Obtaining purified water research process using ion exchange technologies

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Introduction. Water treatment infrastructure faces numerous operational and financial challenges in most regions of the world. Ion exchange is a water treatment technology that can be used to remove various contaminants in drinking water and has shown increased adoption in recent years due to its operational advantages [1].

Materials and methods. Kyiv city water supply system drinking water, Filter Ag particle size 0.6-1.7 mm, cation exchange resin Dowex HCR-S/S, Dowex SBR-P anion exchange resin and Dowex MB 50 mixed ion exchange resin were selected. Total water salt content, total hardness, alkalinity and hydrogen index were the key indicators of the research.

Results. To determine the effectiveness drinking water purification process using filter material and ion exchange resins, a series of studies under dynamic conditions were conducted. To test a reliable and reproducible experiment, 25 tested samples of missed water were taken. A sampling of purified water (PW) was performed at defined intervals (min): from 0 to 215 minutes in steps of 10 minutes.

Drinking water passage with initial values (pH = 6.87; total water hardness – 5.0 mmol/dm^3; total alkalinity – 4.5 mmol/dm^3; total salt content – 195 mg/dm^3) through the installation that includes Filter Ag to remove secondary iron and mechanical impurities, cation exchange resin Dowex HCR-S/S, anion exchanger Dowex SBR-P and double FMA Dowex MB 50.

Based on obtained data a total water hardness dependence graph on its volume was constructed. Filter Ag (the mass was 220,4 g) affects the change in the total water hardness value, which may be due to sampling high rate of the missed water studied samples, as well as the filter material impurities desorption in purified water. Cation exchange resin Dowex HCR-S/S (m=303.3 g) allows reducing the total water hardness content to the lowest values by the determination method sensitivity. The total water hardness changed from 0.75 to 3.0 mg·eq/dm^3 during 5 h of the experiment and the volume of purified water 215 dm^3 was due to water passage through Dowex SBR-P (m= 369.8 g). With increasing experiment time, the hardness in purified water increases. Source water passing through two series-connected FMAs loaded with Dowex MB 50 (m= 242.5 g and m= 242.4 g, respectively), allows to obtain a minimum content of total water hardness value, even after 5 hours of the experiment. The drinking water velocity was 14 m/h, which is acceptable for fast filters filled with ion exchangers.

The treated water pH value dependence on passed water volume through the filter's loadings was also analyzed.

Conclusions. The ion exchange technologies expediency to obtain purified water was established. The necessary stage of work with commercial ion exchangers was their treatment with 20-25% sodium chloride solution to prevent grains cracking and some organic impurities "salting out" from the ion exchangers matrix. By comparing total water hardness change it was found that the most effective stage of purification is FMA, loaded with Dowex MB 50. The softening reached degree was 90% for the volume of purified water 215 dm^3.

Information sources list.

1. Environmental and economic sustainability of ion exchange drinking water treatment for organics removal / Adib Amini,Youngwoon Kim, Jie Zhang, Treavor Boyer, Qiong Zhang /Journal of Cleaner Production. – V. 104. – 2015. – P. 413-421.