ORIGINAL ARTICLE ISSN:-2230-7850

Indian Streams Research Journal

Abstract:-

Thin Layer Chromatography is a very effective tool for examination of ink since beginning. It has proved to be the most convenient methods in separation of inks. Ink is a liquid or a viscous pigmented substance used for writing, printing, and drawing. Ink's composition and its consistency vary accordingly. It depends on the purpose for which it is used. However every ink is composed of components such as pigment or dye called colorant and vehicle. Some of the common types of inks are writing inks, printing inks, drawing inks, visible inks, and invisible or symphetatic inks. If the ink is exposed to certain liquids such as solvents the colour of the ink dissolves and gets separated. If the solution is allowed to soak on to the chromatogram different colour will separate into different spots on the plate according to their respective Rf values.

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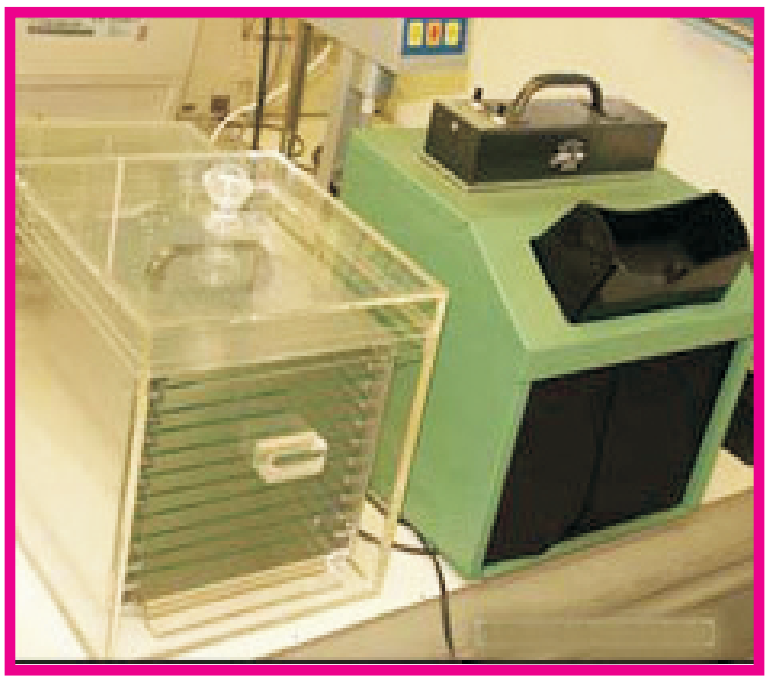

THIN LAYER CHROMATOGRAPHY OF INKS- A FORENSIC APPROACH

In the present study THIN LAYER CHROMATOGRAPHY (TLC) has been applied to different types of inks to individualize them on the basis of their Retention Factor (Rf) which in turn helps the Forensic Expert to understand about the different inks used on the forged document. Thus by comparing the Rf values of these inks with the Rf values of the Questioned ink samples we can easily get an idea about the inks used in the preparation of a Questioned Document.

Keywords:

THIN LAYER CHROMATOGRAPHY (TLC) , Retention Factor , Forensic Science

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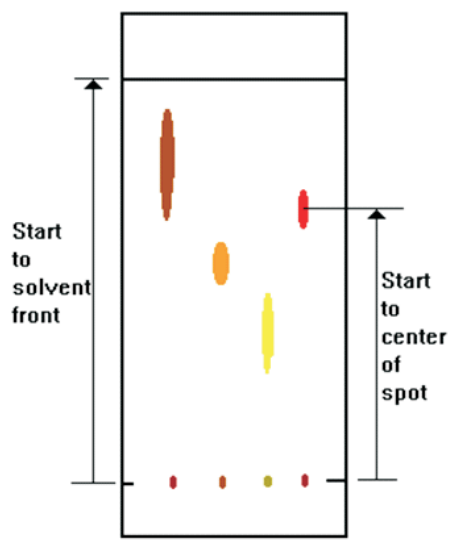
INTRODUCTION

Questioned Document Examination is the oldest one in Forensic Science and Examination of Inks on the Documents is a major task to be performed by Forensic Document Examiner. One of the most problematic situations encountered by the forensic experts is differentiation and identification of inks. Forgery on the documents such as cheques, passports, birth certificates, wills, license cards etc demand analysis of inks in some cases. The examination is furthermore complicated with the invention of new writing materials. Since so many years forensic document examiners are striving to develop new scientific aids for identification and discrimination of inks. Some of the scientific techniques used in the examination of inks are Thin Layer Chromatography, Infrared Luminescence, Ultraviolet photograph techniques, microspectrophotometry, HPLC, Capillary Electrophoresis; Laser induced infrared luminescence, Raman spectroscopy1.

In the Present study attempt has been made to differentiate inks by Thin Layer Chromatography (TLC). TLC is one of the most reliable less time and money consuming technique. Thin layer chromatography (TLC) is a type of chromatography where the stationary phase is a thin layer of adsorbent particles attached to the solid plate. A small amount of sample is applied (spotted) near the bottom of the plate, and the plate is placed in the mobile phase. This solvent is drawn up by capillary action to a predetermined height. Each component, being different in chemical and physical composition, will interact with the stationary phase at a different time (retention time), thereby creating the individual bands on the plate. The retention time or retention factor (Rf) is used to characterize and compare components of various samples. The same basic procedure is used for paper chromatography, however, with paper chromatography, regular or specially treated paper is used instead of a solid plate2.



Diagramatic representation of Thin LayerChromatography2

METHODOLOGY:

In the present research the attempt has been made to differentiate inks of pens manufactured by different registered companies and their Rf values is calculated. The companies are named as follows Rotomac, Renolyds, Cello, Claro, Linc, Natraj, Classmate, Parker. Organic solvent pyridine was used to dilute the ink samples. The solvent system used to develop the chromatogram is nbutanol: ethanol: acetic acid: distilled water (18:2:2:2). Different ink samples were dissolved in organic solvent pyridine. Slurry of silica get- G was prepared with distilled water in the ratio 2:1 which was evenly spread on glass plates of size 15x5 cm to form a coating of 2mm thickness and later this plate was kept for activation under a temperature of 110 degrees for an hour. The solvent system was left in glass chamber for an hour. The activated plates were marked with ink spots at a distance of 1.5cm each. After the marking was done the spots were allowed to dry for some time and later the plates were placed in the solvent chamber for the solute and solvent to run. The solvent was observed as it moved from the place of origin and stopped at a point and it was marked as Solvent Front which was found to be at a distance of 10cms. The plates were removed as soon as the solvent reached the solvent front. The colour obtained due to dyes present in inks was noted and their distance from origin was measured and later the Rf values of each spot was calculated by the following formula.

$$R_f = \frac{\text{Distance traveled by the solute from the point of origin}}{\text{Distance traveled by the solvent system from the point of origin}}$$

RESULTS

TABLE 1: DETAILS OF THE COLOUR AND RF VALUES OF THE INK SAMPLES

SL NO	NAME OF THE INK SAMPLE	COLOUR	R_f VALUES
1.	ROTOMAC	Light blue Pink	0.35 0.98
2.	REYNOLDS LIQUFLO	Dark blue Light blue	0.83 0.97
3.	CELLO BLACK	Light black Purple Dark purple Yellowish purple Yellow	0.46 0.52 0.85 0.93 0.10
4.	CLARO	Lilac blue Light purple Dark purple	0.31 0.72 0.8
5.	LINC CELEB	Light blue Light purple	0.27 0.92
6.	NATRAJ	No spot	-
7.	REYNOLDS RACER GEL	Faint Red	0.10
8.	CASSMATE OCTANE	No spot	-
9.	CELLO GEL	No spot	-
10.	REYNOLDS JIFFY	Light blue Lilac blue Purple Dark purple Faint purple	0.01 0.3 0.41 0.53 0.82
11.	PARKER	Light blue Blue Faint blue Light blue	0.08 0.12 0.39 0.55

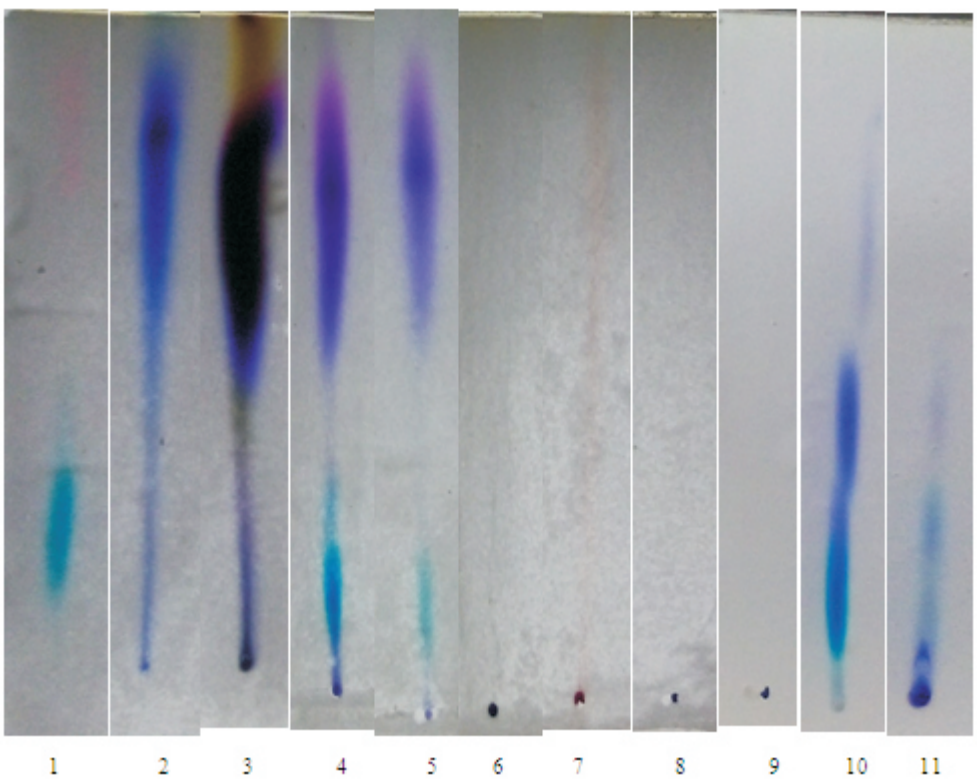


Figure 1: Showing Thin Layer Chromatography of 11 Different Inks

DISCUSSION AND CONCLUSION:

The need to differentiate inks arises in the examination of the Questioned documents which are altered or back dated. Establishment of the age of ink is a challenge to forensic document experts. Few years before the colour of the ink was due to a single component i. e. a single dye so after the analysis by TLC a single spot was observed but now a days the manufacturers are involved in the production of inks with the mixture of dyes. Therefore it has become necessary to distinguish between inks of same types which will allow the forensic experts to determine the identity of the pens used in preparing the forged

document and the year of manufacture. Since the colour of ink is due to the mixture of dyes, it becomes essential to separate the dyes from each other to differentiate the ink. These dyes can be differentiated by TLC. In the present study the attempt has been made to separate the dye components using a solvent system n butanol: ethanol: acetic acid: distilled water (18:2:2:2) the ink samples were diluted in pyridine. It is observed that three inks i.e. Nataraj, Classmate and Cello gel did not run with the solvent and no colour was observed. Table No 1 gives all the details of colours developed by the spots and their Rf values. This table also shows that three inks did no run with the solvent and no colour was produced therefore No Spot is written in the adjacent block Thus by comparing the Rf values of these inks with the Rf values of Questioned ink samples one can easily come to a conclusion that both the inks are from same origin.

Examination and differentiation of inks is a major task for a forensic expert. Various inks are used to commit forgeries such as additions, alterations, anonymous letters, forged cheques, birth certificates etc. Such forgeries can be detected with the help of Thin Layer Chromatography by comparing the Rf values of ink on the Questioned document with the standard ink sample. If the Rf values matches then it can be concluded that the ink on the Questioned Document and standard sample of ink are one and the same.

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