



Determining Sequence of Strokes of Green Pen Ink and Blue Seal



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Abstract

The relative chronological sequence of intersecting pen strokes with seal ink has been determined using non-invasive technique. The exemplars were prepared at different time intervals. The results were obtained by observing specular reflection, Relative gloss of the ball point ink, Spreading of ink, and Dragging of ink pigments. Intersections of blue seal impression with green colour ball point pen ink or gel pen ink strokes. Strokes were examined under Documenter- NIRVIS. The effectiveness of instrument for examination of sequence of stroke has been compared.

Keywords: Seal impression; Pen inks; Intersections; Documenter- NIRVIS; Green ink; Blue seal

Introduction

Many techniques have been developed to determine the sequence of strokes depending on the nature of writing instrument, type of ink or type of material. Determining the sequence of stroke is still very challengeable job for forensic document experts. With the popularity in different types of writing instruments and ink, the determination of sequence of stroke can be problematic. The application of allied sciences and analytical techniques of forensic science to questions concerning documents is termed forensic document examination. Determining sequence of strokes is an integral part of forensic document examination. The need for the investigation of sequence of strokes of writing emerges when it is alleged that a statement is written after the signature was done on the document or this examination can be performed to learn which of the handwriting was last written. The examination of sequence determination is very important job to fix the accountability of the person who had forged the document by making additions after the accomplishment of the document. By examining properties of ink like absorption of ink onto the paper, color of the ink, properties of ink like gloss and luminescence can help in more easier and faster detection of sequence of intersecting lines [1-6]. It is possible to observe how the pen tip, besides releasing the ink, deforms the paper. This is because; the writing

pressure leaves more or less deep impressions, according to: Writing pressure (amount of pressure exerted over the paper during act of writing) ;Underlying material (sheet of paper lying on metal surface or on paper block); Writing material (fountain pen, pencil, gel pen, ballpoint pen interact in different ways with paper); Type of paper used (the production process determines the size and the morphology of the fiber's layers in the paper) (*Max Frei theory revisitation: does really strokes depth changes along time*). (*Based on microscopic analysis*) claimed that strokes are time dependent, due to the (supposed by his observations) 3-years paper elastic release time. According to his theory it is possible to try to date the handwritten document studying depth change over time. Montani, et al. [7], Examination of Heterogeneous Crossing Sequences between Toner and Roller ball Pen Strokes by Digital Microscopy and 3-D Laser Profilometry [7] . Giuseppe Schirripa Spagnolo [4] Potentiality of 3D laser profilometry to determine the sequence of homogenous crossing lines on questioned documents. In this paper the potentiality of the 3D micro-topography to resolve the writing order of signatures to detect the tampering of manuscripts, to analyze pressure variation, and to identify strokes in handwritten [4]. A study to visualize and determine the sequencing of intersecting ink lines examined sequence of

strokes using Raman spectroscopy by doing the analysis of inks. Intersections are formed by the writing of ink; they can also be formed by printed text, paper fold, typewriting, indenture, and etc [8,9]. Sequence discrimination of heterogeneous crossing of seal impression and ink-printed text using adhesive tapes, explained technique to discriminate the sequence of stamped seal impression and ink-printed text in a document to detect falsely signed documents [9,10]. Systematic study of the lifting technique for determining the writing sequence of intersecting ball pen strokes using Kromekote technique. A theory is proposed to explain the lifting of ball pen ink and its application in the method [10].

Materials and Method

Sample Size

Total of 240 intersections were prepared with Blue seal ink and green pen ink using different type of writing instrument (Ball pen and Gel pen) on A4 size white sheet.

Sample Preparation

In this the blue colour ink and round seal is used. The content written on the seal- Institute of Forensic Science, GFSU, Gandhinagar, with University Logo in the center. The sequence of preparing sample was either seal was placed first or pen was written first. The samples were prepared in a batch of 6 i.e. in the different time interval ;In first batch of samples the seal was immediately placed on the signature and vice versa; In second batch of samples the seal was placed on the signature after the time interval of 10 minutes and vice versa; In third batch of samples the seal was placed on the signature after the time interval of 2 hours and vice versa; In fourth batch of samples the seal was placed on the signature after the time interval of 3 days and vice versa; The fifth batch of samples the seal was placed on the signature after the time interval of 10 days and vice versa; The sixth batch of samples the seal was placed on the signature after the time interval of 1 month and vice versa.

Type of Paper

A4 size sheets were used of Xerox Company for the purpose of sample preparation.

Writing Instrument

Ball pen of Flair, Gel pen of Cello brands were used.

Instrument Used

The Documenter NIRVIS with excellent optics, high resolution digital camera, fully controlled working sequences and functions permit investigations in various UV and in the IR and IR luminescence range [11,12].

Result and Discussion

Ball Pen

When samples were observed in **White Light** the following observations were made:

No **Dragging** of ink pigments were seen in samples when seal was over signature. When signature was over seal, in samples with no time interval i.e. immediate samples, with 10 minutes time interval and 2 hours interval out of all intersecting points approximately 70 % of them were showing dragging of seal ink pigments. In the samples of time interval 3 days, 10 days and 1 month dragging of ink was not seen when signature was over seal. When seal was over signature the **Continuity** of pen stroke was seen instead of seal ink i.e. where pen strokes were present there were no / or relatively very less interaction of seal ink with paper. This was seen in the samples of immediate and 10 minutes interval. In the time interval of 2 hours, 3 days and 10 days the continuity of pen stroke at some intersecting points and at some points the continuity of seal ink were seen. Last in the time interval of 1 month the continuity of only seal ink was seen. When signature was over seal only continuity of seal ink were seen in all the samples. No **Spreading** of ink were seen when seal was over signature in any sample. When signature was over seal out of all intersecting lines only samples with no time gap i.e. immediate samples were showing Spreading of seal ink pigments in approximately 60% intersections. **Relative gloss** of the ball point ink is seen in approximately 25% of intersecting points when seal was over signature, and when signature was over seal it was seen in approximately 65 % of intersecting points.

When samples were observed in **Top Side Light** and **Oblique Light** the following observations were made:

When seen under top side light the pen pressure was seen clearly, due to which when seal was over signature there was light depression at intersection point whereas when signature was over seal at intersecting points there was raise in the writing. And all other points remained the same.

Gel pen

When samples were observed in **White Light** the following observations were made:

No **Dragging** of ink pigments were seen in samples when seal was over signature. When signature was over seal, in samples with no time interval i.e. immediate samples, with 10 minutes time interval and 2 hours interval out of all intersecting points approximately 60 % of them were showing dragging of seal ink pigments. In the samples of time interval 3 days, 10 days and 1 month dragging of ink was not seen when signature was over seal. When seal was over signature the **Continuity** of pen stroke was seen instead of seal ink i.e. where pen strokes were present there were no / or relatively very less interaction of seal ink with paper. This was seen in the samples of immediate and 10 minutes time interval. In the samples of time interval of 2 hours the continuity of pen stroke at some intersecting points and at some points the continuity of seal ink were seen. Last in the samples of time interval of 3 days, 10 days and 1 month the continuity of only seal ink was seen. When signature was over

seal only continuity of seal ink were seen in all the samples. No **Spreading** of ink were seen when seal was over signature in any sample. When signature was over seal out of all intersecting points, samples with no time gap i.e. immediate samples and samples of 10 minutes time interval were showing Spreading of seal ink pigments in approximately 50% intersections. In the samples with time interval of 2 hours, 3 days, 10 days and 1 month no spreading were seen even when signature was over seal. **Specular reflection** was seen when seal was over signature in approximately 60% of intersecting points. But when signature was over seal approximately 15% of intersecting points were showing specular reflection.

When samples were observed in **Top Side Light and Oblique Light** the following observations were made:

When seen under top side light the pen pressure was seen clearly, due to which when seal was over signature there was light depression at intersection point whereas when signature was over seal at intersecting points there was raise in the writing. And all other points remained the same.

Validation of The Study

For the purpose of validity of the work, the samples were examined by the 5 – 10 experts of questioned document. They were asked to determine whether seal was over signature or vice-versa. Their observation: It was difficult to determine when signature was over seal impressions as in 70 % intersecting points were showing continuity of seal ink. Only at some intersecting points spreading of ink was seen, also in most cases spreading of seal ink is seen at very few intersecting points spreading of pen ink was seen. Dragging of ink was also not consistent in all intersecting point. But dragging of ink was whenever seen was seen only when signature was over seal impression. Relative gloss of ball point pen was observed when signature was over seal impressions in about 60% of cases. Specular reflection was seen in gel pen intersecting points in approximately 50% intersections.

Conclusion

Dragging of ink was not seen when seal was over signature whereas when signature was over seal dragging was seen in

around 50 % of intersecting point. Continuity of pen was seen in only 20% of intersecting point whereas continuity of seal was seen in 80% of intersecting point. Spreading of seal was seen in around 80% of intersecting points. Relative gloss of ball pen was seen in about 70% of intersecting point. Specular reflection was seen in gel pen in around 60% intersecting point. When samples of signature over seal were observed under oblique light and top side light the pen stroke were showing raised impression.

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