Chapter 8
Oxidative Degradation of Cellulosic Fibers in Historical Textiles

Madian Hamed Abdel Hady
Faculty of Archaeology, Faypum University, Egypt

ABSTRACT

Museums around the world are filled with large number of cellulosic materials, like textiles that have suffered from the scourge of the consequences of being exposed to the destructive processes of its fibres, dyes, inks, mordants, etc., due to the exposure to the action of transition metals; in a famous mechanism worthy of study, this means valuable sources are lost from time to time. For this, the foregoing motivated this chapter to move toward finding and identifying the causes of these destructive mechanisms of the cellulosic fibres. Not only this, but also to try to find ways that would measure the degree of what results from exposure to destructive interactions, especially the weakness of mechanical properties, free radicals content, depolymerization, and the demise in some cases; as well as the fading and darkening of dyes and inks, or disappearance completely in many cases. Besides the darkening of cellulosic substrates, this chapter will deal with experimental studies, as well as citations and reference studies.

INTRODUCTION

In chemical terms, oxidation expresses a loss of electrons or an increase in the oxidation state by a molecule, an atom, or an ion, where the oxidized substance loses an electron from the outer orbit of its atom's nucleus, and although its reactions are often related to oxides are formed from oxygen molecules. There are specific examples that include the transfer of that electron from an oxidized substance to a reduced one, and in both cases, oxidation and reduction express a change in the oxidation state of these substances, and both are half-reactions. For a change in the oxidation state to occur, the two halves must occur together (Phillips, et al., 2000; Hudlicky, 1990).

DOI: 10.4018/978-1-7998-4811-0.ch008

From the foregoing, we see that oxidation in chemical reactions may take place without the presence of oxygen, and the electrons that are released during the oxidation process - *as mentioned above* - must be acquired by another substance, and it happens that the oxidation number of the compound that loses electrons increases, and in the old concept of oxidation, the process of iron rusting occurs for example, and atmospheric pollutants from nitrogen and sulfur are oxidized to their oxides, while in the modern one, the oxidation of hydrogen H_2 occurs by losing electrons and giving it to fluorine F_2 to form hydrogen fluoride 2HF as examples of different oxidation concepts (Schüring, et al 1999).

In another concept, the oxidation state, the oxidation stage or the number of oxidation represents the degree of oxidation of an atom in a compound, or it is the electrical charge that an atom acquires if all its bonds with other elements are of the ionic bond **type by 100%, So the increase in the oxidation** state of an atom during a chemical reaction called oxidation, and its decrease is known as reduction, and these reactions include the transfer of electrons, and the acquisition of an atom of electrons is consid-

Figure 1. Faded dyes, inks, and fibers on linen and wool tunic due to oxidation
(Istvan, 2009)