J15 Evidential Value of Adhesives in Questioned Document Examinations

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After attending this presentation, attendees will better understand the role and evidential value of adhesives in the examination of questioned documents.

This presentation will impact the forensic science community by alerting questioned document examiners to the evidential importance of detecting and identifying adhesives in the materials (e.g., inks, papers, substrates) of questioned documents cases.

The presence of functional adhesives in questioned document materials is widespread, although these components are often overlooked as useful diagnostic evidence for authentication and linking purposes. Adhesive formulations are found, in one form or another, in written and printed inks, paper substrates, applied laminates, envelope gums, stamps and packaging labels, photographs or security features attached with a glue, and various other document constituents. It is often of probative value to the questioned document analyst to chemically characterize the adhesive formulation for authentication or linking purposes and to understand possible mechanisms by which counterfeiters can chemically remove, alter, or replace an adhesive material in the production of fraudulent documents.

Adhesion can be defined as the tendency of a material to bond to another material. The strength of adhesion, or attraction, between bonded materials depends on many factors, including the means by which the bonding occurs – e.g., by mechanical means, in which the adhesive works its way into small pores of the substrate, or by one of several chemical mechanisms. In some cases, an actual chemical bond is formed between the adhesive and the substrate. In others, electrostatic forces hold the substances together. A third mechanism involves the *van der Waals* forces that develop between molecules, while a fourth means involves the diffusion of the glue into the substrate, followed by hardening.

In the case of written or printed inks, formulations require chemical and mechanical forces to hold their multiple constituents together as a single entity and to bond tightly to the substrate after application. The vehicle system of the ink largely determines its adhesive properties. On absorbent substrates, such as paper, adhesion is influenced by the degree of vehicle penetration into the matrix, while on non-absorbent substrates such as films or foil, adhesion is primarily controlled by the film-forming ability of the resin and the molecular affinity for the substrate. Inkmakers often use adhesion promoters in small amounts to enhance the compatibility between substrate and ink to provide improved chemical bonding.

Binders such as starch act as adhesives in the production of paper by increasing the strength of the inter-fiber bonding. The fiber-to-starch link is stronger than the fiber-to-fiber bond, which translates directly to the strength of the paper fibers, with the greatest percentage gain in strength noted in cotton fiber content papers. Applied laminates, or films, which are added to one or both sides of a printed document (e.g. passports, identification cards, photo badges) to protect the document from degradation due to handling and exposure, are available as either

self-adhesive films, cold (or *tape*) laminating films, or hot (or *thermal*) laminating films, depending on the intended application. The adhesives contained in envelope gums, stamps, packaging labels and various glue-based document features also consist of resin formulations which can be analyzed by questioned document examiners.

Various types of adhesives that are used in the production of document materials (inks, papers, laminates, et al) will be described, including heat set, solvent and pressure sensitive adhesives, and will discuss analytical techniques that are available to characterize the adhesives to provide diagnostic forensic information. A basic description of the principles of adhesion, and how adhesives are developed and incorporated into document materials, in particular, will also be covered in this presentation.

Adhesives, Documents, Bonding

 ** Presenting Author*