Lecture Notes in Mechanical Engineering

Volodymyr Tonkonogyi · Vitalii Ivanov · Justyna Trojanowska · Gennadii Oborskyi · Milan Edl · Ivan Kuric · Ivan Pavlenko · Predrag Dasic *Editors*

Advanced Manufacturing Processes

Selected Papers from the Grabchenko's International Conference on Advanced Manufacturing Processes (InterPartner-2019), September 10–13, 2019, Odessa, Ukraine

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Harmonization of the EU and Ukrainian Normative Documentation: Case Study on Determination of Barium Content in Mineral Waters to Develop Quality and Safety Criteria

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Abstract. The article presents the results of a study on the development of a criterion for the quality and safety of barium content in mineral waters in order to harmonize regulatory documents of the European Union and Ukraine. To develop metrological support for the analysis, it is justified to select the optimal method for determining the content of barium in waters – atomic absorption spectrometry. Validation of the methodology confirmed the conformity of metrological characteristics with the requirements of Directive 2003/40/EC. For the first time, barium content studies in 36 mineral waters of Ukraine were carried out. The concentration of barium in mineral Tab. waters (TDS) ≤ 1.0 g/l ranged from 0.058 mg/l to 0.8846 mg/l, i.e. <1.0 mg/l (criteria according to Directive 2003/40/EC). The barium concentration range in medicinal-Tab. mineral waters varies from 0.0443 mg/l to 3.7013 mg/l. In 10 of them, the concentration of barium was >1.0 mg/l, not complying with Directive 2003/40/EC. They can affect a person drinking them. Using the correlation and factor analysis, the dominant factor in the formation of the chemical composition of the studied mineral waters was determined, which included bicarbonates, sodium and potassium, total mineralization, orthoboric acid and barium. The criteria for barium concentration assessment in the natural mineral and natural therapeutic and prophylactic waters of Ukraine (1.3 mg/l and 5.0 mg/l respectively) are proposed.

Keywords: Barium concentration · Human exposure · Natural mineral waters · Atomic Absorption Spectrometry Method (AAS)

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1 Introduction

Today, Ukraine is confidently following the path of European integration, harmonization of the national and European systems of technical regulation. In this regard, a pressing issue arising refers to the harmonization of Ukraine's normative documentation for mineral waters (MW) with the European requirements. This implies to expand the Ukrainian MW safety indicators list with the indicators governed by relevant of Directive 2003/40/EC [1]. In particular, it concerns the regulation of barium concentration. Therefore, there exists need to develop the appropriate metrological support for the analysis according to the requirements of [1], conduct tests on the content of barium in MW, and develop criteria for MW in Ukraine [3].

2 Literature Review

The barium is not included to the safety indicators listed by the current Ukrainian normative documentation for MW.

It's essential to note the difference in the Ukrainian and European MW classification. In Ukraine, there are natural mineral medicinal-Tab. waters (TDS >1.0 g/l, or <1.0 g/l, but their biologically active components and compounds content exceed the balneological norm), which can be used both in the diseases treatment and prevention according to the developed medical indications, and Tab. drinking water non-systematically being taking and depending on the amount consumed. After harmonization with European normative documentation, given the absence of restrictions on MW mineralization, some part of the natural medicinal-Tab. waters of Ukraine shall shift to the natural mineral waters category, provided that they meet all the requirements of Directives [1] and [2].

Recently, both in Ukraine and in Europe the MW consumption per individual in everyday life increased, so the need for MW safety strict control is evident. Therefore, it is necessary to strictly monitor its safety, especially the content of hazardous trace elements, heavy metals. Barium is one of such safety indicators. The MW composition depends on the geochemical conditions and anthropogenic factors. Barium is a natural MW component. Barium is found in nature more often as a divalent cation. The earth's crust contains 0.05% barium in the form of sulfates, carbonates, silicates, and aluminosilicates [3, 4]. The main barium minerals are barite (barium sulfate) and witherite (barium carbonate). Barium is also released into the environment as part of industrial emissions. There is evidence of barium pollution of aquifers in oil and gas fields due to the use of barite [5, 6].

Excessive amounts of barium divalent compounds are toxic. In excessive bodily concentration, barium affects the blood cells, muscle tissue, neurons, heart tissue [6–8]. Barium can replace calcium ions in bone tissue leading to osteoporosis [9]. Since 200 mg of Ba is considered to be a toxic dose for a human, and about 1 g is a lethal dose, the standard values of barium content in drinking water – 1.3 mg/l [10].

Due to the fact that in Ukraine barium in MW has not been standardized yet, studies on the content of barium in MW have not been conducted before. In the drinking waters of Ukraine, the barium content does not exceed the norms specified in [10].

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