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GRAVIMETRIC ESTIMATION OF CYANIDE AS SILVER CHLORIDE

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INTRODUCTION

This brief technical note suggests how cyanide can be estimated gravimetrically as silver chloride. The principle underlying the estimation is the fact that cyanide can be destroyed by ClO^- under alkaline conditions (pH 8-9) with concomitant generation of Cl^- [1] as given below.

$$2NaCN + 2NaClO \longrightarrow 2NaCNO + 2NaCl \quad (1)$$

$$2NaCNO + 3NaClO + H_2O \longrightarrow N_2 + 3NaCl + 2NaHCO_3 \quad (2)$$

$$2NaCN + 5NaClO + H_2O \longrightarrow 5NaCl + N_2 + 2NaHCO_3 \quad (3)$$

The stoichiometric requirement of ClO^- by CN^- in the ratio of 2:5:1 makes the estimation possible. In a typical estimation, to 500 ml of the solution containing cyanide (1×10^{-5} to 1×10^{-3} Kg) is added 0.35 g of KOH and 6 to 8 ml of commercial (5% w/v) sodium hypochlorite solution. The mixture is vigorously stirred for a few seconds first and left to stand for 2 h with occasional stirring. The solution is then acidified with 20 ml of 20% nitric acid and 0.025 *M* $AgNO_3$ solution is added slowly in small quantities (drop by drop) with constant stirring until the precipitation is complete. The resulting mixture is gently heated to about 333 K on a water bath, to convert the colloidal form of AgCl to the precipitate form. AgCl is filtered, washed with 1% HNO_3 several times and finally three times with distilled water [2] and weighed. A blank precipitation is carried out with the sodium hypochlorite solution in the absence of cyanide. The difference between the weight of AgCl in two experiments corresponds to the amount of cyanide present in the solution.

Let W_1 be the weight of AgCl obtained from the cyanide containing solution and let W_2 be the corresponding weight in the blank experiment. Then,

$$W = W_2 - W_1 \equiv \text{wt. of } CN^- \quad (4)$$

$$W \text{ Kg of AgCl contains } \frac{35.46\ W}{143.33} \text{ Kg of } Cl^-$$

from the stoichiometry of the chemical reaction between ClO^- and CN^-, it is understood that

$$5Cl^- \equiv 2CN^- \quad (5)$$

Therefore, the quantity of CN^- present in the solution is given by

$$W_{CN^-} = \frac{W \times 2 \times 26}{5 \times 143.33} \quad (6)$$

We have employed this method for the estimation of free cyanide and gold cyanide in the plating baths as well as in the wastes of zari industry and have obtained, precise values for the cyanide (Table I). As is seen from the Table I, the weight of cyanide is magnified 13.78 times as it is converted into AgCl. The method advocated in the

TABLE I: Relationship between the quantity of cyanide in solution and the quantity of AgCl precipitate obtained

Wt of CN^- in soln Kg	Wt of AgCl Kg
1.0×10^{-5}	1.3810×10^{-4}
2.5×10^{-5}	3.4530×10^{-4}
5.0×10^{-5}	6.9380×10^{-4}
1.0×10^{-4}	1.3074×10^{-3}
2.0×10^{-4}	2.7643×10^{-3}
5.0×10^{-4}	6.9421×10^{-3}
7.5×10^{-4}	1.0039×10^{-2}
1.0×10^{-3}	1.3790×10^{-2}

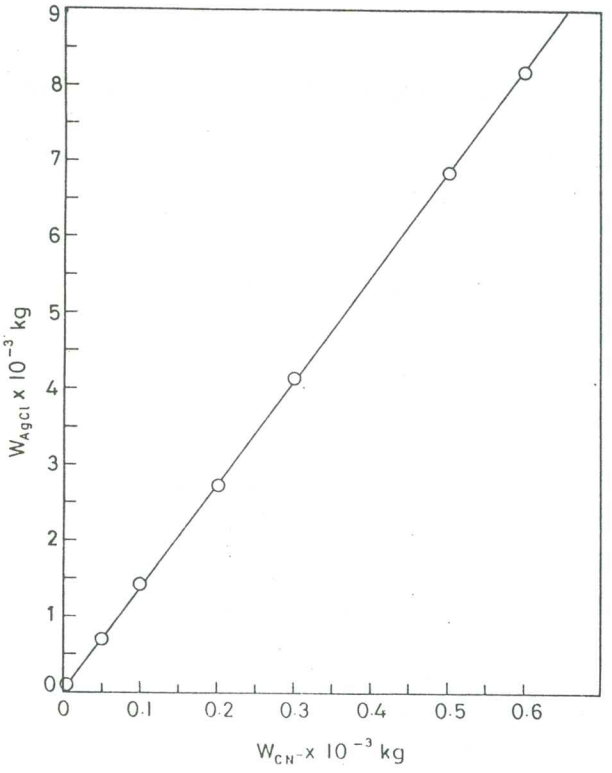

Fig. 1:

present study would prove to be a particularly useful approach in the determination of free cyanide and gold cyanide in gold plating baths and plating waste waters. The educator community could consider using this method for laboratory exercise of cyanide estimation. The advantage of the approach is increased accuracy over argentimetric titration [2], reproducibility and reliability. A calibration curve can be drawn by plotting W_{CN^-} versus W_{AgCl}. The weight of CN^- present in a cyanide solution of unknown concentration can be determined by interception.

REFERENCES

1. H Wada, *J Surf Finish Soc, Jpn,* **48** (1997) 1091
2. *"Vogel's Text Book of Inorganic Analysis"* 4th Edn, ELBS, London (1986) 345