# File:Chapter 30 - Innovative Method for the separation of mixture of ions (Ni2+ & Co2+) by Paper Chromatographic Technique, pp 236-239.pdf

From WikiEducator



Chapter_30_-_Innovative_Method_for_the_separation_of_mixture_of_ions_(Ni2+_&_Co2+)_by_Paper_Chromatographic_Technique,_pp_236-239.pdf
(0 × 0 pixels, file size: 4.18 MB, MIME type: application/pdf)

## 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 ($Ni^{2+}$ & $Co^{2+}$) based on their colored spots and the retardation factors or retention factors (Rf) values by using different eluting solutions. |
| **Source** | Own work |
| **Date** | 2025-04-07 23:33:49 |
| **Author** | Arijit Das |
| **Permission** | See below. |

## Licensing

## File history

Click on a date/time to view the file as it appeared at that time.

| | Date/Time | Dimensions | User | Comment |
|---|---|---|---|---|
| current | 00:20, 9 April 2025 | 0 × 0 (4.18 MB) | Arijitdas78chem (Talk \| contribs) | User created page with UploadWizard |

- You cannot overwrite this file.

## File usage

There are no pages that link to this file.

Retrieved from "https://wikieducator.org/index.php?title=File:Chapter_30_-_Innovative_Method_for_the_separation_of_mixture_of_ions_(Ni2%2B_%26_Co2%2B)_by_Paper_Chromatographic_Technique,_pp_236-239.pdf&oldid=1108631"
Categories: Uploaded with UploadWizard │ Qualitative analysis │ UG Experiment
│ Separation of Group IV Metal ions (Ni2+ & Co2+) by PC

- This page was last modified on 9 April 2025, at 00:20.

<u>Chapter-30</u>

# Innovative Method for the Separation of Mixture of ions (Ni$^{2+}$ & Co$^{2+}$) 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 (Ni$^{2+}$ & Co$^{2+}$) 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 IV Metal ions (Ni$^{2+}$ & Co$^{2+}$) by 5% NH$_4$OH solution*

## 1.1. Materials and method

**i) Experimental**

**Requirements**

**A. Apparatus & chemical required**

i) Chromatographic jar   ii) 5% NH$_4$OH Solution    iii) Measuring cylinder   iv) Nickel nitrate hexahydrate Ni(NO$_3$)$_2$. 6H$_2$O   v) Cobalt nitrate Co(NO$_3$)$_2$.6H$_2$O   vi) Spotting capillaries    vii) Small test tubes   viii) 10ml, 100ml, 250ml beaker  ix) Whatman quantitative filter paper grade 41  x) Distilled water

**(B) Solution required**

(i) Metal salts solution: Prepared saturated solution of both metal nitrates by dissolving them in distilled water (1mg/mL**)** in the 10ml beaker.

(ii) Detector:   Prepared 5% $NH_4OH$ solution in distilled water in the 100ml beaker.

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

**ii) Procedure**

  Whatman grade 41 filter paper strip was suspended in the chromatographic jar. On this stripe drawn a line at about 1cm from the bottom and put dot in the side of the line. This end will be the bottom of the strip and development will take place from this end. The saturated solution of $Ni^{2+}$ and $Co^{2+}$ applied separately on the filter paper with help of a fine capillary through two (02) spots. A fresh capillary was used for each solution.  Then, filter paper containing 02 spots was dried in open air. The spotted and dried filter paper strip was then suspended again in the chromatographic jar containing distilled water with the upper end pinned to the steel rod and lower end touching the developer (water). It is observed that the strip is vertical. The spot should always be above the developer level. The developer (water) is allowed to rise along the filter paper **(Fig. 1a)** and wait till developer (solvent front) reaches near the upper end of the filter paper along with rise of two metal ions **(Fig. 1b)**.The filter paper was then removed from the chromatography jar and marked the solvent front with the help of pen. Then the paper was dried to evaporate the developer. As a separating solvent or spraying reagent 5% $NH_4OH$ solution was taken in a sprayer and scattered it on the dried filter paper. **Green gel** and **bluish green** colored spots developed immediately **(Fig. 1c)** with the reaction of $NH_4OH$ corresponding to the identification of $Ni^{2+}$ and $Co^{2+}$ ions respectively.  The coloured zones were marked with pen.

Attempt was made in the PC experiment initially by using 1% $NH_4OH$ solution but not achieved satisfactory result for $Ni^{2+}$ **(Fig.2).**
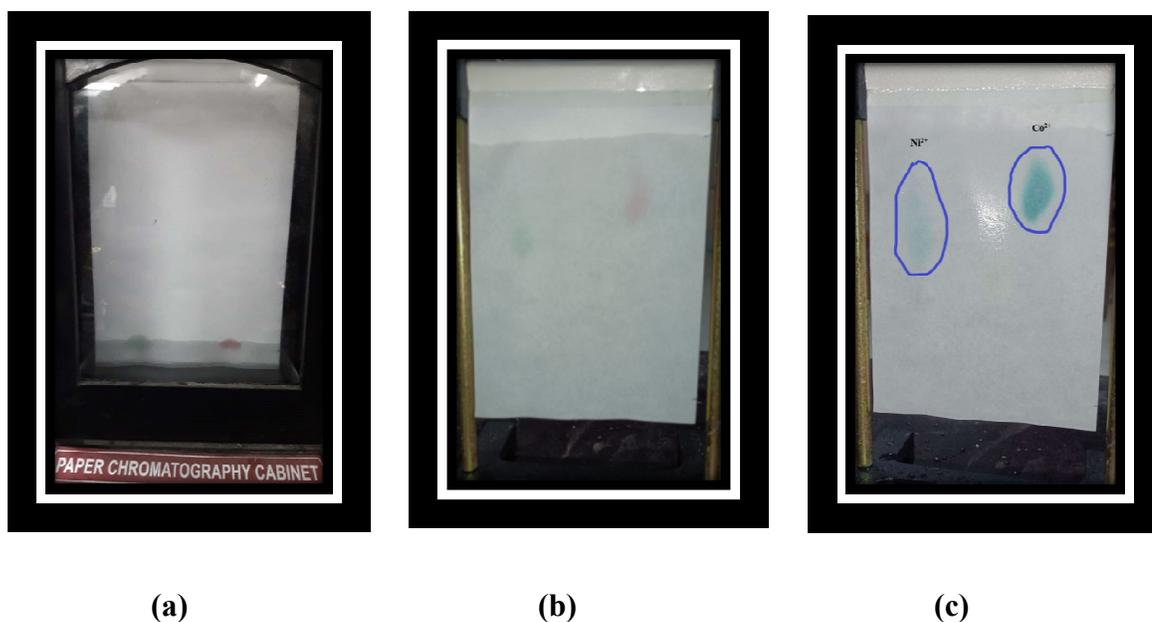
(a)                                   (b)                                   (c)

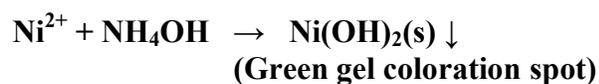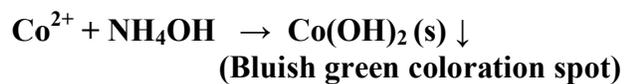**Figure 1. Separation of metal ions (Ni$^{2+}$ and Co$^{2+}$) by paper chromatography by using 5% NH$_4$OH solution**



**Figure 2. Separation of metal ions (Ni$^{2+}$ and Co$^{2+}$) by paper chromatography by using 1% NH$_4$OH solution**

## 2. Results and Analysis

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

Nickel and cobalt (II) nitrate solutions are mixed with 5% NH$_4$OH solution to generate metal hydroxide, which results of colored spots in the Whatman grade 41 filter paper that are green gel and bluish green, respectively.

$$Co^{2+} + NH_4OH \ \rightarrow \ Co(OH)_2 \ (s) \downarrow$$
**(Bluish green coloration spot)**

$$Ni^{2+} + NH_4OH \ \rightarrow \ Ni(OH)_2(s) \downarrow$$
**(Green gel coloration spot)**

## 2.2. Data Analysis

Two cations ($Ni^{2+}$ and $Co^{2+}$) were identified and separated by comparing their color spots and retention factor values. First spot appeared as green gel due to formation of nickel hydroxide $Ni(OH)_2$ indicated the distance travelled by one solute zone as $Ni^{2+}$ ($ds_3$) and second spot $Co^{2+}$ appeared as bluish green due to formation of cobalt hydroxide $Co(OH)_2$ indicated the distance travelled by another solute zone ($ds_4$). Then calculated retardation factors or retention factors ($R_f$) values **(Table-1).**

**Retention Factor ($R_f$) = $\underline{\text{Distance travelled by the centre of solute zone in cm (ds}_1 \text{or ds}_2\text{)}}$**
**Distance travelled by the solvent front in cm (dm)**

**Table 1: Separation of metal ions ($Ni^{2+}$ and $Co^{2+}$) 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) | Rf value = ds/dm |
|---|---|---|---|---|---|---|
| | | | | | | |
| **Separation of metal ions ($Ni^{2+}$ and $Co^{2+}$) by paper chromatography** | $Ni(NO_3)_2.6H_2O$ ($Ni^{2+}$ ion) | **5% NH$_4$OH solution** | Green gel | 12.2 ($ds_1$) | 15.2 | 0.8026 |
| | $Co(NO_3)_2.6H_2O$ ($Co^{2+}$ ion) | | Bluish green | 12.7 ($ds_2$) | 15.2 | 0.8355 |

## 3. Conclusion

Using water as mobile phase (developer), separation of metal ions [($Ni^{2+}$ & $Co^{2+}$)] has been done by taking eluting agent like 5% $NH_4OH$ solution based on their colored spots and the retardation factors or retention factors ($R_f$) values. Thus, by using this improved technique, make paper chromatography easy to separate two cations [($Ni^{2+}$ & $Co^{2+}$)] from the group IV of the analytical table.

## References:

1. *Paper Chromatography: A Laboratory Manual*, Richard Joseph Block, Raymond Le Strange, Gunter Zweig, Academic Press, 1952.

2. *Paper Chromatography and Electrophoresis*, Gunter Zweig, John R. Whitaker, Joseph Sherma, Academic Press, 1967.

3. Arijit Das, Digvijoya Sarmaa, Paresh Debnath, and Bijaya Paul, *"Metal Ions Separation Via Paper Chromatography: Enhanced Methods Using Eluting Solutions."* World Journal of Chemical Education, vol. 11, no. 4 (2023): 134-140. doi: 10.12691/wjce-11-4-2.

----------------------------