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Examination of Chemicals Used In Trap Cases

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ABSTRACT

Although a number of different techniques using different chemicals such as fluorescent dyes, starch powder, phenolphthalein powders etc have been adopted but phenolphthalein powder in anticorruption cases has remained most popular in India. Phenolphthalein is a weak acid; its unionized molecules are colourles while on ionization give pink colour. The sodium carbonate washings containing traces of transferred phenolphthalein from accused is submitted to Forensic Science Laboratories (FSLs) for examination. There are so many conventional and instrumental techniques (Thin Layer Chromatography, UV-Visible Spectrophotometer, High Performance Liquid Chromatography, High Performance Thin Layer Chromatography etc.) which may be used for the confirmation of phenolphthalein.

KEYWORDS: Trap Case, Phenolphthalein, Anthracene, Carbonate Ions, Sodium, Calcium.

1. INTRODUCTION

Law Enforcement Agencies arrange a trap for illegal transaction (bribe) with the help of the complainant where in the accused is given currency notes on which chemical like phenolphthalein or anthracene powder has been applied. Now a days phenolphthalein is being used in most of the trap cases. If the accused touches the notes then the part of the chemical,

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which may be in traces, is transferred on his hands or fingers. If he keeps these currency notes in his pocket, bag, briefcase or file etc, this chemical is also transferred to these objects (Locard's Principle of exchange). In case of phenolphthalein the object (hand, bag, pocket etc) are washed with a colorless solution of sodium carbonate (or sometimes with lime water), which becomes immediately pink confirming the touching of currency notes/ transferred of phenolphthalein to the object. These washings are being collected and sent to the forensic laboratories along with other relevant articles to establish the presence of phenolphthalein which can be considered as vital evidence in the court. The pink color of this solution persists for some days or months depending on the quantity of the phenolphthalein and strength of the alkali solution. It gradually fades and sometimes becomes colorless at the time of trial in the court. This creates unnecessary doubt and investigating officer is put in an awkward position. Anthracene powder is also rarely used for this purpose in trap cases as it does not pose such problem of color fading and has an advantage because of its fluorescence property. The hands, clothes etc of the suspect can be immediately examined under U. V light, violet/blue fluorescence can be clearly seen. This proves direct contact of the suspect with currency notes. Pure anthracene exhibits blue fluorescence but impure anthracene due to presence of tetracene, naphthacene etc exhibits yellow with green fluorescence.

2. CHEMISTRY OF PHENOLPHTHALEIN

Phenolphthalein is an organic compound of the phenolphthalein family with the chemical formula $C_{20}H_{14}O_4$. It is a smooth white powder that is widely employed as an acid-base indicator and as a laxative.

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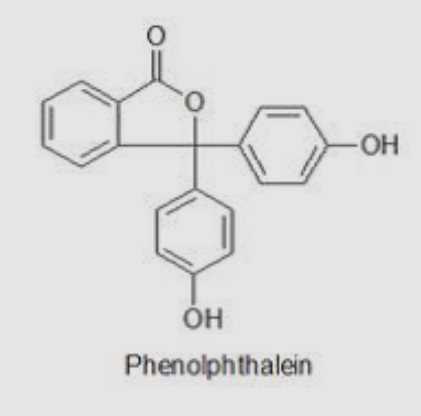
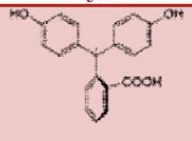
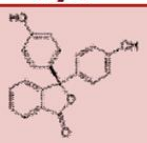
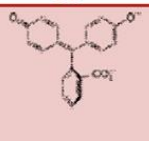
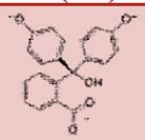


Chemical Structure of phenolphthalein

The molecule has four forms, which correspond to the different colors it will become, based on the pH of the solution. It turns colorless in acidic solutions and pink in basic solutions. Just as there is a range of acidic and basic pH values, there is also a range in colors in which Phenolphthalein will appear. In strongly acidic solutions where the pH is at or near zero, Phenolphthalein will appear orange. In acidic to neutral solutions where the pH is between 0-8.2,Phenolphthalein will appear colorless. In basic solutions with pH values between 8.2 and 12, it will appear fuchsia. In strongly basic solutions above 12, Phenolphthalein will appear colorless like that of acidic or neutral solutions. Its unionized molecules are colourless whilst on ionization give colourless H+ and pink coloured phenolphthalein ions. The molecule has following four forms:

Species	H_3In^+	H_2In	In^{2-}	$In(OH)^{3-}$
Structure				
pH	<0	0–8.2	8.2–12.0	>13.0
Conditions	strongly acidic	acidic or near-neutral	Basic	strongly basic
Color	Orange	Colorless	pink to fuchsia	Colorless
Image				

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The hand washings, bag washings, cloth washings etc of the suspect collected in dilute sodium carbonate-water solution or lime water along with other relevant articles from the scene of crime such as currency notes, clothes, bags etc shall be sent to the laboratory for the chemical examination. In case of untreated objects, ethyl alcoholic wash/ extract of the appropriate portion of the exhibits can be taken for the examination for the detection of the phenolphthalein. Alternatively, dilute solution of alkali (sodium carbonate) in water can also be used for washing/extracting the exhibits. These washing shall be used only for the detection of the phenolphthalein and not for the detection of the sodium and carbonate ions. In case of alkali treated objects, wash the appropriate portion of the exhibits with water and used for the detection of the phenolphthalein, sodium and carbonate ions etc.

3. TEST FOR PHENOLPHTHALEIN

- **pH Test**: Observe the pH of the solution exhibit with the pH paper. More than pH 9 (pH range 8.3-10) with pink /red color indicates the positive test for the presence of phenolphthalein.
- **Acid-Alkali Test:** Take an appropriate portion of the exhibit solution. Add few drops dilute hydrochloric acid. The pink color of the exhibit disappears. Now add few drops of dilute solution of sodium hydroxide in water, the pink color reappears. If required, this test can also be performed on residue obtained after evaporation of ethanol extract of the exhibit, but in this case first add alkali solution and then acid. Appearing and disappearing of pink color indicates the positive test for the presence of phenolphthalein.
- **Instrumental techniques:** Spectrophotometric examination: Take a portion of max absorbance value by spectrophotometer in appropriate dilution using a standard solution of phenolphthalein in aqueous alkali (sodium carbonate) for comparison. The pink color of phenolphthalein in aq. Sodium carbonate solution gives the lambda max in between around 550-555 nm. Aqueous solution of sodium carbonate is used as blank solution for the experiment.
- **Thin Layer Chromatography**

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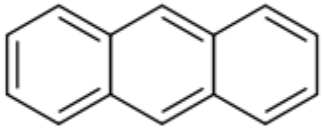
- Stationary Phase: TLC plate coated with silica gel G.
- Mobile Phase: Chloroform and Acetone (80:20)
- Developing Reagent: Spray with dilute sodium hydroxide solution and then acidified potassium permanganate solution after visualization observed under U.V. light for fluorescence.

- **UV Spectroscopy:** A Normal UV spectrum of phenolphthalein is known to show maxima at 277 nm in methanol.

4. CHEMISTRY OF ANTHRACENE

Anthracene ($C_{14}H_{10}$) is a solid polycyclic aromatic hydrocarbon consisting of three fused benzene rings. It is a constituent of coal tar. Anthracene is used in the production of the red dye alizarin and other dyes. It is colourless but shows blue (400-500 nm) fluorescence under ultraviolet light.



Chemical Structure of Anthracene

Articles from the scene of crime such as currency notes, clothes, bags etc along with traces of powder collected by carefully brushing the suspected area of contact of accused shall be sent to the laboratory for the examination. In case of the object of anthracene, the appropriate portion of the object/ exhibit (after examination under u.v. light) can be wash with ethyl alcohol for the examination.

5. TEST FOR ANTHRACENE

- **Color Test:** Observation under U.V. light – Violet/blue/green fluorescence.
- **Thin Layer Chromatography**

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- Stationary phase : Silica gel G
- Mobile phase : Heptane : Hexane
- After visualization observe the plate under UV light for fluorescence.

- **Gas Liquid Chromatography:**
  - Detector : Flame ionization
  - Column : S S column 1/8 inch dia. 2 meter length
  - Packing : 10% S E 30 80/100 chromosorb W-HP
  - Carrier Gas: Nitrogen
  - Flow rate : 25 ml/min
  - Injector temperature : 2500C
  - Column temperature : 2200C Isothermal
  - Detector temperature: 2500C
  - Sample preparation : In ethanol

6. TEST FOR CARBONATE IONS

- **Test with acid:** To a potion of the exhibit solution add few drops of dilute hydrochloric acid, effervescence are observed. If needed, the resulting gas can be passed through baryata water/ lime water. Turbidity/ curdy white precipitate appears. If the gas is passed for long time, the precipitate or turbidity slowly disappears. The exhibit may be gently heated with dilute hydrochloric acid to produce sufficient effervescence/ gas.
- **Barium Chloride Test:** To a portion of the exhibit solution add few drops of barium chloride solution (about 5-6 % barium chloride in water. Formation of white precipitate, which is soluble in mineral acids, indicates the positive test for the presence of carbonate ions. Bicarbonate ions do not form white precipitate, as they do not react with barium chloride solution.
- **Silver Nitrate Test:** To a portion of the exhibit solution add few drops of silver nitrate solution (about 2 % in water). Formation of white precipitate, which is soluble in ammonia solution, indicates the positive test for the presence of carbonate ions.

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7. TEST FOR SODIUM

- **Uranyl Zinc Acetate Test:** Take a portion of exhibit solution and make it neutralized with acetic acid. Add few drops of uranyl zinc acetate reagent, shake/ stir with glass rod. Formation of yellow precipitate or cloudiness indicates positive test for the presence of sodium.

8. TEST FOR CALCIUM

- **Test with Sodium Rhodizonate:** Take one drop of neutral or weakly acid test solution add a drop of freshly prepared 0.2% a sodium rhodizonate solution add one drop of 0.5 N sodium hydroxide solution, a violet colour indicates the presence of calcium.
- **Flame test:** Take appropriate portion of the exhibit as such or its water (distilled) extract evaporate to dryness, moisten with a few drops of conc. Hydrochloric acid to make past. Take a small portion of paste with the platinum wire and introduce into the non-luminous flame of a semi-micro burner. A persistence golden yellow flame indicates the presence of sodium and a brick red (yellowish red) flame indicates the presence of calcium.

9. CONCLUSION

The coloured alkaline phenolphthalein solution unfortunately has a tendency to fade away with passage of time due to chemical changes. If the initial solution is highly coloured, with passage of time varying up to several months, its intensity may decrease but still it will be patently visible. On the other hand, if the alkali solution of phenolphthalein was only pink to light pink initially, because of very low quantity of transferred chemical it may become faint or even colourless after several weeks to months. Consequently when this physical evidence is finally produced in the court, often several months to year or more after the initial trap, the alkali solution may appear to be colourless or almost colourless. As the courts place reliance on the visual appearance of red colour of the alkali solution of phenolphthalein as a proof of transfer of

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phenolphthalein. The absence or doubtful presence of phenolphthalein complicates matters. Defense often tries to take advantage of this situation. Although this problem has been solved by adding small quantity of hydroquinone (an antioxidant), but still more work has to be done in this area.

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