Forensic Identification of Suspected Document on the Basis of their Ink Profiling

Suneet Kumar¹, Vaibhav Saran², Rajeev Kumar³, Mahipal Singh Sankhla⁴*, Ramesh Kumar Pandey⁴

¹Assistant Professor, Division of Forensic Science, SBAS, Galgotias University, Greater Noida, India
²Assistant Professor, Department of Forensic Science, Sam Higinbottom Institute of Agriculture, Technology & Sciences, Deemed University, Prayagraj, India
³Associate Professor, Division of Forensic Science, SBAS, Galgotias University, Greater Noida, India
⁴Research Scholars, Division of Forensic Science, SBAS, Galgotias University, Greater Noida, India

*Corresponding Author: Mahipal Singh Sankhla, Research Scholars, Division of Forensic Science, SBAS, Galgotias University, Greater Noida, India, Email: mahipal4n6@gmail.com

Abstract: Ink analysis is an important forensic procedure that can reveal useful information about questioned document. The wide array of materials used in inks, coupled with complex analytical challenges to conduct such analysis, the aim of most such analysis is to determine whether two pieces of written text are originated from the same ink, therefore comparison of different writing inks on a document is the main goal of most investigations. The present study will emphasize on the ink profiling by various analytical methods. The study was carried out at the Division of Forensic Science, Galgotias University. In the study various brands of ink samples were analysed by physicochemical methods, including chromatography and Spectrophotometer analysis to make their profile. The work will be an efficient method for identification of altered document by comparing the ink profile.

Keywords: Ink, Document, Profile, Investigation, etc.

1. INTRODUCTION

The forensic suspected/questioned document is a very challenging ground. Hardly a day energy by deprived of some document playing a portion in the life of human lives. Questioned documents are verified consistently in forensic science laboratories for their genuineness. Human development has observed script organizations mean while early period also for footage determinations or as a means of communication. The script resources and tools used in the earlier comprised stone, wax, vellum, quills, leaf, wooden materials, etc. [1]. In questioned document cases, one of the current significant features contains the proof of identity and judgement of indicator (permanent and whiteboard) pen inks which are extensively used for numerous requests. These inks are finished up of colorants (i.e., dye or pigment), a solvent or thinners, resins, surfactants, lubricants, emulsifiers, and additives [2]. The most significant query for file specialists is to response whether the liquid ink used is similar or dissimilar in the manufacture of a document. Consequently, the present method delivers valued vision to the forensic expert production with questioned document inspections. It also helps in the connection of unidentified pointer inks to the enduring or whiteboard markers which can thin down the statistics of alleged samples [3].

2. MATERIAL AND METHODOLOGY

In the present work, 10 different samples of ink of various brands and producers collected at the stretch of Greater Noida were analyzed for their profiling the major four types of test viz., Physical test, Spectrophotometric test, Paper chromatography test and Chemical test were followed. In physical test, the colour and density of ink were identified. The transmittance and absorbance of ink were measured by Spectrophotometric test. In paper chromatography 10 different type of ink sample were examined by 2 different combinations of solvents and some inks were separated into 3-4 different colours in different lengths. The chemical test was followed by saturated aqueous solution of bleaching powder (Reagent D), 2N aqueous
solution of NaOH (Reagent B) and 10% aqueous solution SnCl₂ (Reagent C). In chemical test the colour of ink was changed after the adding the above solution.

### 3. RESULT AND DISCUSSIONS

The detailed results are reported from table 1 to table 6.

#### Table1: General appearance of various brands of inks

| S.No. | Sample name | Brand               | Appearance                                                                 |
|-------|-------------|---------------------|---------------------------------------------------------------------------|
| 1     | B1          | Parker blue         | A fluid low viscosity and flows swiftly quick drying                       |
| 2     | B2          | Chelpark blue       | Slightly viscous in comparison to Quink, flows slower are in its comparison but faster than camel |
| 3     | B3          | Camel blue          | Flows slower than chelpark, but faster than Luxor and quick drying in comparison to Luxor |
| 4     | B4          | Luxor sketch pen blue | Flow slower than camel less drying in comparison to camel                    |
| 5     | BL1         | Parker black        | Flow faster than camel black, quick drying than camel black                |
| 6     | BL2         | Chelpark black      | Flow faster than Parker and quick drying than Parker black                 |
| 7     | BL3         | Camel black         | Flow slower than Parker and quick drying than Luxor                         |
| 8     | BL4         | Luxor sketch pen black | Flow slower than camel, less drying in comparison to Camel                  |
| 9     | B- BL1      | Chelpark blue-black | Flow and drying, slower than camel and faster than Luxor                    |
| 10    | R1          | Chelpark ruby red   | Flow and dries faster than all other ink tested.                            |

#### Table2: Test for the density of different brands of Ink

| S. No. | Sample Name | Wt. of empty Measuring Cylinder (W₁) | Wt. of ink with Measuring Cylinder (W₂) | Volume of ink | X = (W₂ - W₁)/V |
|--------|-------------|--------------------------------------|----------------------------------------|---------------|-----------------|
| 1.     | B1          | 91.9                                 | 100.3                                  | 10 ml         | 0.84            |
| 2.     | B2          | 91.9                                 | 100.5                                  | 10 ml         | 0.86            |
| 3.     | B3          | 91.9                                 | 100.8                                  | 10 ml         | 0.89            |
| 4.     | B4          | 91.9                                 | 101.4                                  | 10 ml         | 0.95            |
| 5.     | BL1         | 91.9                                 | 100.5                                  | 10 ml         | 0.86            |
| 6.     | BL2         | 91.9                                 | 101.1                                  | 10 ml         | 0.92            |
| 7.     | BL3         | 91.9                                 | 100.7                                  | 10 ml         | 0.88            |
| 8.     | BL4         | 91.9                                 | 100.8                                  | 10 ml         | 0.89            |
| 9.     | B- BL1      | 91.9                                 | 100.7                                  | 10 ml         | 0.88            |
| 10.    | R1          | 91.9                                 | 101.1                                  | 10 ml         | 0.92            |

#### Table3: Shows the result of chemical test of various brands of inks

| Sample Name | Observation with Reagent D | Observation with Reagent B | Observation with Reagent C |
|-------------|----------------------------|----------------------------|---------------------------|
| B1          | Turned to fade blue immediately | The colour turned to slightly grayish black | Turns dark brown          |
| B2          | Turned to fade blue immediately | Colour slowly change to brownish yellow | Turns to rapidly reddish yellow |
| B3          | Turned to fade blue immediately | Turned to brownish yellow | Colour change to brownish yellow immediately |
| B4          | Colour change to torques blue | The colour turns to dark sky blue immediately | Turns to purple          |
| BL1         | Colour rapidly change to greenish black | Colour turned to brown immediately | Change to light brownish black |
| BL2         | No action | The colour immediately change to pale blue | Colour rapidly changed to pale blue |
| BL3         | No action | No action | Change to dark brownish black |
| BL4         | Turns to slightly greenish black | Change to fade green | Colour turns brown immediately |
| B-BL1       | Unaffected instead of slow bleaches of colour. | Bleaches or fades pale blue-green. | Colour bleaches pale blue-green. |
| R1          | Turned to purplish blue immediately | Colour change to fade brown | Colour turned to fade brownish blacks |
Table 4: RF values of different type of ink by using solvent system (water)

| S. No. | Sample Name | Colour            | RF Value       |
|--------|-------------|-------------------|----------------|
| 1.     | S₁          | Gray              | 9/10.8=0.833   |
| 2.     | S₂          | Blue              | 10/11=0.909    |
| 3.     | S₃          | Light sky blue    | 9.4/11=0.85    |
| 4.     | S₄          | Orangish black    | 9.5/11=0.772   |
| 5.     | S₅          | Light blue        | 9/11=0.818     |
| 6.     | S₆          | Light blue        | 9/11=0.854     |
| 7.     | S₇          | Light blue        | 8.7/10=0.87    |
| 8.     | S₈          | Sky blue          | 4.3/10=0.43    |
| 9.     | S₉          | Light purple      | 2.2/10=0.22    |
| 10.    | S₁₀         | Light sky blue    | 0.5/10=0.05    |
| 11.    | S₁₁         | Yellowish green   | 0.5/10=0.05    |
| 12.    | S₁₂         | Blue              | 0.6/10=0.06    |
| 13.    | S₁₃         | Sky blue          | 9/10.7=0.841   |
| 14.    | S₁₄         | Sky blue          | 2/10.5=0.190   |
| 15.    | S₁₅         | Purple            | 4/10.5=0.380   |
| 16.    | S₁₆         | Yellowish green   | 1.2/10.5=0.190 |
| 17.    | S₁₇         | Light blue        | 0.8/10.5=0.076 |
| 18.    | S₁₈         | Torques blue      | 0.8/10.5=0.076 |
| 19.    | S₁₉         | Pink              | 9/11=0.818     |
Figure 1: Paper Chromatography result of different type of ink by using solvent system (water).

Table 5: RF values of different type of ink by using solvent system (Water+Ethyl Alcohol+Acetic Acid)

| S. No. | Sample Name | Colour      | RF Value   |
|--------|-------------|-------------|------------|
| 1.     | S₁          | Black       | 9/11=0.818 |
| 2.     | S₂          | Blue        | 9/11.3=0.796 |
| 3.     | S₃          | Sky blue    | 9/11.3=0.796 |
| 4.     | S₄          | Black       | 8.5/10.2=0.833 |
| 5.     | S₅          | Blue        | 8.6/10.5=0.819 |
| 6.     | S₆          | Blue        | 8.5/10.2=0.833 |
| 7.     | S₇          | Blue        | 8.3/10.5=0.790 |
| 8.     | S₈          | Blue        | 1.5/10.5=0.142 |
| 9.     | S₉          | Toques blue | 4.5/11=0.409 |
| 10.    | S₁₀         | Blue        | 2.5/11=0.227 |
| 11.    | S₁₁         | Toques blue | 3.4/10.3=0.330 |
| 12.    | S₁₂         | Light pink  | 5/10.3=0.485 |
| 13.    | S₁₃         | Pink        | 9/11=0.818 |

Figure 3: Paper Chromatography result of different type of ink by using solvent system (Water+Ethyl Alcohol+Acetic Acid).
Table 6: shows the absorbance and transmittance of different brands of ink using spectrophotometer

| Sample Name | Brands            | Absorbance | Transmittance |
|-------------|-------------------|------------|---------------|
|             |                   |            | 1  | 2  | 3  | 4  | 5  |
| B1          | Chelpark          | 84.9       | 15.1| 15.1| 15.1| 15.1| 15.1|
| B1          | Chelpark          | 79.5       | 22.3| 22.3| 22.3| 22.3| 22.3|
| R1          | Chelpark          | 83.6       | 14.1| 14.1| 14.1| 14.1| 14.1|
| B1          | Camel             | 85.9       | 17.7| 17.7| 17.7| 17.7| 17.7|
| B-BL1       | Parker (quink)    | 83.5       | 16.5| 16.5| 16.5| 16.5| 16.5|
| B5          | Luxor hi-Tec      | 82.9       | 17.1| 17.1| 17.1| 17.1| 17.1|
| B-BL5       | Luxor hi-Tech     | 78.0       | 22.0| 22.0| 22.0| 22.0| 22.0|
| B4          | Luxor Sketch Pen  | 78.8       | 21.2| 21.2| 21.2| 21.2| 21.2|
| B-BL4       | Luxor Sketch Pen  | 78.4       | 21.6| 21.6| 21.6| 21.6| 21.6|

The results reported here in table no. 1 to 6 includes the results of various physicochemical analysis performed for this study, the results are clear and illustrative and the findings satisfies the objectives of the study as on the basis of these results various brands of inks was profiled, which provides a simple method to characterize inks and by the change in profile of ink in the original and altered writing the fraudulent can be depicted.

4. CONCLUSION

This study will help forensic document examiners to evaluate and interpret documents written in different ink pen which is most widely used script in India. The purpose of this study was to examine the ink in the suspected document and from the results reported. If the same ink pen used for alteration or obliteration found to easily identify this technique. In future more research can be done on ink examination by adding instrumentation technique and also increasing large no of samples.

REFERENCES

[1] Hilton, O. Scientific Examination of Questioned Documents-- Revised Edition; Elsevier: New York, 1993.
[2] Kunjappu, J. T. Ink Chemistry; Royal Society of Chemistry, London, 2003; https://www.chemistryworld.com/news/ink_chemistry/3002158.article (accessed 15 September, 2017).
[3] Sharma, V., Kumar, R., Devgan, K., Mishra, P. K., Ekielski, A., Kumar, V., & Kumar, V. (2018). Multivariate analysis for forensic characterization, discrimination, and classification of marker pen inks. Spectroscopy Letters, 51(5), 205-215.