

Determination of Precipitation Limit of Zn(II) Ion with (2S)-2-Aminobutanedioic Acid

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Abstract: Problem statement: In this study we examined the precipitation of Zn(II) ion in water solutions of $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ (1.10^{-2} and 5.10^{-3} mol L^{-1}) with (2S)-2-aminobutanedioic acid (1.10^{-1} - 1.10^{-3} mol L^{-1}) in constant ionic strength of 0.6 mol L^{-1} NaCl. We have determined the concentration region where we have found the clear solution and solid phase. The solid phase is analyzed by IR spectroscopy. **Approach:** From precipitation diagrams of zinc with (2S)-2-aminobutanedioic acid in ionic force 0.6 mol L^{-1} NaCl, we have found that during decreasing the concentration (2S)-2-aminobutanedioic acid in case of constant concentration of Zn(II) the limit of precipitation is shifted to lower values of pH. **Results:** Also from precipitation diagrams we can see that when the concentration of zinc increases, in case of constant concentration of (2S)-2-aminobutanedioic acid the limit of precipitation will shift at lower values of pH. **Conclusion:** From the IR spectroscopic analysis we can conclude that Zn (II) ion has reacted with (2S)-2-aminobutanedioic acid.

Key words: Precipitation, Zn(II) Ion, (2S)-2-aminobutanedioic acid, IR spectroscopy

INTRODUCTION

The oceans and seas water contain metals also zinc and other helate ligands in normal quantity but sometimes depends on pollution they can contain high level of this metals and ligands. We can find complexes which are not so stable with different inorganic ligands, as example chloride ions and complexes which are stable formed from metals and helate ligands from organic maters or formed from polluted water^[1].

Toxic metals as zinc are considered as non toxic when it is complexes with helate ligands. Water organisms (fish's) can eat these complexes, but it is not believed that these kinds of compounds can entry to the nutritative chain. But this should investigate very carefully in each case^[1].

Taking Pb, Zn and Cd not helated and accumulation of these from planktons and fishes are described from researchers^[2]. The quantity of this metals accumulated in fishes depend on sort of fishes and increase if the pH of environment decrease^[2].

From investigation, on human population, now it is known that these metals can cause negative effects on organisms.

Gorell and collaborators^[3] have investigated the population with 50 years old and they have found that

this metals especially zinc are very danger factors on the Parkinson disease.

Some studies which are done to some Japanese worker it is found that Cu and Zn have different neurological effect compared to the Pb^[4,5].

The Aim of this work was to investigate the condition for removing of Zn cation through precipitation method with (2S)-2-aminobutanedioic acid as ligand.

MATERIALS AND METHODS

In this study we used: $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$, (2S)-2-aminobutanedioic acid as a ligand, sodium hydroxide and sodium chloride. For this investigation we have prepared some concentrated soluble which are stored on glass bottles in room temperature. Diluted solution we have prepared fresh for each series of precipitated systems. The precipitated systems are prepared using methods from Tezhak and collaborators^[6].

Precipitated system $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ with (2S)-2-aminobutanedioic acid is investigated in the long region of concentration with ionic force of NaCl 0.6 mol L^{-1} .

As example, one series it's prepared in this way:

- The solution was added in two line of test-tube. In the first line of test tubes is added the solution of

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ZnSO₄·7H₂O with determinate concentration (as example 0.1 mol L⁻¹). In second line of test tube we have added the (2S)-2-aminobutanedioic acid solution with determined concentration (as example 1 mol L⁻¹). The second line of test tube we have added also the NaCl in that way that ionic force to be 0.6 mol L⁻¹. After that we added the solution of NaOH to increase the pH value. The total volume in each test tube should be 10 mL. The differences till 10 mL we have fill with distillate water

- Contain of solution to the first line of test tube was added to the solution of second test tube (7 times per 20 sec). All the concentration is calculated on the total volume after mixing that means at 10 mL. The systems after mixed are stored on thermostat for 24 h in the temperature 25°. To determine the precipitated diagrams, if the concentration of Zn ions stays unchanged, we have to change the concentration of (2S)-2-aminobutanedioic acid. For that we used three deferent concentration of (2S)-2-aminobutanedioic acid for one concentration of Zn ion. We used concentration of (2S)-2-aminobutanedioic acid 1.10⁻¹, 1.10⁻² and 1.10⁻³ mol L⁻¹ for each concentration of Zn(II). For zinc ion we used two concentration 1.10⁻² and 5.10⁻³ mol L⁻¹. All of these systems we added solution of NaCl in that way that ionic force to be 0.6 mol L⁻¹. Also we added the NaOH to change the pH values. Precipitated systems are monitories after 24 h. It is determinate the concentration which cause the difference between clear solution and precipitation. Then it is measured the pH value on the top of precipitate with pH meter, Metrohm”
- Some precipitates are prepared in large quantity for quantity analysis. Systems have stored in thermostat for 24 h in the temperature of 25°, then the pH value is measured on the top of precipitate. These systems are filtered (filtered paper with blue line) and are dried on the air. We used the IR spectre to characterize and to find the presence of organic components to this precipitate

RESULTS

Precipitation of zinc(II) with (2S)-2-aminobutanedioic acid was investigated to concentration of zinc 1.10⁻² and 5.10⁻³ mol L⁻¹ with different concentration of (2S)-2-aminobutanedioic acid (1.10⁻¹, 1.10⁻² and 1.10⁻³ mol L⁻¹). We have added the solution of NaCl because we want that general ionic force to be 0.6 mol L⁻¹. In this mixture we added the

NaOH solution in that way that pH increase continually and from here to find at which pH value it precipitate.

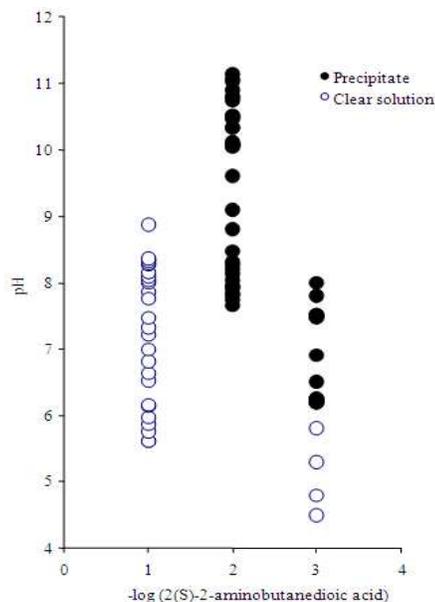


Fig. 1: Precipitate diagram of Zn (II) in concentration 1.10⁻² mol L⁻¹ with (2S)-2-aminobutanedioic acid

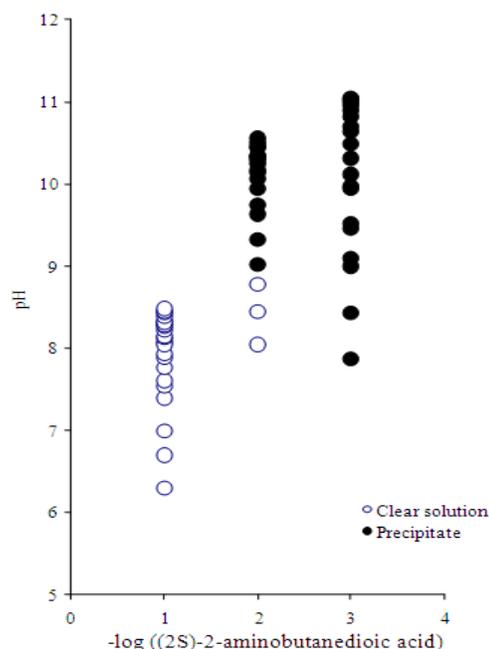


Fig. 2: Precipitate diagram of Zn (II) in concentration 5.10⁻³ mol L⁻¹ with (2S)-2-aminobutanedioic acid

We have found that diagrams have not changed after a long stored and for that the time of 24 h it's approved as time of achieved the equilibrium. To analyze the precipitate some of test tubes are filtered and are dried in the room temperature. These precipitate are characterized with IR spectra (Fig. 4 and 5). We have obtained also the IR spectra of (2S)-2-aminobutanedioic acid (Fig. 3).

DISCUSSION

From the precipitation diagram (Fig. 1) of zinc (II) with (2S)-2-aminobutanedioic acid we can see that when concentration of zinc is 1.10^{-2} mol L⁻¹ and concentration of (2S)-2-aminobutanedioic acid 1.10^{-1} mol L⁻¹ we have not the precipitate, but the precipitate start when the concentration of (2S)-2-

aminobutanedioic acid is 1.10^{-2} and 1.10^{-3} mol L⁻¹ at the value of pH = 7.66 respectively 6.18.

From the precipitation diagram (Fig. 2) of zinc(II) with (2S)-2-aminobutanedioic acid we can see that when concentration of zinc is 5.10^{-3} mol L⁻¹ and concentration of (2S)-2-aminobutanedioic acid 1.10^{-1} mol L⁻¹ we have not the precipitate, but the precipitate start when the concentration of (2S)-2-aminobutanedioic acid is 1.10^{-2} and 1.10^{-3} mol L⁻¹ at the value of pH = 9.02 respectively 7.87.

From precipitation diagrams (Fig. 1 and 2) of zinc with (2S)-2-aminobutanedioic acid in ionic force 0.6 mol L⁻¹ NaCl, we have found that during decreasing the concentration (2S)-2-aminobutanedioic acid the limit of precipitation I s shifted to lower values of pH (Fig. 1 and 2).

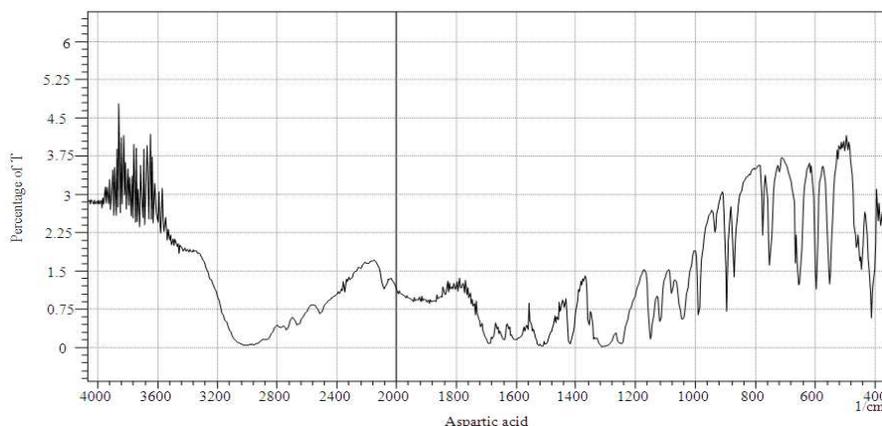


Fig. 3: IR spectra of (2S)-2-aminobutanedioic acid

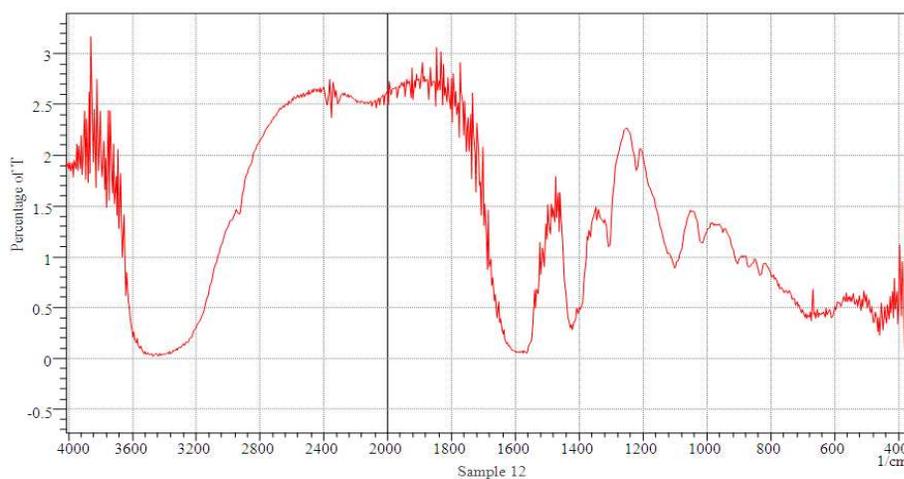


Fig. 4: IR spectra of precipitate which is formed after interaction of Zn(II) with (2S)-2-aminobutanedioic acid: $c(\text{zinc(II)}) = 5.10^{-3}$ mol L⁻¹; $c(\text{(2S)-2-aminobutanedioic acid}) = 1.10^{-3}$ mol L⁻¹; pH = 7.87

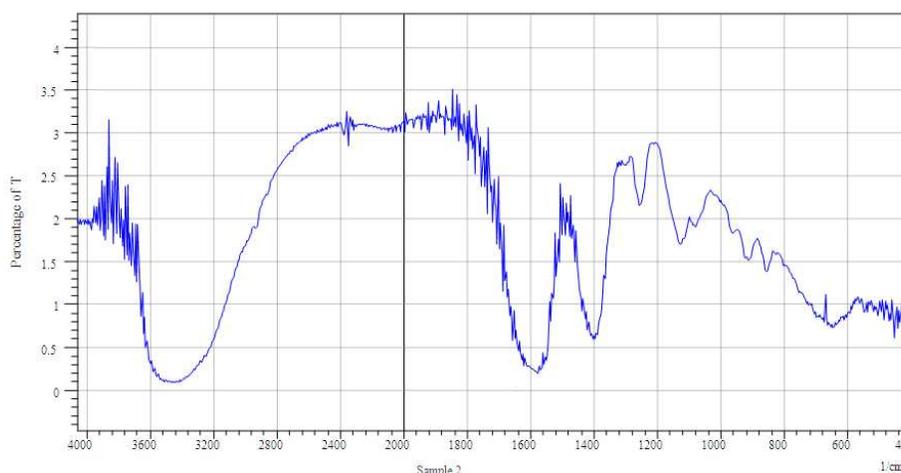


Fig. 5: IR spectra of precipitate which is formed after interaction of Zn(II) with (2S)-2-aminobutanedioic acid: $c(\text{zinc(II)}) = 1.10^{-2} \text{ mol L}^{-1}$; $c((2S)\text{-2-aminobutanedioic acid}) = 1.10^{-2} \text{ mol L}^{-1}$; $\text{pH} = 9.02$

Comparing the IR spectres we can conclude that we have interaction between zinc and (2S)-2-aminobutanedioic acid. To the (2S)-2-aminobutanedioic acid IR spectra (Fig. 3.) we see the peaks at 1710 cm^{-1} which characterize the carboxyl group. At solid phase this peaks are shifted at lower values, 1600 cm^{-1} (Fig. 4 and 5). This tells us for the interaction of zinc with (2S)-2-aminobutanedioic acid.

CONCLUSION

From the precipitation diagrams (Fig. and 2) of zinc(II) with (2S)-2-aminobutanedioic acid we can see that when concentration of zinc is 1.10^{-2} and $5.10^{-3} \text{ mol L}^{-1}$ and concentration of (2S)-2-aminobutanedioic acid $1.10^{-1} \text{ mol L}^{-1}$, zinc not form precipitate. The precipitation of zinc with (2S)-2-aminobutanedioic acid starts with decreasing of concentration of (2S)-2-aminobutanedioic acid in 1.10^{-2} and $1.10^{-3} \text{ mol L}^{-1}$ and in this case the limit of precipitation shifted in low values of pH in case of decreasing of concentration of (2S)-2-aminobutanedioic acid. Also from precipitation diagrams we can see that when the concentration of zinc increase, in case of constant concentration of (2S)-2-aminobutanedioic acid the limit of precipitation will shift at lower values of pH.

Solid precipitates are analyzed by IR spectrophotometer and the IR spectra which we have obtained are compared with IR spectra of (2S)-2-aminobutanedioic acid. From the IR spectra of solid phase and IR spectre of (2S)-2-aminobutanedioic acid we can see that they are not same. From the IR spectra

of solid phase we can conclude that zinc can react with (2S)-2-aminobutanedioic acid. The IR spectra of (2S)-2-aminobutanedioic acid and precipitates are not same if we compare in the form and in the intensity of peaks. This investigation of interaction between (2S)-2-aminobutanedioic acid and zinc are very interesting for environmental aspects and for that we have investigate the precipitate diagram of zinc with (2S)-2-aminobutanedioic acid.

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