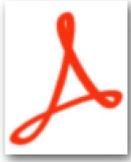


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Summary

Description	Chromatography is an essential physical technique that allows the constituent components of a mixture to be identified, separated, and purified in preparation for qualitative examination. Paper chromatography (PC) is a sort of planar chromatography, which refers to a stationary phase that is a solid, flat surface. In this illustration stationary phase is a particular kind of paper (Whatman quantitative filter paper grade 41). The fundamental idea behind paper chromatography is the differential passage of a mixture's constituent parts through filter paper or chromatography paper. A quick method for separating mixtures of metal ions, amino acids, carbohydrates, colors, and pharmaceuticals is paper chromatography (PC). For this qualitative analysis, only a very small sample is needed. Metal cation separation has seen increased by the use of the PC approach. Here, the experiment shows how PC may be used to separate metal ions [(Pb ²⁺ & Cu ²⁺) based on their colored spots and the retardation factors or retention factors (R _f) values by using different eluting solutions.
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Categories: Uploaded with UploadWizard | Qualitative analysis | Separation of Group II Metal ions (Pb²⁺ & Cu²⁺) by PC | PC Experiment | UG Experiment | Retardation factors or Retention factors (R_f) values

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Chapter-29**Innovative Method for the Separation of Mixture of ions (Pb^{2+} & Cu^{2+}) by Paper Chromatographic Technique****Arijit Das****Department of Chemistry, Bir Bikram Memorial College, Agartala, Tripura, India****Email: arijitdas78chem@gmail.com**

Principle:- Chromatography is an essential physical technique that allows the constituent components of a mixture to be identified, separated, and purified in preparation for qualitative examination. Paper chromatography (PC) is a sort of planar chromatography, which refers to a stationary phase that is a solid, flat surface. In this illustration stationary phase is a particular kind of paper (Whatman quantitative filter paper grade 41). The fundamental idea behind paper chromatography is the differential passage of a mixture's constituent parts through filter paper or chromatography paper. A quick method for separating mixtures of metal ions, amino acids, carbohydrates, colors, and pharmaceuticals is paper chromatography (PC). For this qualitative analysis, only a very small sample is needed. Metal cation separation has seen increased by the use of the PC approach. Here, the experiment shows how PC may be used to separate metal ions [Pb^{2+} & Cu^{2+}] based on their colored spots and the retardation factors or retention factors (R_f) values by using different eluting solutions.

Keywords: *qualitative analysis, chromatographic jar, spotting capillaries, colored spots, retention factor, under graduate experiment*

1. PC Experiment : Separation of Group II Metal ions (Pb^{2+} & Cu^{2+}) by 10% KI solution**1.1. Materials and method****i) Experimental****Requirements****A. Apparatus & chemical required**

i) Chromatographic jar ii) 10% KI Solution iii) Measuring cylinder iv) Lead nitrate $\text{Pb}(\text{NO}_3)_2$ v) Copper sulfate $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ vi) Spotting capillaries vii) Small test tubes viii) 10ml and 250ml beaker ix) Whatman quantitative filter paper grade 41 x) Distilled water

(B) Solution required

(i) Metal salts solution: Prepared saturated solution of lead nitrate and copper sulfate by dissolving them in distilled water (1mg/mL) in the 10ml beaker.

(ii) Detector: Prepared 10% KI solution in distilled water in the 250ml beaker.

(C) Developer: 200ml Distilled water in the 250ml beaker.

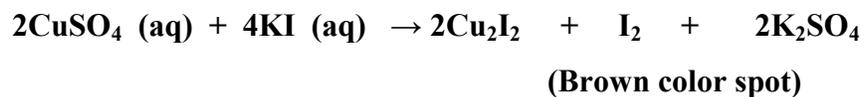
ii) Procedure

The chromatographic jar had a suspended Whatman grade 41 filter paper strip. Place a dot on the side of the line that you drew on this stripe, around 0.5 cm from the bottom. Development will start at this end, which will be the strip's bottom. Using a small capillary to pass through two (02) places on the filter paper, the saturated solutions of Pb^{2+} and Cu^{2+} were applied separately. For every remedy, a brand-new capillary was used. The filter paper with the 02 spots was then allowed to dry outside. After that, the dried and stained filter paper strip was once more suspended in the distilled water-filled chromatographic jar, with the top end secured to the steel rod and the bottom end touching the developer (water). The strip is shown to be vertical. Always place the point above the level of the developer. As the developer (solvent front) approaches the upper end of the filter paper (**Fig. 1b**), the developer (water) is let to climb along the filter paper (**Fig. 1a**). After taking the filter paper out of the chromatography jar, the solvent front was indicated with a pen. The developer was then removed from the paper by drying it. 10% KI solution was taken in a sprayer and applied to the dry filter paper as a separating solvent or spraying reagent. With the KI reaction, one yellow and one brown colored spot appeared right away (**Fig. 1c**), signifying the identification of Pb^{2+} and Cu^{2+} ions, respectively. Pencils were used to mark the colored zones.

2. Results and Analysis

2.1. Reactions involved during formation of colour spots by interaction with solute zone

In a redox reaction, 10% potassium iodide (KI) added to a copper sulfate solution causes the copper sulfate to combine with the KI solution, the iodide ions reduce Cu(II) to Cu(I) , and the iodide (I^-) ion oxidizes to iodine (I_2), forming a brown color spot on the Whatman 41 filter paper. The solute zone (Cu^{2+} ion) traveled a distance where the Cu^{2+} reaction with KI happened, and since I_2 escaped quickly, this was immediately noted by marking the brown color spot with a pen.



However, potassium iodide (KI) and lead nitrate [$\text{Pb}(\text{NO}_3)_2$] interacted to form an ion exchange that resulted in the production of potassium nitrate (KNO_3) and a yellow-colored spot of lead iodide (PbI_2).

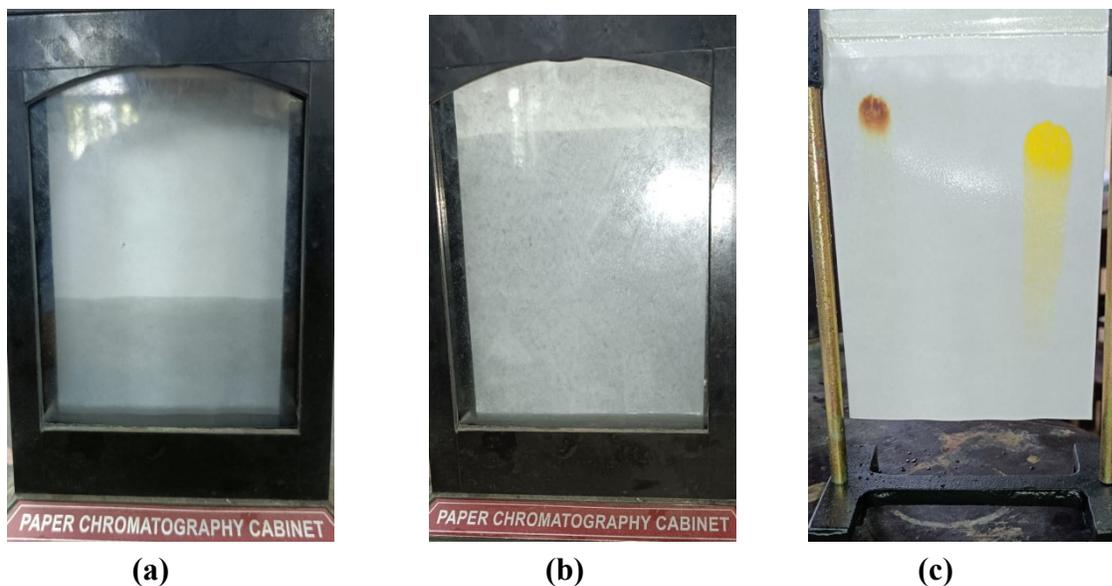
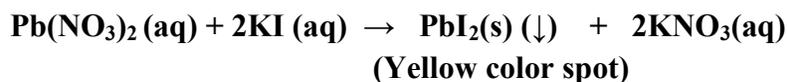


Figure 1. Separation of metal ions (Pb^{2+} and Cu^{2+}) by paper chromatography

2.2. Data Analysis

Observed the colored spots corresponding to two different cations. Two cations (Pb^{2+} and Cu^{2+}) were identified and separated by comparing color spots and retention factor values. The first spot appeared as brown due to the liberation of I_2 after the reaction of KI with $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ indicated the distance traveled by one solute zone as Cu^{2+} (ds_1) and the second spot Pb^{2+} appeared as yellow indicating the distance traveled by another solute zone (ds_2). Then, measured the distance of the color zones of each solute from the point of application. Also measured the distance between the solvent front (water) and the starting line, labeled this distance as distance traveled by the solvent (dm). Then calculated retardation factors or retention factors (R_f) values of each cation (**Table-1**) by the following equation:

$$\text{Retention Factor (R}_f\text{)} = \frac{\text{Distance travelled by the centre of solute zone in cm (ds)}}{\text{Distance travelled by the solvent front in cm (dm)}}$$

Table 1: Separation of metal ions (Pb²⁺ and Cu²⁺) by paper chromatography

Experiment Name	Solution used (Cation Present)	Eluting Solution	Color of the spot	Distance travelled by solute (ds) (cm)	Distance travelled by solvent (dm) (cm)	R _f value = ds/dm
Separation of metal ions (Pb ²⁺ and Cu ²⁺) by paper chromatography	CuSO ₄ .5H ₂ O (Cu ²⁺ ion)	aqueous solution of 10% KI	Brown	14 (ds ₁)	15.5	0.903
	Pb(NO ₃) ₂ (Pb ²⁺ ion)		Yellow	13 (ds ₂)	15.5	0.838

3. Conclusion

Using water as mobile phase (developer), separation of metal ions [(Pb²⁺ & Cu²⁺) has been done by taking eluting agent like aqueous solution of 10% KI based on their colored spots and the retardation factors or retention factors (R_f) values. Thus, by using this improved techniques, make paper chromatography easy to separate two cations from the same groups of the analytical table.

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