of oxidation in printed samples is lower than in acidic manuscripts. So, Characteristics and oxidation condition of manuscript is very important in order to understand well behaviour and results when applying different restoration processes.

3 Interactions between treatment and initial condition of manuscript

In this step of the work we want to point several thoughts which are in mind of people who work doing manuscript restoration.

3.1 Hydrolysis and pH

Acidity brings about hydrolysis of cellulose. In fact, several deacidification water solutions with calcium, magnesium or bicarbonate and calcium hydroxide has been tried and scientifically studied. It seems that alkaline buffering and capacity of water to make soluble acidity works well. Nevertheless, other factors like initial oxidation degree of cellulose, pH of solution during deacidification, as well as pH of deacidified paper, should to be take into account. This is specially important for manuscripts because we know that it exists oxidation of cellulose in degraded iron gall ink manuscripts. We also know that high alkaline pH during and after deacidification can brings about alkaline hydrolysis in this oxidized cellulose and results in bad ageing behaviour. PH of calcium hydroxide solutions is too high to be used in aqueous treatments, but this is useful to prepare tyloses and glues because calcium carbonate particles precipitate and are mixed with the mucilage that gives this alkaline buffering when gluing manuscripts.

3.2 Calcium and magnesium bicarbonate

Several studies focused to test both bicarbonates (calcium and magnesium) gave conflicting results. Depending on the original condition of the paper (hand made paper from rags or not), samples show different ageing behaviour. It seems that level of oxidation of cellulose and chemical treatments applied when paper and pulp were produced (from wood or not) can influence the results obtained with both bicarbonates. So, it is important to consider these important factors:

a) Origin and condition of cellulose.
b) Solubility of bicarbonates.
c) pH of aqueous solution and pH of paper after treatment.
d) Mg coordination possibilities.

3.3 Water and alcohol

Solubility of ink compounds are different in water than in alcohol.. It is useful to take advantage of this organic solvent and to use diluted solutions . They can be applied after aqueous treatments taking advantage of reduction in ion migration and accelerating manuscript drying. Nevertheless, possible elimination of soluble acidity is reduced, but polarity is probably enough to assume that advantages of polar solvents is still in progress. It should be used with previous judgment of its benefits of bad results.

4 Fragility of corroded papers. Adhesives

Most of the manuscripts show ink in both faces of the paper . When corrosion develops the paper is very degraded. So, apart of new reagents to counteract oxidation of cellulose and acidity, corrode manuscripts demand reinforcement of the support.

4.1 Reinforcement

Consolidation of manuscripts has been done strengthening paper with a) traditional lamination or b) by inner lamination. Both processes use adhesives and tissue, but the general opinion is not too much favourable. Poor support strength becomes difficulties when applying aqueous treatments. Modern chemical technology and outstanding adhesives and tissues (organic chemistry) are being developed. Probably, it already exists useful products, that with good scientific judgment can be tested to improve the results.

5 Conclusion

1. Scientific research focused to test treatments in manuscripts demands to take into account global characteristics of this documents in order to reason well results obtained.