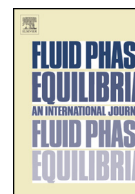


Contents lists available at [ScienceDirect](http://ScienceDirect.com)

# Fluid Phase Equilibria

journal homepage: [www.elsevier.com/locate/fluid](http://www.elsevier.com/locate/fluid)

## Vaporization enthalpies of a series of the fluoro- and chloro-substituted methylbenzenes

Sergey P. Verevkin<sup>a,\*</sup>, Vladimir N. Emel'yanenko<sup>b</sup>, Mikhail A. Varfolomeev<sup>b</sup>, Boris N. Solomonov<sup>b</sup>, Kseniya V. Zherikova<sup>c</sup>

<sup>a</sup> Department of Physical Chemistry, University of Rostock, 18059 Rostock, Germany

<sup>b</sup> Department of Physical Chemistry, Kazan Federal University, Kremlevskaya str. 18, 420008 Kazan, Russia

<sup>c</sup> Nikolaev Institute of Inorganic Chemistry of Siberian Branch of Russian Academy of Sciences, Lavrentiev Avenue 3, 630090 Novosibirsk, Russia



### ARTICLE INFO

#### Article history:

Received 15 May 2014

Accepted 22 July 2014

Available online 1 August 2014

#### Keywords:

Fluorobenzenes

Chlorobenzenes

Methylbenzenes

Vapor pressure

Enthalpy of vaporization

Correlation gas-chromatography

Group-additivity

### ABSTRACT

Vapor pressures of fluorobenzene, chlorobenzene, 2-chloro-, 3-chloro-, and 4-chloro-methylbenzenes, 2-chloro-1,3-dimethylbenzene, 2,6-dichloro-1-methylbenzene were measured by the transpiration method. Molar standard enthalpies of vaporization at the reference temperature were calculated from temperature dependences of vapor pressures. Available literature data on halogenobenzenes were collected and evaluated by using correlation gas-chromatographic method. Simple group-additivity procedure was developed for estimation vaporization enthalpies of mono- and di-halogen-substituted benzenes.

© 2014 Elsevier B.V. All rights reserved.

### 1. Introduction

Halogen substituted benzenes belong to the long-lived pollutants frequently found in industrial effluents. Reliable thermodynamic data for these compounds are of an environmental interest [1]. Careful search for primary experimental data on halogenobenzenes available in literature has been performed in this work. It has turned out that the good quality primary vapor pressures and vaporization enthalpies exist only for fluorobenzene and chlorobenzene (see Table 1). Collection of experimental data available for fluoro- and chloro-substituted methylbenzenes suffered from ambiguity. Indeed, the comprehensive compilations by Stull [2] and by Stephenson and Malanowski [3] contain vapor pressure data for numerous halogen substituted benzenes over a wide range of temperature. The origin of the data presented there is not clear, methods of measurements are unknown, as well as errors of measurements and purities of compounds. In this context, additional measurements on halogen substituted methylbenzenes are desired. As a part of our systematic research on thermochemical properties of halogen organic compounds [4–6] this paper

presents new vapor pressure data for seven halogen substituted benzenes and methylbenzenes: fluorobenzene, chlorobenzene, 2-chloro-, 3-chloro-, and 4-chloro-methylbenzenes, 2-chloro-1,3-dimethylbenzene, 2,6-dichloro-1-methylbenzene. Molar standard enthalpies of vaporization,  $\Delta_1^g H_m$ , for these compounds were calculated from temperature dependences of vapor pressures. We also collected vapor pressures of halo-methylbenzenes available in the literature and treated these data uniformly in order to derive and evaluate their enthalpies of vaporization. The evaluated values  $\Delta_1^g H_m$  (298.15 K) were used to develop a group-additivity procedure for mono- and di-halogen-substituted benzenes.

### 2. Experimental

#### 2.1. Materials

The samples used for the transpiration experiments were of commercial origin. Origin of samples and initial purity are given in Table 1. Prior to experiments the samples were purified by repeated vacuum fractional distillation with the Teflon spinning band column under reduced pressure. The final degree of sample purity was determined by using a Hewlett Packard gas chromatograph 5890 Series II equipped with a flame ionization detector and a Hewlett Packard 3390A integrator. The carrier gas (nitrogen)

\* Corresponding author. Tel.: +49 381 498 6508; fax: +49 381 498 6524.  
E-mail address: [sergey.verevkin@uni-rostock.de](mailto:sergey.verevkin@uni-rostock.de) (S.P. Verevkin).