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WATER TREATMENT  
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## Electrolytical Properties of Solutions of Lithium Hydroxide at High Temperatures and Pressures

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**Abstract**—This paper presents experimental and calculated data on dissociation constants and specific and molar (limiting) electric conductivity of aqueous and vapor solutions of LiOH at concentrations ranging from  $7.24 \times 10^{-7}$  to  $3.34 \times 10^{-1}$  mol/kg and temperatures ranging from 298.15 to 646.65 K on the saturation line. To extend the capabilities of estimating the physico-chemical processes at lithium water chemistry under conditions of high temperatures, the graphical dependence of the specific conductivity of aqueous solutions of LiOH on concentration and temperature is given, which shows the advisability of determining concentration from a specific conductivity in the region of a maximum of curves describing the dependence of the specific conductivity on temperature.

The values of pH and pOH of solutions of LiOH within the indicated range of concentrations and temperatures have been calculated. It is shown that on dosing LiOH solutions into the boiler water at concentrations from  $7.24 \times 10^{-7}$  to  $8.7 \times 10^{-6}$  mol/kg the values of pH for LiOH and H<sub>2</sub>O are virtually the same at the temperature of 553 K, which scarcely affects the formation of protective lithium-ferrite film.

Five relationships for calculating pH at different values of concentration and specific conductivity of LiOH solutions on isotherms ranging from 373.15 to 616.35 K have been worked out.

**Keywords:** lithium hydroxide, electrolytical properties, lithium water chemistry, corrosion protection, pH of solutions, control systems

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Previously, in published works of scientists of our country the advantages of lithium hydroxide used for alkalization of the boiler water as compared with sodium hydroxide, and of the lithium water chemistry at power units of thermal and nuclear power plants has time and again been reported on. Owing to the manifestation of special properties (limited intrinsic solubility of LiOH and iron in LiOH solutions, the lowest chemical activity, the highest ionization potential, etc.) LiOH is a corrosion inhibitor and a retarder of the process of corrosion cracking of heat-exchange tubes (HETs) in steam generators (SGs) of nuclear power plants [1, 2]. Therefore, beginning in February 2000 at Russian nuclear power plants the new standard “Water Chemistry in the Secondary Circuit of Nuclear Power Plants Equipped with Reactors of the VVER-1000 Type” came into force, which involves corrective treatment of the SG water by lithium hydroxide [3]. To optimize the lithium water chemistry, it is also necessary to be aware of the trends in varying such physico-chemical properties of high-temperature LiOH solutions as the specific ( $\chi$ ) and molar ( $\Lambda$ ) conductivity, dissociation constants  $K_d$ , and values of pH<sub>*t*</sub> of the heat carrier at its working temperatures  $T$  and pressures  $p$ . In the present work such regularities for aqueous and vapor solutions that have been obtained by the authors previously by means of the MASVP program with the

use of experimental data on the conductivity of high-temperature LiOH solutions are investigated [4].

The purposes of the investigation in question are the following:

—to calculate values of pH<sub>*t*</sub> for LiOH solutions when changing its concentration  $C_{\text{LiOH}}$  from  $7.24 \times 10^{-7}$  to  $3.34 \times 10^{-1}$  mol/kg;

—to determine dependences pH<sub>*t*</sub> of  $C_{\text{LiOH}}$  on  $T$  and  $\chi$  at  $T < 646$  K on the saturation line and present them in the form that lends itself well for prompt control of the heat carrier quality at high temperatures.

Such a wide range of LiOH concentrations is considered here, because different values of  $C_{\text{LiOH}}$ , at which the required technological effect is achieved, are given in the literature. For example, on alkalization of the PGV-1000 boiler water in order to maintain pH within the limits from 8.7 to 9.2 in samples cooled down to room temperature, it suffices to provide  $C_{\text{LiOH}}$  in it ranging from  $7.24 \times 10^{-7}$  to  $8.7 \times 10^{-6}$  mol/kg [3]; the process of oxygen-promoted corrosion of steel in the flowing LiOH solution at room temperature stops at  $C_{\text{LiOH}} = 2.09 \times 10^{-3}$  mol/kg [5]; to create a protective lithium-ferrite film on the metal surface of HETs in SGs of nuclear power plants equipped with VVER-type reactors and to provide conditions for a constant growth rate of this film, a value of  $C_{\text{LiOH}}$  within the