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Short Communication

Greener Identification of Cd in presence of Cu in Qualitative Analysis

A.V. Prasada Rao[1] and K. Deepthi[2]*

1. Department of Inorganic and Analytical Chemistry, Andhra University, Visakhapatnam, **INDIA**
2. Department of Chemistry, Adikavi Nannaya University, Rajahmundry, **INDIA**

Email: deepthikorabandi@gmail.com

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ABSTRACT

Cations identification in Qualitative analysis is tiresome and involves use of harmful and toxic reagents. When comes to the case of identification and confirmation Cu and Cd, use of KCN, H_2S is unavoidable which are toxic. The present method describes the use of less toxic reagents like $K_4[Fe(CN)]_6$ and $K_3[Fe(CN)]_6$ for the identification of Cd in presence of Cu.

Keywords: Qualitative analysis, Cd, Cu, Greener identification, use of $K_4[Fe(CN)]_6$, $K_3[Fe(CN)]_6$ etc.

INTRODUCTION

For identification of cations in qualitative analysis, Cu(II) and Cd(II) are precipitated as sulphides in HCl medium in 2nd group along with Pb and Hg [**1-4**]. Detection of Cd in presence of Cu poses a severe problem because both these ions exhibit the same type of reactivity in several reactions. Typical text book procedure [**5**] indicates identification of Cd(II) in presence of Cu(II) by making use of KCN because $[Cu(CN)_4]^{1-}$ is a more stable complex compared to $[Cd(CN)_4]^{2-}$ so that when H_2S is passed through the mixed solution, CdS alone gets precipitated preferentially, leaving Cu(II) in solution as soluble cyano complex. Several other schemes were also reported for identification of Cd(II) in presence of Cu(II). King. E .J [**6**] reported the use of sodium dithionite and sodium acetate; but dithionite is unstable in aqueous solution and requires preparation of reagent freshly every time which may not be practical [**7**]. Mattney Cole Jr and William Waggoner [**8**] suggested that CdS dissolves in 6M HCl and on addition of $K_4[Fe(CN)_6]$ yields a pale yellow precipitate of $Cd_2[Fe(CN)_6]$ which looks more like colloidal dispersion of sulfur and causes a confusion. Hayden and Hunt [**9**] reported a different method for separation of Cu from Cd based on conversion of Cu (II) to Cu (I) using an iodide-thiocyanate solution to form a light colored precipitate CuSCN. Addition of $Na_2S_2O_3$ discharges the color of the solution due to iodine. Addition of dil. ammonia and ammonium sulphide to the above solution then yields CdS. Recently Siddhwani and Chaudhury [**10**] reported detection of Cd through a spot-test using Fe(α,α'–dipy)I_2 , which gives a red spot in presence of KI. In ammonical medium Cu, Co, and Ni do not interfere. This being a spot-test, may not be of use in regular macro or semi-micro qualitative analysis. All the above reported processes are not safe because, use is made of either highly poisonous KCN or toxic H_2S or other sulfur yielding compounds.

In view of the above, the present authors report a simple green reaction for the facile identification of Cd(II) in presence of Cu(II) without using either KCN or H_2S. The test is based on the following two observations.

MATERIALS AND METHODS

First, both Cu(II) and Cd(II) give characteristic colored precipitates with $K_4[Fe(CN)]_6$ and $K_3[Fe(CN)]_6$ as shown below:

$$Cu(II) + K_4[Fe(CN)]_6 \longrightarrow Cu_2[Fe(CN)_6]\downarrow \quad \text{(Reddish brown)}$$
$$3Cu(II) + 2\,K_3[Fe(CN)]_6 \longrightarrow Cu_3[Fe(CN)_6]_2\downarrow \quad \text{(Greenish yellow)}$$
$$Cd(II) + K_4[Fe(CN)]_6 \longrightarrow Cd_2[Fe(CN)_6]\downarrow \quad \text{(White)}$$
$$3Cd(II) + 2\,K_3[Fe(CN)]_6 \longrightarrow Cd_3[Fe(CN)_6]_2\downarrow \quad \text{(Yellow)}$$

Second, Cu(II) undergoes reductive precipitation with ammonium bisulphite and KSCN [**9**].

$$Cu(II) + KCNS \xrightarrow{(NH_4)HSO_3} CuSCN\downarrow$$

RESULTS AND DISCUSSION

The test is conducted as follows: To the mixed solution of Cu(II) and Cd(II), add ammonium bisulphite followed by addition of potassium thiocyanate reagent. Cu(II) selectively gets reduced to Cu(I) and gets precipitated as CuSCN, leaving Cd(II) in solution. Separate the solution and add $K_3[Fe(CN)]_6$ reagent. Yellow precipitate occurs due to the formation of $Cd_3[Fe(CN)_6]_2$.This way we can separate and confirm the presence of Cu(II) and Cd(II) from a mixed solution in qualitative analysis.

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