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# PHYSICS OF THE PHENOMENON OF ELECTRICALLY INDUCED ELEMENTS SEPARATION IN SOLUTIONS OF SALTS IN LIQUID POLAR DIELECTRICS

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*In experiments [1,2] the phenomenon of induced selective drift of cationic aquacomplexes in water solutions of salts under action of asymmetric electric fields which frequency does not exceed tens of kilohertz was revealed. In this case the grid electrodes placed in a solution and forming the field have been isolated from the solution, and the current through the border between a solution and an electrode was absent. Action of a variable magnetic field on the water solution of salt also excited intensive mass-transport. Experimental data and theoretical estimations [3] have shown that excitation of rotary-onward motions of solvated cations (clusters) with various inertial properties can become a basis for technology of separation of rare earth elements in water solutions of their salts. The further theoretical and experimental researches have demanded to use new not-contradicting and complementary approximations, and specify existence of new applications of solvation process of ions in solutions of salts in liquid polar dielectrics. As it was clarified the conditions providing use of solvation process for the decision of various applied problems, first of all are determined by the sizes of solvated ions (clusters). In the present work we carry out the generalization of results of researches which have been directed on studying of relations between these conditions and properties of clusters.*

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## 1. The phenomenon of induced drift of solvated ions

In the work [4] it was shown the possibility of using the phenomenon of electrically-induced selective drift of cationic aquacomplexes in the water solution of salts for creating new, non-electrode, power-saving technology of the solution enrichment by desired element. The development of the naturally-scientific basis of this technology has shown that inertial properties of formed in the solution over-molecular structural units – clusters depend on their dimensions. Dimensions of these clusters are in limits from scores of angstrom to fractions of micron, at the same time liquid media are the base of functioning both biological and technological systems. Thus, water solution of salt contains nanoparticles and biological and many technological systems are functioning with the assistance of nanoparticles (for example, the ordinary blood circulatory system or many of chemical processes). The casual or intentional action of the aperiodic electric field on systems containing salts solutions produces some positive or negative effects.

The general physical model of process of selective drift of cationic aquacomplexes in water solutions of salts under action of asymmetric electric and variable magnetic fields is based on the following positions.

Each cation (anion) causes the polarization of surrounded solvent (water): the "atmosphere" is forming around each cation (anion) with abundance of polarized molecules of the water. This "atmosphere" is shielding cation’s (anion's) field. The generalized electronic shell of each polarized molecule of water is deformed concerning unperturbed configuration, when the total spin of the molecule is a zero. The perturbation is caused by the action of the cation’s (anion's) electric field. The deformation of the shell leads to the fact that the part of nucleus' charge or electrons in the water molecule will be uncompensated. This uncompensated part of a charge represents a polarizing charge of a molecule of water in a non-uniform electric field of the charged particle–cation (anion). Thus the polarizing charge of molecules of water is determined by a charge of a particle which they shield. The sum of polarizing charges of all molecules, associated around one particle, is equal to a charge of the particle (on absolute value). The polarized charge is positive if molecules of water are shielding anions, and negative if they are shielding cations. This "atmosphere" ("fur") with abundance polarized molecules of water represents a solvate shell.

A non-excited aquacomplex, in which the solvated shell is not deformed, is neutral. The shell carries out a function of the screen which interferes with action of a constant component of the high-frequency electric field. Deformation of the solvated shell and, hence, a formation at aquacomplex a polarizing charge, creates conditions for action of the constant component of the field and, hence, for excitation of the oriented drift of aquacomplex [2].

For today the mechanism of the ion-molecular of interaction remains not clear. There are experimental data [5] which testify that the size of solvated shells in water electrolytes makes some tens sizes of molecules of water. There are also experimental data which testify that introduction of a volumetric electric charge into the weakly-conducting liquid is accompanied by formation of over-molecular structural units - “clusters” which linear sizes make about 1 micron [6].

For definition of amplitude-frequency parameters of the electric fields, providing excitation of induced selective drift of solvated ions, a correct definition of the sizes of solvated shells was required. Thus the traditional approach to consideration of properties of solvated ions, based on the approximation of Debue-Hukkel, did not give quantitative results on the sizes of environments. In this connection the problem of description of the solvation process in terms of electrodynamics of continuous media has been stated and solved.

## 2. Single ion in liquid polar dielectric

Quantitative measure of polarization of dielectrics is the polarization vector $\vec{P}$
For homogeneous dielectric being in a homogeneous electric field

$$\vec{P} = \bar{n} < \overrightarrow{p_0} >, \tag{1}$$

where $< \overrightarrow{p_0} >$ is the value of the central component of the constant dipole moment of a molecule of dielectric along intensity of a field, $\bar{n}$ is the average quantity of molecules in unit of volume of dielectric.

The density of a polarizing charge is defined by the ratio

$$\rho_{pol} = -\nabla\vec{P}, \tag{2}$$

in which the polarization vector $\vec{P}$ is linearly connected with the vector of intensity of the electric field $\vec{E}$ created by an ion:

$$\vec{P} = \chi\,\varepsilon_0\,\vec{E}, \tag{3}$$

where $\chi$ is the dialectic susceptibility of a dielectric, $\varepsilon_0$ is the dielectric constant of vacuum.

The ion, having a charge $q$, creates in the dielectric medium the field which distribution is described by the relation

$$\vec{E} = \frac{q\,\vec{r}}{4\pi\,\varepsilon_0\,\aleph r^3}, \tag{4}$$

where $\aleph = 1 + \chi$ is the relative dielectric permittivity, $\vec{r}$ the radius-vector, which origin coincides with the geometric center of the ion.

It was shown [7] that in view of dipole–dipole interaction between molecules of water the formation of “molecular bridges” in water under is possible high-intensity electric field action. For that process the critical electric field $E_{cr}$ exists.

At $E > E_{cr}$ polarized molecules will be connected by the dipole–dipole interaction and oriented in the direction of the field of the central ion. At $E < E_{cr}$ the thermal movement of molecules should destroy the bridges. The relation corresponding to the condition $|E| = |E_{cr}|$ is obtained, allowing defining the radius of the cluster:

$$\frac{1}{r_{cl}^2} \cdot \ln\frac{C_1}{r_{cl}^a} \approx \frac{1}{\alpha}\left[(p_0^2 + 2\cdot\alpha\cdot k\cdot T)^{1/2} - p_0\right] \tag{5}$$

The given condition means that at $r = r_{cl}$ the field of the central ion "is balanced" by the opposite directed field of "bridges" of the formed dipoles. That is, "fur coat" from the built dipoles shields the central ion. The solution of equation (5) gives the value of $\boldsymbol{r_{cl}}$. The constant $C_1$ is defined by corresponding boundary conditions.

### 3. The self-consistent field in the water solution of salt

According to the concept of the self-consistent field [8] there is such a distribution of an electric field in the system of cooperating charged particles which creates the distribution of particles exciting this field. Salt solution is possible to consider as a system of interacting cations, anions, positively and negatively polarized molecules of water. Certainly, in the solution there are non-polarized molecules of water, but their distribution (at first approximation) does not influence the distribution of charged particles.

For finding the self-consistent field we use the Poisson equation

$$\Delta\varphi = -4\pi q \tag{6}$$

and the Boltzmann distribution

$$n_k = \tilde{n}_k \exp\left(-\frac{Z_k e\varphi}{kT}\right), \tag{7}$$

where $n_k$ is the concentration of particles with charge number $Z_k$ in a point with the potential $\varphi$. For electrons, for example, $Z = -1$. But in a solution free electrons are absent. For cations $Z = m$ and for anions $Z = -m$, where $m$ is the valency of metal which salt is dissolved. In distribution (7) $\tilde{n}_k$ is a concentration of particles with charge number $Z_k$ in a point with the zero potential, equal to average concentration of these particles overall volume of the solution.

Further an index *«i»* designates cations, an index *«a»* – anions, «*p*+» – polarized and being around of anions molecules of water, *«p*⁻*»* – molecules of water around cations.

The average concentration $\tilde{n}_k$ satisfies the condition of quasi-neutrality:

$$\begin{aligned}&\sum_i \tilde{n}_i Z_i + \sum_a \tilde{n}_a Z_a + \sum_{p^+} \tilde{n}_{p^+} Z_{p^+} + \\ &+\sum_{p^-} \tilde{n}_{p^-} Z_{p^-} = 0\end{aligned}, \tag{8}$$

which reflects the fact that the solution as a whole (from outside) is neutral.

It is necessary to consider that charging numbers of cation and anion are equal on absolute value, but opposite, and charging numbers of the polarized molecules of water are determined by the surrounding where they associated: around anions $Z_{p^+} > 0$ and around cations $Z_{p^-} < 0$.

Thus,

$$\sum_k \tilde{n}_k Z_k = 0 \text{ , k=i, a, p+ , p -.} \tag{9}$$

Also the following connections take place:

$$\begin{gathered} Z_a = -Z_i = Z; \quad Z_{p^-} = \frac{1}{N_a} Z_a; \\ Z_{p^+} = \frac{1}{N_i} Z_i; \tilde{n}_{p^-} = N_a \tilde{n}_a; \\ \tilde{n}_{p^+} = N_i \tilde{n}_i; \quad \tilde{n}_a = \tilde{n}_i = n_m; \end{gathered} \tag{10}$$

where $N_a$ is the number of molecules of water associated around one anion; $N_i$ the number of molecules of water associated around one cation; Z the valency of metal which salt is dissolved; $n_m$ the concentration of molecules of salt in a solution, if we consider that they are not dissociated.

Thus, the volume charge has the form

$$q = e\sum_k Z_k n_k \text{ ,} \tag{11}$$

where $e$ is the module of the electron charge (in system of SI $1.6\times10^{-19}$C).

The solution of Poisson equation in which distribution of a volumetric charge is defined by expression (11), for spherically symmetric distribution of potential (cation or anion) looks like

$$\varphi = \frac{C}{r}\exp(-\chi r)\text{ ,} \tag{12}$$

where the screening constant has the form

$$\chi = \left( \frac{8\pi e^2}{kT} Z^2 n_m \right)^{0,5} . \tag{13}$$

The inverse value $l = 1/\chi$ refers to as a screening length and it is possible to consider that its value defines the radius of solvation sphere within the limits of which the polarized molecules of water are arranged. They also insulate a field of the cation (anion). Thus, the value of the cluster radius (solvated cation or anion) can be estimated, using the relation

$$r_{cl} \approx \left( \frac{8\pi e^2}{kT} Z^2 n_m \right)^{-0.5} . \tag{14}$$

## 4. Fluctuations of a Polarized Charge in the Solution

In an external electric field, polarized due to deformation of the aquation shell of aquacomplexes are displaced. As a result there is a separation of aquacomplexes displaced to a greater or lesser extent. Polarized charges of the separated aquacomplexes differ, at least, on absolute value. Thus, there is a separation of charges and electrostatic forces in the volume of solution. Electrostatic forces should lead to excitation of own electrostatic fluctuations in volume of the solution on the average neutral (in enough great volumes or for enough greater time intervals).

Let as a result of division of the polarized aquacomplexes in a solution a polarized charge $\boldsymbol{q}$ arise. Thus

$$q = -\boldsymbol{divP}, \tag{15}$$

where $\boldsymbol{P} = \chi\varepsilon_0\boldsymbol{E}$ is the polarization vector; $\chi$ the dielectric susceptibility of a solution; $\varepsilon_0$ the dielectric constant of vacuum; $\boldsymbol{E}$ the vector of intensity of the electric field acting on a solution. We remind that it is a question of solutions of salts of metals in polar dielectric liquids. Therefore

$$\chi = \bar{n} \cdot \alpha, \tag{16}$$

where $\alpha$ is the factor of polarizability of the solvated ion - cluster; $\bar{n}$ the average number of clusters per unit volume of the solution, and $\bar{n} = 2n_m$, where $n_m$ is the number of dissociated molecules of salt per unit volume of the solution.

The polarized charge of one cluster $\left(p = q/\bar{n}\right)$ will be defined, thus, by the expression

$$p = -\frac{\chi\varepsilon_0}{2n_m}\boldsymbol{divE} = -\alpha\varepsilon_0\boldsymbol{divE}. \tag{17}$$

According to the charge conservation law

$$\frac{\partial q}{\partial t} = -\boldsymbol{divj}, \tag{18}$$

where $\boldsymbol{j}$ is the density of the current. Thus the current is carried by the polarized aquacomplexes. Then

$$\boldsymbol{j} = 2n_m p\mathbf{v}, \tag{19}$$

where $\mathbf{v}$ is the speed of the aquacomplexes carrying a current. The equation of motion of a polarized aquacomplex having mass $m$, has the form

$$m\frac{d\mathbf{v}}{dt} = p\boldsymbol{E}. \tag{20}$$

Differentiating equations (18) and (19) over time and substituting (19) into (18), we get

$$\frac{\partial^2 q}{\partial t^2} = -2n_m p\boldsymbol{div}\frac{\partial \mathbf{v}}{\partial t}. \tag{21}$$

Substituting in (21) the expression for $\partial \mathbf{v}/\partial t$, obtained from (20), and considering that $\boldsymbol{divE} = 4\pi q$, we derive

$$\frac{\partial^2 q}{\partial t^2} = -\frac{8\pi n_m p^2}{m} q \,. \tag{22}$$

The obtained equation describes a simple harmonic fluctuation with the circular frequency

$$\omega_0 = \sqrt{\frac{8\pi n_m p^2}{m}} \,. \tag{23}$$

If the solution is placed between two flat electrodes, the distance between which is not large, consideration of the process can be carried out in one-dimensional geometry. We designate through $E_x$ the absolute value of intensity of the electric field acting on the solution. Then

$$\omega_0 = \alpha\varepsilon_0 \boldsymbol{divE} \sqrt{\frac{8\pi n_m}{m}} \tag{24}$$

or

$$\omega_0 = \alpha\varepsilon_0 \frac{E_x}{\Delta} \sqrt{\frac{8\pi n_m}{m}} \,, \tag{25}$$

where $\Delta$ is the thickness of a layer of the solution between the potential and earthed flat electrodes.

Thus, the density of a volumetric polarized charge in a solution will change with the circular frequency $\omega_0$ $(\nu_0 = \omega_0/2\pi)$ after action of an external electric field on the solution. In this case the frequency of fluctuations is defined not by the amplitude of this field, but the divergence of intensity of the field intensity in volume of the solution.

## 5. Influence of the Electromagnetic Wave on the Solution

As in plasma, any separation of charges in a solution of salt in liquid polar dielectric leads to fluctuations of the density of charge. On the average, for many periods of fluctuations the solution behaves as a quasi-neutral medium. Separation of polarizing charges is possible only on temporary intervals, smaller in comparison with the temporary scale of separation of charges $t_0 \sim (\omega_0)^{-1}$. For spatial scale of separation of the charges *d* it is possible to accept a distance which the solvated ion migrate at the thermal movement in time $t_0$, that is $d \sim \langle \upsilon \rangle / \omega_0$, where $\langle \upsilon \rangle$ is the average speed of thermal movement of solvated ions (clusters), having mass *m*. In spatial scales, greater in comparison with *d*, it is observed quasi-neutrality of the solution.

By definition the dielectric constant of the continuous medium $\varepsilon$ is the ratio of intensity of the external electric field $E$ to the intensity of the weakened field inside this medium $E'$ (dielectric). Thus $\varepsilon$ always is more than 1.

In a solution $E/E' > 1$. Hence, for a solution $\varepsilon < 1$. Thus the smaller frequency of an external electric field $\omega$ ( $\nu = \omega/2\pi$ ) the more the "range" of fluctuations polarized solvated ions, i.e. the amplitude of their displacement. It turns out that with a decrease in $\omega$ the dielectric constant of a solution $\varepsilon$ decreases also.

Also behave free electrons in plasma that is used in techniques of sounding of plasma by radiowaves. In case of plasma there is a critical value of frequency $\omega_k$ of radiowaves, at which dielectric constant of plasma $\varepsilon = 0$. The value of this frequency coincides with the value of the Langmuir frequency of plasma.

In our case the analog of the Langmuir frequency is the frequency of fluctuations of the polarized charge in volume of a solution, $\omega_0$.

The dielectric constant of plasma is defined by the ratio

$$\varepsilon = 1 - \omega_k/\omega, \tag{26}$$

where $\omega$ is frequency of an external radio emission. If this frequency $\omega < \omega_k$, then $\varepsilon < 0$.

In Maxwell's works it is established that the refraction index of an electromagnetic wave in a substance $\gamma = \sqrt{\varepsilon}$ . At $\varepsilon < 0$ electromagnetic waves cannot propagate in the substance and should be reflected completely from it. Therefore in relation to waves with frequency $\omega < \omega_k$ plasma is an ideal reflector. By analogy it is possible to assume that a solution salt in a liquid, polar dielectric will be a reflector for waves with the frequency

$$\omega_0 < \alpha\varepsilon_0 \boldsymbol{divE}\sqrt{\frac{8\pi n_m}{m}}, \tag{27}$$

where $\boldsymbol{E}$ is the intensity of the electric field in the wave.

## 6. Expected values of frequencies of excitation of the effect by external electric field

The values of frequencies obtained in approximation of a single ion in a liquid polar dielectric, do not exceed units of kilohertz for various components of rotary-onward motions of solvated ions-clusters. The determined sizes of clusters and characteristic values of frequencies of the electric field have allowed estimating values of parameters at which it is necessary to expect display of effect of the electroinduced drift of aquacomplexes in water solutions of salts [9, 10]. In fact, the oriented drift was observed experimentally at the frequencies making units of kilohertz. The further experimental researches of conditions of the maximal effect have shown that in certain cases the full separation factor achieves great values at essentially smaller frequencies. This has caused carrying out of estimations of the sizes of clusters with use of other assumptions and approximations.

Values of the frequencies corresponding to various components of rotary-onward motions of cation aquacomplexes, and values of the frequencies corresponding to transition of oscillatory movements in rotary, obtained in approximation of existence of the self-consistent field in a solution, make units of hertz at concentration of salt in water of the order of one gram per liter.

In these approximations, the effect of electroinduced selective drift of the cationic aquacomplexes should be expected at the frequencies of an electric field which are not exceed units of Hz.

In this case, as follows from the relation (14), the size of the cluster is inversely proportional to the square root from the value of concentration of the salt in water. Values of the frequencies, in turn, are inversely proportional to the value of the moment of inertia of the cluster.

The moment of inertia is proportional to the equivalent mass of the cluster, which is the quantity of molecules of water in the solvated shell $g = \left(r_{cl} / r\right)^3$, and the square of radius of cluster $r_{cl}^2$. It turns out that the moment of inertia $I \sim r_{cl}^5$ and values of the frequencies of excitation of various components of motions $\nu \sim r_{cl}^{-5}$. Thus, values of frequencies $\nu \sim n_m^{2.5}$.

It is necessary to expect, that at increase in concentration of salt in 3–5 times the values of frequencies of excitation of various components of movements, determined in approximation of existence of the self-coordinated field in a solution will increase in 15–60 times.

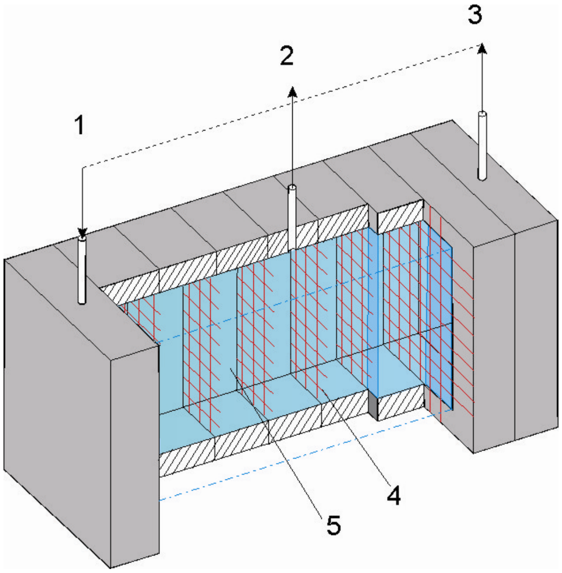
## 7. The possible applications of the process of the induced transport of solvated ions

If it is possible to consider the cost price of nuclear fuel in the size is defined only by a technological level of its manufacturing, then its cost is defined by a number not dependent on perfection of technology of factors. For example, uranium-containing ore extracted in gold-bearing mines, can be offered in the world market under the lowest price. This fact will be caused not by perfection of technology of extraction of ore, but that it is extracted in passing with gold-bearing ore on the same manufactures. In this connection from thorium-containing minerals is distinguished monazite. Power and quantity of deposits of monazite sand allows considering it, as one of potential sources of raw material for large-scale thorium nuclear power. Monazite (Ce, La, Y, Th) $PO_4$ contains about 12% of thorium dioxide $ThO_2$. At action on monazite the concentrated solutions of acids, for example nitric or hydrochloric, the mix of salts of cerium, lanthanum, yttrium and thorium are formed. Modern technological receptions allow allocating from this mix a thorium concentrate in the form of this or that chemical compound. The remained pulp represents very valuable raw material for reception or in the form of connections, or in the pure state rare-earth metals. Thus, realization of a technological variant in which the thorium concentrate is a passing material at reception of concentrates of cerium, lanthanum and yttrium is possible.

The demand and the price for these elements are very high. Thus, enough caused there is a necessity of search and development of new technological receptions of enrichment of water solutions of a mix of salts rare-earth metals on one of them. This process can be named the element enrichment of a water solution of a mix of the salts.

The experiments specifying an opportunity of use of the phenomenon of induced selective drift of cationic aquacomplexes in water solutions of salts under action of asymmetric electric fields for element enrichment of the water solution of a mix of salts of yttrium and cerium have been lead.

Experiments were performed in a technological cell which scheme is shown in Fig. 1.



*1 - the branch pipe for submission of a solution; 2 - the branch pipe for selection of a solution; 3 - the branch pipe for selection and the organizations of compulsory circulation of a solution; 4 - the potential grid isolated from a solution; 5 - the solution*

Fig. 1: Technological cell

The internal volume of a technological cell was filled with a water solution of a mix of salts $Ce(NO_3)_3$ and $Y(NO_3)_3$ with concentrations 3.5 and 3 g/l, accordingly. Circulation of a solution was absent. Sampling was made from branch pipes 1, 2 and 3. On potential grids the asymmetric voltage was applied in accordance with the scheme described in work [4].

For specified above parameters of the field primary drift of the $Ce^{3+}$ cations aside potential electrodes and increase of their concentration in the central section is observed. Enrichment of a water solution of a mix of salts $Ce(NO_3)_3$ and $Y(NO_3)_3$ by aquacomplexes of cerium in the central section in a various degree occurs in the range of frequencies 1.6-7 kHz at the same intensity of the field and factor of asymmetry. The increase in frequency above 7 kHz complicates a picture of the directed drift of aquacomplexes of cerium.

At submission on an input of a dividing element on the basis of a technological cell of an initial mix two components (a water solution of a mix of salts $Ce(NO_3)_3$ and $Y(NO_3)_3$ with concentration 3.5 and 3 g/l, accordingly) factors of division in an element without circulation of a solution after 4 hours of influence of a field with the intensity $E^+ = 14{,}3$ V/cm, factor of asymmetry $A^+/A^- = 0.66$, with the frequency 1.6 kHz have made: in selection 1.00499; in the bank 1.00179; full 1.00679. In a solution there was an enrichment on cations of $Ce^{3+}$.

Thus, the established conditions of display of effect in a water solution of salts of cerium and yttrium show an opportunity of its use in technology of element enrichment of water solutions of salts at complex processing nuclear raw materials. Enrichment of a water solution of a mix of salts $Ce(NO_3)_3$ and $Y(NO_3)_3$ by aquacomplexes of cerium at potential electrodes in a various degree occurs in the range of frequencies 1.6 - 7 kHz. Realization of a technological variant in which the thorium concentrate is a passing material at reception of concentrates of cerium, lanthanum and yttrium is possible.

The modified scheme of extraction clearing of the solution of nitrate of thorium allows taking from refined water target rare-earth elements. In technological scheme, well checked up in practice, the new part is added, allowing taking industrially significant quantities target rare-earth elements (for example, yttrium or cerium) [10].

In case of complex hydrochloric acid technologies rare-earth metal raw material the basic scheme of extraction the rare-earth elements from refined water, containing a hydrochloric acid and chlorides of the rare-earth elements, will not change. Certainly, optimum combinations of parameters of the electric field acting on a water solution of a mix of chlorides will be others. Thus orders of sizes of intensity of an electric field and its frequency will not change. The design of a dividing cell, the scheme and power of system of formation of an asymmetric electric field of high frequency will remain constant. Thus, the developed technology is universal in relation to the scheme of the extraction clearing of thorium and to technology of rare-earth metal raw material.

## 8. Conclusion

The solvation process of ions in solutions of salts in liquid, polar dielectrics provides an opportunity of development of essentially new technologies and techniques. The conditions providing use of process mass transfer for the decision of various applied problems, first of all are defined by the sizes of solvated ions (clusters).

In particular, action of periodic electric fields with various combinations of frequency, intensity and the attitude of amplitudes of intensity in half-cycles on solutions of salts in polar dielectrics causes excitation of rotary-forward motion solvated ions (clusters) and, hence, mass transfer. The frequency of this fields does not exceed tens of kilohertz the amplitude of intensity in solutions - tens volt per centimeter. Thus electrodes by means of which in volume of solution various configurations of an electric field are created, are insulated from solutions. Experimental data and theoretical estimations show that distinction of inertial properties of the solvated ions, caused in the different sizes of the solvated shell, can be a basis of technology of element enrichment of solutions of salts of metals.

Values of the sizes of the solvated ions–clusters in solutions of the salts determined in approximation of the oriented association of the polarized molecules of solvent ions and in approximation of existence of the self-consistent field the volumes of a solution of salt differ more than by the order of magnitude. The frequencies of an asymmetric electric field corresponding to excitation of rotary-onward of the solvated ions - clusters and determined in these approximations differ almost by three orders of magnitude.

It is probable that at concentration of salt in the solutions providing performance of the condition $n_i << n_p$ where $n_p$ is the number of solvent molecules in unit of volume, $n_i$ the same for quantity of ions, that is at concentration up to 0.1 g/l, it is possible to assume quantity of molecules of solvent, that the potential becomes smaller on distances, smaller than distances between most close located solvated ions. Then the density of a charge is just the density of the polarizing charge formed by polarization of molecules of solvent. At significant concentrations the salvation process is more precisely described in approximation of existence of the self-consisted field the volume of the solution and values of frequencies of the maximal display of effect of the electroinduced selective drift strongly depend on the values of concentration.

Checking of the condition of water in the solutions of sugars (α-methyl-D-glucopyranoside, α-methyl-D-mannopyranoside, α-methyl-D-glucopyranoside, Lactose and saccharine) by means of Spectrophotometer Perkin-Elmer Model 180 have showed that a marked difference occurs between spectra of light absorption by solution before and after asymmetrical electric field action. The obtained facts confirm that action of the field on the solution causes either changes of certain conditions of water in the solution or changes of biological active compounds concentrations in the gap between potential and neutral electrodes.

Action of an electromagnetic wave on a solution of salt in liquid, polar dielectric causes separation of charges and leads to fluctuations of density of a charge. At the certain combinations of parameters of an electromagnetic wave and a solution it is possible to expect its partial or total reflection from the medium formed by a solution that allows considering the opportunities of use of electromagnetic waves for definition of parameters of solutions.

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