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Methodology for Determining Parameters of Ozone-Safe Fire Extinguishing Substances

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Abstract. In this work, the objects of research are individual chemical substances and multicomponent mixtures (gaseous and liquid) used in extinguishing fires.

The design of automatic gas fire extinguishing installations is associated with the solution of many scientific and technical issues and is based on the calculation and forecasting of such important data as the thermophysical properties of individual substances and mixtures consisting of them. Phase equilibria parameters data are of particular interest. Also, such data are necessary for scientific and practical research in the creation of the latest, more progressive fire extinguishing agents. It is often difficult or simply impossible to obtain experimentally thermophysical characteristics and parameters of phase equilibria for a wide range of states. Moreover, experimental information is expensive and time-consuming.

The work is dedicated to the development of theoretical methods for determining the parameters of phase equilibria of both individual chemicals used to extinguish fires and multicomponent fire-extinguishing mixtures. The use of the proposed techniques makes it possible to obtain numerical values of the required characteristics of fire extinguishing agents by calculation with the required accuracy using a minimum of initial data.

The method of mathematical modeling makes it possible to obtain a mathematical model of phase equilibria based on thermodynamic perturbation theory in order to determine the basic functions of the state in the absence of empirical parameters.

The proposed method for calculating the parameters of phase diagrams for multi component fire-extinguishing mixtures was used to determine the thermodynamic parameters of the ozone-safe fire-extinguishing composition

Introduction

Over the past decades, the ozone layer above the Earth's surface has changed significantly, which indicates the danger that threatens the life of future generations. According to the World Health Organization, 92% of the world's population lives in places where air quality levels exceed recommended limits [1, 2]. The presence of harmful and dangerous gases, as well as suspended particles and aerosols in the atmosphere, poses a serious threat to biological diversity and human health. Constant increase in their concentration leads to a decrease in the level of environmental safety [3, 4]. A state of health and life expectancy of the population depends on the level of environmental safety in general and the quality of atmospheric air in particular [5, 6]. Thus, the Vienna Convention [7] for the Protection of the Ozone Layer (1985) and the Montreal Protocol [8] on Substances that Deplete the Ozone Layer (1987), as well as the amendments to the Montreal Protocol adopted in London, Copenhagen, Beijing and Montreal, that globally, emissions of some ozone-depleting substances can significantly deplete or otherwise alter the ozone layer, with potentially adverse effects on human health and the environment; and as well as detrimental effects on the climate [9, 10]. Large-scale fires cause acid precip-itation and subsequent pollution of aquifers [11, 12]. The conse-quences of fires increasingly often force one to consider the improvement of fire-fighting technologies [13, 14].