

Condensed matter physics

Influence of the pH of aqueous sodium chloride solutions with dissolved carbon dioxide on the temperature interval of human vital activity

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Temporal changes in the temperature and concentration dependences of the pH value in aqueous sodium chloride solutions contacting with atmospheric carbon dioxide have been studied experimentally. The measurements are carried out in a temperature interval of (294–323) K for ion concentrations corresponding to (180–1600) water molecules per sodium or chlorine ion.

The pH value for dilute aqueous solutions of sodium chloride is a sum of two components: reducible and irreducible. The reducible component depends linearly on the temperature and, therefore, cannot be responsible for the specific details of the human and mammalian life activities. Therefore, the main parameters of the latter have to be characterized by the irreducible pH component, which is an order of magnitude smaller than the reducible component. The proportionality between the irreducible pH component value and the sodium chloride concentration may testify that minor pH changes are associated with corresponding changes in the salt composition of blood plasma that affect the state of human organism.

The pH relaxation time in aqueous NaCl solutions with dissolved atmospheric carbon dioxide and its dependence on the temperature and the ion concentration are calculated. The analysis of the obtained temperature dependences of the pH relaxation time testifies that they are similar for various concentrations of NaCl ions in water. The principle of natural selection of the optimal states of aqueous salt solutions characterized by the temperature and the irreducible component of pH has been formulated for the first time: optimal are those states in which the pH relaxation time in aqueous salt solutions is minimum.

The minimum points in the curves of the irreducible pH component for aqueous sodium chloride solutions are directly related to the temperatures that can be interpreted as the lower (approx. 30°C) and upper (approx. 42°C) limits of the temperature interval of the human and mammalian life activities. At the same time, the minimum in a vicinity of the temperature of 37°C can be interpreted as the optimal temperature for the vital activity of humans and mammals.

Since the reducible and irreducible pH components behave themselves differently, of particular importance becomes the issue concerning the conformational modifications of human serum albumin and other proteins, which depend on the pH value. The addition of proteins will change the reducible pH component, and the conformational modification of albumin will be primarily induced by the electric fields of hydrogen cations, which will directly affect the irreducible pH component.

[1] L.A. Bulavin, N.P. Malomuzh, O.V. Khorolskyi. Reducible and irreducible components of the pH value in dilute aqueous solutions of sodium chloride. *Ukrainian Journal of Physics*, 2023, 68(3), 177–183. <https://doi.org/10.15407/ujpe68.3.177>