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Original Paper

Identification of the Stain Structure Caused by Hand Contact on Historical Papers of the Pebdeni Museum of Old Manuscripts, Iran

Mehrnaz Azadi Boyaghchi[1], Ali Nemati Babaylou[*2], Azita Mosavi Majd[3]

[1]Assistant Professor, Faculty of Conservation, Art University of Isfahan, Isfahan, IRAN
[2]Assistant Professor, Faculty of Applied Arts, Tabriz Islamic Art University, Tabriz, IRAN
[3]M.A in Conservation of Cultural Properties, Faculty of Conservation, Art University of Isfahan, Isfahan, IRAN

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Abstract

The stains caused by hand contact on books are one of the problems in conservation of historical papers during the cleaning process. These stains are usually resistant and not easily soluble in solvents. Accordingly, it is necessary to know their structure in order to select the appropriate solvent and cleaning method. The aim of this article is to study the structure of stains caused by hand contact in historical papers. These stains are referred to as greasy stains in some texts, and many of them are old, and their abundance in some cases indicates the amount of object using. So, this article tries to answer the question of what is the chemical structure of the hand-caused stains on historical papers. For this purpose, Fourier Transform Infrared Spectroscopy (FTIR) was used to identify the structure of the stains in 20 samples of paper and paper works of Dariush Pebdeni collection in Foulad Shahr- Iran. Before the analysis, sizing material was identified by the classic methods and analysis carried out on the samples with the starch sizing. The results of this study showed that the structure of the stain is composed of sulfur proteins and does not have a fatty structure. The presence of absorption bands associated with NH and CN and the absence of carbonyl bands associated with carboxylic acids and esters shows that stains have proteinous structure and they are non-fatty stains. The absorption bands of the 700-900 cm^{-1} region can be attributed to out of plan bending N-H, which is combined in amide and amine samples. The strong bands at 1032 cm^{-1} and 1222 cm^{-1} can be due to C-N stretching in aliphatic amines. Also, skeletal vibrations of cycloalkanes can also produce a medium to strong adsorption band in the 1030 cm^{-1} region. The absorption band of the 1363 cm^{-1} in these samples is also due to N-O nitro in amines and amides, and the absorption band of the 1114 cm^{-1} region is probably caused by C-O. Absorption bands related to NH and CN, which is seen in the structure of amides and amines, and two specific absorption bands belonging to sulfur compounds (470 cm^{-1} resulting from S-S and 2518 cm^{-1} related to S-H) can indicate the protein's stains. Sulfuric amino acids in proteins include cysteine, cystine and methionine. The cysteine loses its hydrogen and, by forming a bond between the two sulfur atoms in the structure of the proteins, conjuncts the polypeptide chains. The presence of peptide bonds in the stain can be demonstrated by a C-N-C related absorption bands in the range of 1160 cm^{-1} and 1222 cm^{-1}. Also it should be noted that the presence of adsorption bands related to OH stretching in 3440 cm^{-1} could indicate the oxidation of the product, which could justify the resistance of stains to conventional organic solvents. This absorption band that is

* Corresponding author: a.n.babaylou@tabriziau.ac.ir

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usually strong and broad, is observed in all samples and has overlapping with a stretching NH attraction of about 3300 cm^{-1}. Accordingly, a comparative study of the Fourier Transformation Infrared Spectroscopy results of historical samples with animal proteins indicates the similarity of the spectrum of spots with the spectrum of animal glue and gelatin.
Keywords: Stain, Historical Paper, Pebdeni Collection, FTIR, Sulfur Proteins.

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