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## CALCIUM PHOSPHATES PRECIPITATED FROM WATER SOLUTIONS OF SODIUM HYDRO-MONOPHOSPHATE AND DIFOSPHATE

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**Introduction:** Amorphous phosphoric acid calcium salts are close in their chemical composition to natural bone tissues and are widely used for their treatment, the manufacture of bone implants and prostheses. In the Republic of Kazakhstan, where the significant stocks of apatites are concentrated, there is a need to organize the large-scale production of materials based on nanocrystalline hydroxyapatite. As chemical methods for the production of hydroxyapatite there are exchange reactions between soluble monophosphates and calcium salts, which until recently have not been studied.

The composition and structure of calcium phosphate substances formed from aqueous solutions as a result of the exchange reactions between sodium monophosphate and calcium chloride in the presence of the inhibitor of crystallization of hydroxyapatite – sodium diphosphate were studied.

**Materials and methods:** In the work aqueous solutions of sodium diphosphate  $\text{Na}_4\text{P}_2\text{O}_7$  and sodium hydromonophosphate were used. In order to obtain products, aqueous phosphate solutions were mixed with each other in the required proportions and treated with calcium chloride solution of the same concentration. At the same time, one of the reagents was slowly added dropwise to the solution of the other one with intensive stirring. The acidic index of the medium was maintained at pH 8, and there was room temperature. Precipitated in the form of aqueous suspensions substances were subjected to repeated washing with distilled water until the absence of  $\text{Cl}^-$  ions in the wash waters. After that, the suspensions were settled for 1-2 days, separated from water, first by decanting, and then on a glass porous filter. The substances dried at 60-80 °C were analyzed by X-ray phase analysis and IR spectroscopy.

**Results:** The consequence of exchange reactions of sodium hydromonophosphate and diphosphate with a solution of calcium chloride is also the formation of suspensions, which during separation separate into two



layers – pure solvent and more concentrated suspension. Substances obtained from a solution of sodium hydromonmonophosphate in the presence of sodium diphosphate precipitate much more slowly than the product formed from a solution containing only hydromonophosphate.

X-ray diffraction analysis shows that the product obtained from a solution containing only sodium hydromonophosphate is crystalline hydroxoapatite.

In the presence of a small amount of sodium diphosphate, partially amorphized substances form from the solutions. From the solutions richer in diphosphate, with the molar ratio  $\text{Na}_4\text{P}_2\text{O}_7 / (\text{Na}_4\text{P}_2\text{O}_7 + \text{Na}_2\text{HPO}_4)$  equal to 0.2-0.4 – only amorphous products. Based on the synthesis conditions, it was to be expected that the molecular basis of precipitated amorphous products should be hydroxoapatite and calcium diphosphate. The results of the IR spectroscopic study showed that the content of hydroxoapatite, as an individual substance, in products decreases rapidly as the amount of diphosphate in the initial solutions increases. One of the possible explanations for this is the binding of monophosphate groups  $\text{PO}_4$  of apatite with diphosphate anions  $\text{P}_2\text{O}_7^{4-}$  via  $\text{Ca}^{2+}$  cations. The second one is screening the surface of small particles of hydroxoapatite with diphosphate molecules. Unfortunately, the final conclusion about the actual structure of the coprecipitation products can be made only after more detailed studies, for example, using the  $^{31}\text{P}$  solid-state NMR method.

**Prospects for further research:** The ideas obtained in the work will be useful in the creation of new amorphous materials based on calcium phosphates, and the proposed technology can be practically realized for the production of amorphous apatites. The obtained materials can be used in medicine as restorative materials and precursors of bioceramics, and also as sorbents.

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