Danger Pollution of the Hydrosphere Ammonium Salts

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Abstract – The paper is devoted to the danger pollution of the hydrosphere ammonium salts. We described the basic conditions under which the research was conducted. The methods used and experimental results are presented too.

Key words – ion exchange resins, cell, resistance,“ion exchanger – solution”, system electrical conductivity.

I. Introduction

Ammonium salts is a crystalline substance with an ionic type of Association. The composition of the ammonium salts include one or more of the cations and anion of the acid residue.

Ammonium salts are formed by interaction of corresponding acids with ammonia or a solution of ammonium hydroxide. Most ammonium salts are colorless. In the interaction with strong bases and heating the ammonium salts are easily decomposed with formation of ammonia. In thermal relation to the ammonium salts are unstable and when heated, decompose relatively easily, for example:

$$NH_4Cl \rightarrow NH_3 + HCl$$

$$NH_4NO_2 \rightarrow N_2 + 2H_2O$$

$$NH_4NO_3 \rightarrow N_2O + 2H_2O$$

$$(NH_4)_2SO_4 \rightarrow 2NH_3 + H_2SO_4$$

The most important ammonium salts is ammonium chloride NH_4Cl, ammonium sulfate $(NH_4)_2SO_4$ and ammonium nitrate NH_4NO_3. They are used primarily as nitrogen fertilizer [1].

The main danger of contamination of the hydrosphere ammonium salts consists of saturating water with ammonia. Ammonia is a colourless gas, soluble in water, with a characteristic odor, has toxic effects on aquatic flora and fauna. When water pH is less than 8 is in the form of ammonium when the pH is more than 11 in the form of ammonia, in the range between pH 8-11 – meet as ammonium and ammonia. The sum of ammonia and ammonium-total ammonia nitrogen.

A particular danger is the ammonia in the interaction of water with other chemical elements. Increase the toxicity of ammonia can cause a variety of environmental factors, particularly pH and temperature. Under natural conditions the level of ammonia in groundwater does not exceed 0.2 mg per liter. Higher levels of ammonia (up to 3 mg/l) found in strata rich in humic substances. Normal surface waters contain 12 mg/l of ammonia. The presence of ammonia in high concentrations is an important indicator of fecal contamination of the water.

Indicator of water pollution with organic substances of animal origin salt of ammonia, nitric and nitrous acids. The content of ammonium salt higher than 0.1 mg/dm3, indicating a fresh pollution water, because ammonia is the initial product of decomposition of organic nitrogen-containing substances [2].

Simultaneous maintenance in water of ammonia, nitrites and nitrates indicates the obvious disadvantage of a water source, constant pollution. Increasing the amount of nitrites and nitrates without ammonia indicate the cessation of pollution at present. The presence in water of ammonia and nitrites indicate the recent emergence of a permanent source of contamination. The presence in water of some of the nitrate signals the completion of the process of mineralization.

The main way of ammonia gets into water from sewage treatment plants sewage and animal waste, air pollution and runoff of agricultural land. Excess ammonia levels in the pond, leading to ecological instability of the ecosystem in General, when the displacement of nitrogen-sensitive species are destroyed the functional relationship between all elements of ecosystems (plants, animals, microorganisms), leading to disruption of self-regulation of ecosystems, therefore, on the restoration of the cleanliness of rivers will be expected to work [3].

To establish that, when one-time use of ammonium salts (200–500 mg/kg of body weight), it causes a disturbance of the nervous system, kidneys, causing pulmonary edema. Short-term use of water with a salt concentration of ammonium within 75–360 mg/kg causes an increase in blood pressure. Prolonged exposure to drinking water with high levels of ammonium was observed a reduction of calcium in the body, the pH change in the blood and decreased body weight.

Especially vulnerable are people with decreased metabolism of ammonia that can be caused by enzymatic deficiency via a genetic disorder, impaired liver, kidney. The application of ammonia in ammonium salts, the amount of 100 mg/kg per day, in the human body is disturbed glucose metabolism, sensitivity of tissues to insulin, acid-base balance. Inhalation of ammonia vapors can burn the respiratory tract, lead to toxic poisoning of the body.

How to protect yourself from the negative effects of ammonia? Unfortunately, to determine the level of ammonia in water is impossible, as well as to lose it. Can help only professionals . In addition, the ammonia is only one of the many dangers that You can expect by drinking contaminated water, which can only protect in a timely manner the analysis of water [4].

II. Problem Statement and Approach to Solving

Electrometric method of determining the electrical conductivity allows to accelerate and to increase the accuracy of its determination in comparison to other methods. Determination of electrical conductivity comes to measurement of resistance because it is inversely proportional to the resistance.

The known methods of measurement of specific electrical conductivity of granular resin make impossible to carry out the measurements in a wide range of concentrations of the equilibrium solution. That is why we proposed the approach to measure the resistance of the grains layer of granular resin after the removal of the equilibrium solution by centrifugation.

The ion exchange resin was placed in the electrodialysis cell and set in the balance with the investigated solution. We took the ion exchange column with porous bottom and two fixed in the wall electrodes as a measurement cell The equilibrium solution was removed by centrifugation, the cell was placed in a rubber case and kept in a thermostat at a constant temperature of 25 ^{0}C. With the help of the alternating current bridge (1000 Hz) we determined the electrodialysis cell resistance (R_x), on the base of which the value of specific electrical conductivity of the ion exchange resin ($k_{см}$) was calculated. It was defined from:

$$k_{см} = \frac{\Gamma}{R_x}, \qquad (1)$$

where: Γ – the measurement cell constant determined on the base of known electrical conductivity of the ion exchange resin in the isoelectric point, which has been found from the separate experiment:

$$\Gamma = k_{iso} R_{iso}, \qquad (2)$$

where: R_{iso} – the measurement cell resistance, measured after centrifugation, when the ion exchange resin was in the equilibrium with the isoelectric solution.

III. The Research Methodology and the Results

We have been studying the system of "the KU-2 ion exchange resin – NH_4Cl solution". The research was carried out according to the following algorithm:

1. A series of NH_4Cl solutions (0.1, 0.2 ... 0.8 M) was prepared.
2. We measured the resistance of each solution in the U-shaped tube which is not filled with a resin (in the cell) with the help of electrodes submerged at the same depth.
3. The dependence of 1/R on the NH_4Cl concentration (where R – the electrical resistance of the U-shaped tube) was built for the sodium chloride solution.
4. The U-shaped tube was filled with ion exchange resin.
5. The ion exchange resin have been set in equilibrium with the 0.1 M solution of NH_4Cl in the U-shaped tube. To do this on one knee of the U-shaped tube we placed the separating funnel at 2.0 liters and from it at a low speed the solution has been supplied. The resistance of the solution which flowed from the tube through the other knee has been recorded periodically. The solution supply from a separating funnel has been stopped when the resistance of input and output solution were the same.
6. Only after that the electrodes have been immersed into the U-shaped tube on the same level and the resistance of the resin-solution system has been measured.
7. Similarly, we have set the equilibrium and then measured the resistance of the resin-solution system for NaCl solutions of other concentrations.
8. The dependence of inverse resistance (1/R) of the resin-solution system on the concentration of the solution was calculated.
9. The point of intersection of the obtained dependencies for pure solution and for resin-solution system allowed to determine the concentration of the isoelectric solution (in this concentration the electric conductivity of the solution is the same as the conductivity of the resin).
10. We prepared 1 liter of solution with the concentration of the isoelectric solution.
11. According to the methodology described above (see 5) we have prepared the ion exchange resin in equilibrium to the concentration of the isoelectric solution.
12. One by one the previously prepared examples of ion exchange resin which were in equilibrium to a certain concentrations have been transferred to a centrifuge cell. This cell had the sizes that allowed her to enter the centrifuge (about 5 cm in height and with the required diameter). Electrodes were installed approximately 1 cm from the porous bottom of the cell. Ion exchange resin was placed into centrifuge cell above the electrodes.
13. The measurement cell has been located in the centrifuge and the excess of solution has been removed by centrifugation.
14. The resistance of the cell with ion exchange resin was measured.
15. According to the reference book we have found specific electrical conductivity of NH_4Cl solution, built the concentration dependency and then determined the value of k_{iso} at C_{iso} value using this dependency.
16. The constant of the cell has been calculated by the formula (2).
17. Using the value of Γ constant, the value of the specific electrical conductivity has been calculated for each concentration of the solution.

Conclusion

The results to be obtained by study the system of "the KU-2 ion exchange resin – NH_4Cl solution" allows you to develop and implement effective electrodialysis technology of purification of waste water from ammonium compounds.

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