

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

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**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 SnCl<sub>2</sub>(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 foster 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 (W <sub>1</sub> )	Wt. of ink with Measuring Cylinder (W <sub>2</sub> )	Volume of ink	X= (w <sub>2</sub> - w <sub>1</sub> )/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

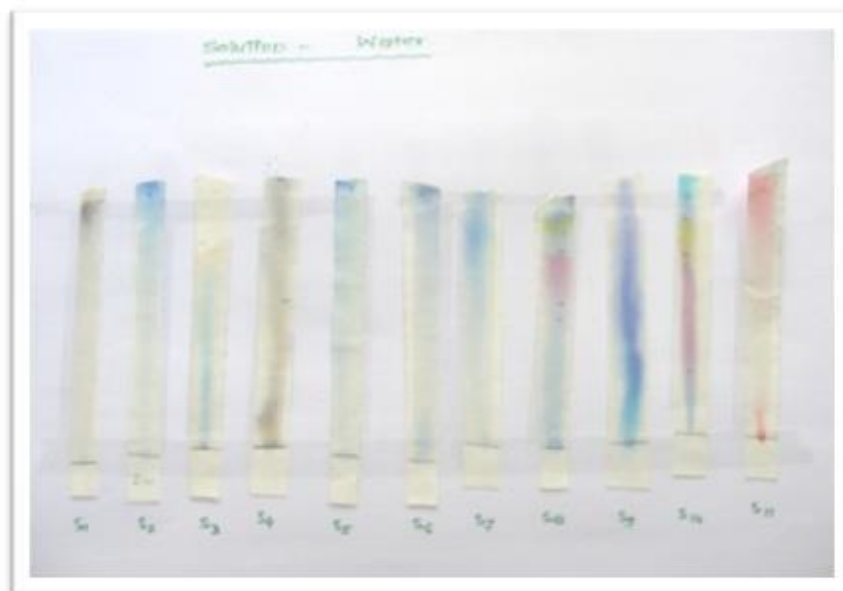
**Table3:** Shows the result of chemical test of various brands of inks

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



**Table4:** RF values of different type of ink by using solvent system (water)

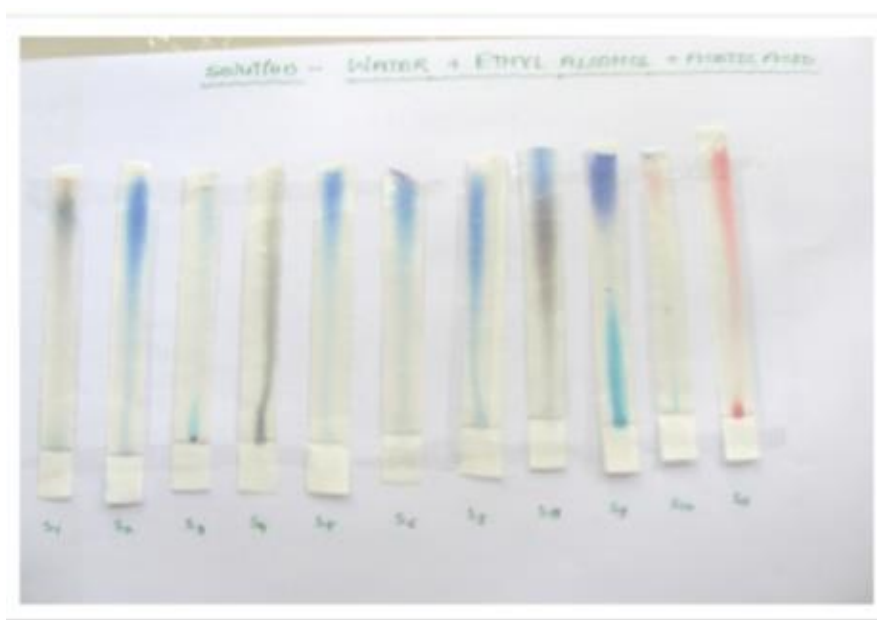
S. No.	Sample Name	Colour	Rf Value
1.	S <sub>1</sub>	Gray	9/10.8=0.833
2.	S <sub>2</sub>	Blue	10/11=0.909
3.	S <sub>3</sub>	Light sky blue	9.4/11=0.85
4.	S <sub>4</sub>	Orangish black	9.5/11=0.772
5.	S <sub>5</sub>	Light blue	9/11=0.818
6.	S <sub>6</sub>	Light blue	9.4/11=0.854
7.	S <sub>7</sub>	Light blue	8.7/10=0.87
8.	S <sub>8</sub>	Sky blue	4.3/10=0.43
9.	S <sub>8</sub>	Light purple	2.2/10=0.22
10.	S <sub>8</sub>	Light sky blue	0.5/10=0.05
11.	S <sub>8</sub>	Yellowish green	0.5/10=0.05
12.	S <sub>8</sub>	Blue	0.6/10=0.06
13.	S <sub>9</sub>	Sky blue	9/10.7=0.841
14.	S <sub>10</sub>	Sky blue	2/10.5=0.190
15.	S <sub>10</sub>	Purple	4/10.5=0.380
16.	S <sub>10</sub>	Yellowish green	1.2/10.5=0.190
17.	S <sub>10</sub>	Light blue	0.8/10.5=0.076
18.	S <sub>10</sub>	Torques blue	0.8/10.5=0.076
19.	S <sub>11</sub>	Pink	9/11=0.818



**Figure1:** Paper Chromatography result of different type of ink by using solvent system (water)

**Table5:** Rf values of different type of ink by using solvent system (Water+Ethyl Alcohol+Acetic Acid)

S. No.	Sample Name	Colour	Rf Value
1.	S <sub>1</sub>	Black	9/11=0.818
2.	S <sub>2</sub>	Blue	9/11.3=0.796
3.	S <sub>3</sub>	Sky blue	9/11.3=0.796
4.	S <sub>4</sub>	Black	8.5/10.2=0.833
5.	S <sub>5</sub>	Blue	8.6/10.5=0.819
6.	S <sub>6</sub>	Blue	8.5/10.2=0.833
7.	S <sub>7</sub>	Blue	8.3/10.5=0.790
8.	S <sub>8</sub>	Blue	1.5/10.5=0.142
9.	S <sub>8</sub>	Toques blue	4.5/11=0.409
10.	S <sub>9</sub>	Blue	2.5/11=0.227
11.	S <sub>9</sub>	Toques blue	3.4/10.3=0.330
12.	S <sub>10</sub>	Light pink	5/10.3=0.485
13.	S <sub>11</sub>	Pink	9/11=0.818



**Figure3:** Paper Chromatography result of different type of ink by using solvent system (Water+Ethyl Alcohol+Acetic Acid).

**Table6:** shows the absorbance and transmittance of different brands of ink using spectrophotometer

Sample Name	Brands	Absorbance	Transmittance				
			1	2	3	4	5
B <sub>2</sub>	Chelpark	84.9	15.1	15.1	15.1	15.1	15.1
Bl <sub>2</sub>	Chelpark	79.5	20.5	20.5	20.5	20.5	20.5
B-bl <sub>1</sub>	Chelpark	77.7	22.3	22.3	22.3	22.3	22.3
R <sub>1</sub>	Chelpark	83.6	16.4	16.4	16.4	16.4	16.4
B <sub>3</sub>	Camel	85.9	14.1	14.1	14.1	14.1	14.1
B-Bl <sub>3</sub>	Camel	82.3	17.7	17.7	17.7	17.7	17.7
B <sub>1</sub>	Parker (quink)	83.5	16.5	16.5	16.5	16.5	16.5
B-BL1	Parker (quink)	78.8	21.2	21.2	21.2	21.2	21.2
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.

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