

QUALITATIVE ANALYSIS OF MANGANESE (II) IONS: SENSITIVE, SELECTIVE AND TIME EFFECTIVE METHOD

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This article discusses about a novel method for identification of Manganese (II) ion in a given substance through a selective test without following the sequence of reactions which is done in the traditional method of qualitative analysis. This can be considered as sensitive, selective and time effective method for qualitative analysis of Mn(II) ions.

KEY WORDS: Qualitative analysis, Manganese (II) ion, Cations, Anions, Reagent, Oxidation state

Introduction

Qualitative analysis is one of the important laboratory works. This is a technique used to determine the identities of chemical substances present in a sample. This is done through a series of chemical tests conducted on a chemical substance to identify or determine the cations and anions present in it. The chemical properties of an unknown substance are determined by the reaction between the unknown substance and a suitable reagent. This provides an opportunity for students to think about the properties and reactions of a great variety of individual compounds and ions through first hand experience. In addition to this, it provides practical illustrations of important chemical concepts, particularly those concerned with ionic equilibrium, solubility product, oxidation-reduction reactions and the formation and stability of complexes.

This article discusses the selective test for identification of Manganese (II) ion in a salt. This can also be used as a demonstration to discuss the chemistry of different oxidation

states of manganese metal and the stability of its salts.

Method in Practice for Qualitative Analysis of Manganese(II) Ion

Generally, identification of Manganese (II) ions is done by the following the standard scheme of qualitative analysis. According to this scheme, cations are divided into groups. A specific reagent is used for their separation from the solution. This separation and identification is done in a particular sequence because some ions of prior groups can also react with the reagent of later groups. In this way Manganese ion is placed in group III with cations which include Cr(III), Al(III), Fe(III), Co(II), Zn(II) and Ni(II) (Vogel's Qualitative Inorganic Analysis).

Alternative Method

Materials

Test tubes, test tube holder, spatula, watch glass, dropper, mortar and pestle, weighing machine.



Fig 1: MnSO_4 in a test tube

Chemicals

Salt of manganese (manganese sulphate, manganese chloride)

Concentrated Hydrochloric Acid (HCl),
Concentrated Nitric Acid (HNO_3)

Experimentation

Take small amount of manganese salt in a dry test tube. Add 2-3 drops of 1:1 mixture of hydrochloric acid (HCl) and nitric acid (HNO_3) in it.

Yellowish brown colouration with precipitate appears within a few seconds which turns darker on standing. Add small quantity of water into it. Brown colour disappears gradually and a transparent solution is obtained. This confirms the presence of manganese(II) ion in the salt.



Fig 2 : After addition of 1:1 mixture of ($\text{HCl} + \text{HNO}_3$)



Fig 3: After addition of water

Care needs to be taken that the test should be done in a dry test tube.

Sensitivity of the Test

The test can be done at micro level. About 0.002g of a salt is sensitive to give observable results for the test.

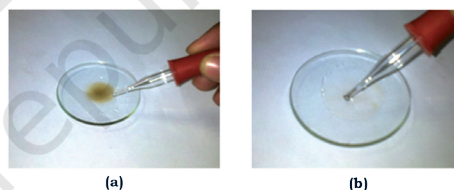


Fig 4: Sensitivity of the test

Selectivity and Time Effectiveness of the Test

This test identifies Mn(II) ion without following the sequence of reactions. This test is reproducible with pure manganese salt as well as mixture of salts with the condition that mixture is colourless. In case of coloured mixtures, the colour of mixture may interfere to identify the colour of resulting solution and may change the colour of precipitate. Taking this into consideration as a limitation, the test

can be considered as a selective and time effective test for Mn(II) ion.

Generally, for qualitative analysis simple, quick and easily doable tests are preferred. This test also possesses all these properties.

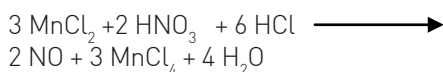
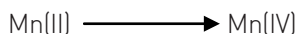
A Classroom Demonstration

This test can also be used for demonstrating the concept of stability of complexes in different oxidation states. Chemistry of Mn(II) and Mn(IV) oxidation states and their relative stabilities can be easily viewed and appreciated with the help of this test.

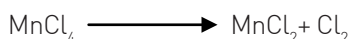
Discussion

Manganese salt contains Mn(II) ions. The mixture of concentrated HNO_3 and HCl

behaves as an oxidising agent and oxidises Mn(II) ions into Mn(IV) ions. The appearance of dark brown precipitate indicates this change.



In acidic medium when water is added Mn(IV) ion reduces into Mn(II) ion.



Due to the presence of large amount of water, hexa aquo complex of Mn(II) is formed resulting into appearance of transparent solution.



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