Accurate high-pressure thermal conductivity measurements have been performed on $\text{H}_2\text{O} + \text{SrCl}_2$ and $\text{H}_2\text{O} + \text{Sr(NO}_3\text{)}_2$ mixtures at pressures up to 100 MPa over a temperature range between 293 and 473 K using a parallel-plate apparatus. The concentrations studied were 0.025, 0.05, 0.10, 0.15, and 0.20 mass fraction of the salts. The estimated accuracy of the method is about ±1.6%. The pressure, temperature, and concentration dependences of the thermal conductivity have been studied. Measurements were made on six isobars, namely, 0.1, 20, 40, 60, 80, and 100 MPa. The thermal conductivity shows a linear dependence on pressure and concentration for all isotherms. Along each isobar, a given concentration shows the thermal-conductivity maximum at a temperature of about 413 K. The measured values of thermal conductivity at atmospheric pressure are compared with the results of other investigators. Literature data at atmospheric pressure reported by Ridel and by Zaitzev and Aseev agree with our thermal conductivity values within the estimated uncertainty.

KEY WORDS: aqueous solutions; density; high pressure; parallel-plate method; salt; thermal conductivity; water.

I. INTRODUCTION

Only limited experimental thermal-conductivity data over a wide range of temperatures, pressures, and concentrations are available in the literature.

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for aqueous salt solutions. The thermal conductivity of \( \text{H}_2\text{O} + \text{SrCl}_2 \) and \( \text{H}_2\text{O} + \text{Sr(NO}_3)_2 \) solutions has been investigated previously [1, 2]. All measurements in these papers were performed at atmospheric pressure. In the paper of Ridel [1] the thermal conductivity of \( \text{H}_2\text{O} + \text{SrCl}_2 \) and \( \text{H}_2\text{O} + \text{Sr(NO}_3)_2 \) solutions were measured in a temperature range from 293 to 373 K at a pressure of 0.10 MPa for concentrations from 0.025 to 0.2 mass fraction of salt using a parallel-plate method. The thermal conductivity of liquid \( \text{H}_2\text{O} + \text{SrCl}_2 \) and \( \text{H}_2\text{O} + \text{Sr(NO}_3)_2 \) solutions at atmospheric pressure and at a temperature of 293 K has been reported by Zaitzev and Aseev [2] for concentrations from 0.05 to 0.25 mass fraction using a coaxial-cylinder method.

In this investigation, a parallel-plate cell was constructed for measuring the thermal conductivity of aqueous solutions of salts in the liquid and vapor phases at high temperatures (up to 473 K) and pressures up to 100 MPa.

2. EXPERIMENTAL

The apparatus and experimental procedures have been described in detail in previous publications [3–5], and only a brief description of the approach is given here. Essentially, the apparatus consists of a thermal-conductivity cell, a high-pressure vessel, and a liquid thermostat, dead-weight pressure gauge, a water-to-oil separator, and containers for degassed water and for solutions. The thermal-conductivity cell consists of three plates: guard plate, upper plate, and lower plate. The guard plate is surrounded by a guard heater. The thermal-conductivity cell has a cylindrical shape with a 21-mm height and 90-mm diameter. The cell is made from stainless steel. The fluid surrounds the cell and fills the gap between upper and lower plates. All plates were polished with powder of a small grain size (320 nm). In this way heat transport by radiation is small compared to the heat transport by conduction.

The thermal conductivity measurements were based on the measurement of the power transferred \( Q \) from the upper plate to the lower plate by conduction through the fluid layer, and the temperature difference, \( \Delta T \), across the fluid layer. The thermal conductivity \( \lambda \) of the fluid is deduced from the relation:

\[
\lambda = \frac{QD}{S \Delta T}
\]

where \( S = (36.38 \pm 0.01) \text{ cm}^2 \) is the effective area of the upper plate and \( d \) is the width of the measurement layer. The experimentally determined