

Nanocomposites and nanomaterials

Organic-inorganic ion-exchangers for purification of water after whey processing

Yu.G. Zmievskii¹, V.V. Zakharov¹, Yu.S. Dzyazko², L.M. rozhdestvenska²,
V.G. Myronchuk¹

¹ National University of Food Technologies, Vladimirskaya str. 48, Kiev-01601, Ukraine

E-mail: saharoff.911@gmail.com

² V.I. Vernadskii Institute of General & Inorganic Chemistry of the NAS of Ukraine, Palladin Ave. 32/34, Kiev-03680, Ukraine

Following scheme has been proposed for processing of nanofiltration permeate, which is formed during whey processing. First the permeate is passed through the columns filled by sand and activated carbon (for removal of colloidal particles and lactose, respectively). Further ion exchange method is applied to remove anions (chlorides, (di)hydrophosphates, citrates, lactates). At last, CO₂ was purged through the alkaline effluent. As a result, the solution containing sodium and potassium hydrocarbonates is obtained, the liquid can be used further for washing of membrane systems and equipment.

The ion exchange resin accumulates organics (citrates, lactates), particularly due adsorption on hydrophobic parts of hydrocarbonaceous chains. This causes a decrease of ion exchange capacity of the resin from cycle to cycle of sorption-regeneration. In order to prevent fouling, the composite ion-exchanger containing both non-aggregated nanoparticles of hydrated zirconium dioxide and their aggregates was used. In order to obtain the composite ion-exchangers, some precipitation conditions were varied according to the original equation:

$$r = \frac{\beta V_m \sigma}{RT \ln \frac{K_{sp}}{C_p \left(C_p - \frac{(A + [An]_{ad}) V_i}{V_p} \right)}}$$

Here r is the particle radius, C_∞ is the concentration of saturated solution of the inorganic constituent, β is the shape factor of particles, v_m is the molar volume of the compound, σ is the surface tension of the solvent, φ is the wetting angle, R is the gas constant, T is the temperature, K_{sp} is the solubility product, A is the total sorption capacity of the resin, $[An]_{ad}$ is the concentration of zirconium-containing anions sorbed according to additional mechanism, V_i and V_p are the volumes of ion-exchanger and precipitator (NH₄OH) respectively, C_p is the volume of precipitator. The equation allows us to control the particle size.