INTRODUCTION

Because of modern conditions of shortages of power and materials resources, there are societal demands to increase effectiveness of technological processes. The best way to approach this problem [1, 2] is the use of computer aided design systems which permit the evaluations and comparison of many design variables. In technical processes which involve the flow of liquids, mathematical models are utilized in which the thermophysical properties (TPP) of the liquids appear as independent parameters in the problems. Thus, the need arises to develop efficient and accurate methods to measure these thermophysical properties which consist of thermal conductivity, thermal diffusivity and specific heat.

The flows of real technological liquids in many cases consist of dispersion systems (suspensions, emulsions or liquid-gaseous mixtures). Effective values of TPP in dispersion systems can be measured only in a flow process. Conventional methods and apparatus of thermophysical measurements are based on the assumption that the liquid being investigated must be in a motionless or «quasi-solid» state in process of measurement. (There must be no convection heat transfer). Therefore these methods and apparatus are not applicable to measure the effective TPP of liquids under flow conditions.

Research experience has shown that one of the most appropriate methods for the measurement of TPP of such technological liquids are methods of laminar flow. The merits of such methods are both the possibility of continuous in time measurements of TPP of liquids in the process of flow through measuring devices and the possibility of experimental investigations of the dependence of liquids thermal conductivity on shear rate in non-Newtonian flows. This second advantage has especially great meaning in connection with published articles during last decade in the heat transfer scientific-technical literature. These articles are devoted to theoretical investigations of the effects of anisotropy of heat transfer in convective liquids flows. But experimental data indicating anisotropy of thermal conductivity during such liquid flows has not been published up to now.

The problems of automatization of measuring operations and experimental data processing is an important aspect of the development and use of the laminar flow methods of TPP measurements. The solution of this problem permits us to obtain the necessary information about the character and the value of the changes of TPP during an experiment and to use this information to create liquids with specified TPP.

The aim of this book is to present to the reader information about laminar flow methods and information about measuring devices based on these methods. The methods and devices considered in this book have the following

merits as compared to conventional methods and devices of thermophysical property measurements:

a) the ability to perform measurements of thermophysical properties of liquids continuously in time in flow process of scientific and engineering experiments and in real technological processes.

b) to experimentally determine the dependence of the second diagonal components of tensors of thermal conductivity and thermal diffusivity of liquids on shear rate.

c) to automate with sufficient simplicity the processes both to control the experiments and to process experimental information with the use of simple computers.

A brief review of classical measurement methods of thermophysical properties is given in the first chapter.

The second, the third and the fourth chapter are devoted to the theoretical basis of methods of laminar flow and devices.

The fifth chapter is devoted to the analysis of sources of measurement errors of TPP with use of the described methods and devices.

The design of measuring devices and the composition of experimental apparatus are considered in the sixth chapter.

The results of calculated and experimental evaluations of errors of liquid TPP measurements are discussed in the seventh chapter.

The results of experimental measurements of liquids TPP are presented in the eighth chapter. The results of using these methods for monitoring of changes of liquid's TPP in scientific experiments or real technological process are also given in this chapter.

The results of theoretical and experimental investigations which supplement and substantiate the contests of the main chapters of the book are considered in the appendix.

This book is intended for engineers and scientists, for senior students and post-graduates specializing in the area of thermophysical investigations.