

## ABSTRACT AND REFERENCES

## ECOLOGY

**RESEARCH INTO ION EXCHANGE SOFTENING OF HIGHLY MINERALIZED WATERS (p. 4-9)**

**Mikolai Gomelya, Valentyna Hrabitchenko, Anna Trohymenko, Tat'jana Shablji**

Very often in the processes of water purification it is required to apply the processes of water desalting and conditioning. Their use is predetermined by the increased mineralization and high level of hardness of surface sources of water consumption. It is expedient to use methods of ion exchange for purification of these waters.

We present the results of research into ion exchange softening of highly mineralized waters on weak- and strong acidic cationites.

It is demonstrated that with the increase in the content of sodium ions in water, total exchanging dynamic capacity of strong acidic cationite KU-2-8 is reduced from 1744 to 1295 mg-equiv/dm<sup>3</sup>. This decrease in efficiency of the sorption of hardness ions is due to the increasing degree of desorption of calcium and magnesium ions at high concentrations of sodium ions.

We defined conditions of softening highly mineralized solutions on weak acidic cationite Dowex Mac-3 in the Na<sup>+</sup> form and it was shown that the efficiency of softening of these solutions depends little on the concentration of sodium ions. It was found that this cationite in the Na<sup>+</sup> form is capable to absorb the hardness ions under those conditions when, in the case of strong acidic cationite KU-2-8, their desorption occurs.

We defined conditions of consistent regeneration of strong- and weak acidic cationites by the solutions of acids. In this case, the solutions after regeneration of strong acidic cationite were further used for regeneration of weak acidic cationite. When carrying out such regeneration, almost total desorption of the hardness ions was achieved from both strong- and weak acidic cationite.

**Keywords:** desalting of water, cationite, water softening, regeneration of cationite, acidity, alkalinity.

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**ELECTROMAGNETIC FOCUSING OF IMPURITIES IN WATER PURIFICATION (p. 10-15)**

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The study focuses on the principle of water purification by electromagnetic focusing of the charged particles of contaminants. We have designed an electromagnetic control device (EMCD) of water treatment. A water flow is treated in an axially symmetric electromagnetic field. Aggressiveness of the filtrate is reduced due to a multi-stage process. The first stage involves the selection of the most aggressive components of the filtrate. The second stage is the choice of the physical impact on the flow of contaminants for their subsequent removal. The effect of the axially symmetric electromagnetic field on the charged particles of impurities provides the Larmor precession of the magnetic moment. The precession makes the impurity

ions rotate around the vector of the external magnetic field. This spins the trajectory of the charged particles, whose total mass forms a paraboloid of revolution. The filtrate treatment involves focusing contaminants and removing them from the general flow. This allows controlling the mechanical trajectory of impurities when the latter are removed from the main flow. We have found the inverse relationship of the Larmor radius of the impurities and the focusing coil current. The value of the Larmor radius of impurities of 0.07 m is obtained by increasing the focusing coil current up to 0.1 A.

**Keywords:** purification, filtrate, focusing, control of the mechanical trajectory of contaminants, the Larmor precession.

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## DEVELOPMENT OF POTENTIOMETRIC SENSORS FOR DETERMINING THE CONCENTRATION OF ETHAN-1,2-DICARBOXYLIC AND 2-HYDROXYBENZOIC ACIDS (p. 16-23)

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The study suggests developed potentiometric sensors for determining the concentration of succinic and salicylic acids through using ion associates of succinic acid with safranin T and salicylic acid with safranin T as an electrode-active material of a plasticized film membrane. It is an important task of analytic practice to determine the contents of succinic and salicylic acids in samples with a complex matrix (the environment, foodstuffs, and pharmaceuticals). The research has revealed analytical electrode characteristics of the designed sensors: the dynamic range (4–7 and 3–8 pC); the electrode function slope of 31 and 49 mV/pC; the minimum detectable concentration of  $C_{\min}=9 \cdot 10^{-9}$  mol/L and  $8 \cdot 10^{-8}$  mol/L; the optimum pH range of 5.5–8.0 in the sensors operation; the conditioning time of 24 hours; the response time of 1–2 min; the lifetime of 11 months, respectively, for succinic acid and salicylic acid. We have found the selectivity coefficients ( $K_{\text{sel}}$ ) for the devised sensors by the method of individual solutions with respect to carboxylic acids (citrate ( $1.0 \cdot 10^{-3}$ ), tartaric ( $1.0 \cdot 10^{-1}$ ), oxalic ( $3.0 \cdot 10^{-3}$ ), and acetic ( $2.0 \cdot 10^{-3}$ )). The method of additives was used to find the succinic acid content in samples of kvass ( $s_r=4.0$  %), red wine ( $s_r=5.0$  %), walnut leaves ( $s_r=5.8$  %), whereas salicylic acid was studied in salicylic ointment ( $s_r=4.6$  %) and the solution of salicylic acid and resorcinol ( $s_r=4.0$  %). The correctness of the results was tested by the alternative alkalimetry method. The reproducibility of the suggested ionometric and alternative alkalimetric methods by the Fisher criterion ( $F_{\text{exp}} < F_{\text{tabl}}$ ) was found to be the same. The proposed sensors can be used in analytical laboratories for quality control of foodstuffs and pharmaceuticals.

**Keywords:** potentiometry, sensor, succinic acid, salicylic acid, ion associate, food, kvass, red wine, walnut leaves, pharmaceuticals.

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#### A METHOD OF ESTABLISHING REGIONAL STANDARDS OF SURFACE WATER QUALITY UNDER ANTHROPOGENIC LOADS (p. 24-30)

Oleg Proskurnin, Irina Kirpicheva, Svetlana Smirnova,

The study analyses the existing methodological framework of estimating a rational wastewater discharge into water bodies. It has been proven that it is impossible to use the basin principle of calculating permissible wastewater discharges into watercourses within the boundaries of administrative regions. It is suggested to divide a river basin into local sites, which entails the need to establish regional standards for natural water quality that would be more rigid in comparison with the officially established ones. The purpose of establishing these standards is to provide relatively equal economic conditions for enterprises located in the lower and upper parts of a river basin. An algorithm is suggested for determining regional water quality standards. Its characteristic features are the division of a river basin into local sites, accounting for the degree of self-purification of water in a WB according to the considered indicators of contamination, and control over the impact of water treatment facilities of water-using enterprises. The study describes a demonstrational example calculation for the Udy river (Kharkiv region, Ukraine). Phosphates are chosen as an indicator of natural water quality in the demonstrational example. The major research result is that in some cases the calculated regional regulations are more than twice stricter than the conventional values. The findings of this study may be useful in

the improvement of the water protection legislation both in terms of setting standards of natural water quality and a refinement of the methodological basis of calculating the MPD.

**Keywords:** wastewater, water body, pollutant, quality standards, control point, permissible discharge, local site.

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#### EVALUATION OF EFFECTIVENESS OF WOOD FIRE PROTECTION UPON EXPOSURE TO FLAME OF MAGNESIUM (p. 31-36)

Juriy Tsapko, Sergii Guzii, Mykhailo Remenets, Anastasiia Kravchenko, Aleksii Tsapko

An analysis of unforeseen fires and explosions at ammunition storage sites was conducted and it was found that one of the biggest risks is their fire hazard as storage of such products is realized using wood, both in building construction and packaging products, and necessity of efficient fire retardant treatment was established. To determine efficiency when developing fire retardant coatings studies were conducted for the determination of the combustibility group of wood in terms of weight loss and raise of the flue gas temperature, and it was found that when treating of wood with coatings, the mass loss did not exceed 5 % and the temperature did not exceed

260 °C. The results of the determination of the efficiency of fire retardant treatment of wood with geocement and organic-mineral coatings showed that the material burn-out and structural failure did not occur when exposed to high-temperature flame. Studies to determine the quality of the fire retardant treatment of wood with a coating have shown that the rate of wood charring in case of untreated sample was 2 mm/min, and in case of samples treated with fire retardant agents it did not exceed 0.5 mm/min which allowed us to conclude as to feasibility of the use of fire retardants based on inorganic and organic binding materials for the treatment of wooden structures. To assess the effectiveness of the fire retardant treatment of structures made of wood, the duration of magnesium flame impingement on the surface of the flame of wood treated with fire retardant agents was studied, and it was found that the sample treated with organic-mineral protective coating prevented impact of high temperature and rate of wood charring more efficiently due to the creation of the swollen coke layer than coatings based on inorganic compounds, the mechanism of action of which was aimed at heat isolation.

**Keywords:** fire resistance, coating, wood, weight loss, charring, temperature, flame, surface treatment.

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## DEVELOPMENT OF A TWO-STEP TECHNOLOGY OF SCOURING WOOL BY THE METHOD OF HIGH-ENERGY DISCRETE TREATMENT (p. 36-43)

Oleksandra Kunik, Olga Semeshko, Tatiana Asulyuk, Yulia Saribekova, Sergey Myasnykov

The process of pretreatment of wool fiber is the main factor, which determines the state of the raw material base of wool. The prime cost and the quality of the finished products depend on how and in what way wool scouring was performed. The traditional technologies of the wool pretreatment are expensive and inefficient; furthermore, the problem of extraction of wool grease from the used washing waters is not paid sufficient attention to. The solution to this problem is applying innovative technology of high-energy discrete processing.

Based on the conducted experimental studies, we proposed the technology of two-stage wool scouring by the method of high-energy discrete processing, which includes the following sequence of technological operations: mechanical scouring of wool, the high-energy discrete processing of wool for 3 minutes, washing of wool in the SAS solution with the concentration of 1,5 g/l, at the temperature of 45 °C, washing of wool in clean water, drying.

It was determined that the application of high-energy discrete processing of wool fiber for 3 minutes at the stage of washing contributes to improvement of the qualitative characteristics and to the increase in the output of wool grease up to 96 % in comparison with the amount of grease extracted from the unprocessed fiber.

**Keywords:** Tsigeian wool, Sulside, residual grease content, acid number.

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