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Research Article

An investigation of gross α & gross β radioactivity level of Xiaoqing River from 2008 to 2015

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ABSTRACT

Background: Purpose of current study was to investigate the gross α & gross β radioactivity level of Xiaoqing River in Jinan from 2008 to 2015.
Methods: According to National Standards of P.R., China.
Results: The gross α radioactivity concentration ranges from 0.02 to 0.17) Bq/L with an average concentration value of 0.05Bq/L; the gross β radioactivity concentration ranges from 0.09 to 0.23) Bq/L with an average concentration value of 0.15Bq/L.
Conclusions: The gross α & gross β radioactivity level of Xiaoqing River were in the normal background range during the years from 2008 to 2015.

Keywords: Xiaoqing River, Gross α radioactivity level, Gross β radioactivity level

INTRODUCTION

Xiaoqing River is located northern outskirt of Jinan City to the South of Yellow River in Shandong Province. Xiaoqing River is an important provincial river whose trunk stream starts from Jinan Muli Floodgate and flows from west to east through Jinan, Zibo, Binzhou, Dongying, Weifang, and enters the sea at Shouguang City. The length of its trunk stream if 237 km, and its basin area is 10336 sq. km. Xiaoqing River is the only drainage outlet of the main urban area of Jinan City. It is also an important draining river in middle Shandong Province with a secondary function of farmland irrigation. It is necessary to take long term dynamic monitoring and evaluation on the radioactivity levels of Xiaoqing River.

Principle and definition: α decay is a kind of radioactive decay where a radioactive atomic nucleus emits an α particle and decays into another kind of elemental atom. β decay is a kind of radioactive decay where a beta particle is emitted and a proton is transformed into a neutron in a radioactive atomic nucleus. Since the gross α and gross β radioactivity concentration level is generally low in water, evaporation method is used to concentrate radioactive elements onto solid impurities, which are prepared into sample sources to measure the gross α and gross β radioactivity level in water. The purpose of measuring the gross α and gross β radioactivity level in river water is to detect the existence of radioactivity elements and their specific activities in order to quantitatively evaluate the radiation environment quality and provide data for radiation environment management.

METHODS

Equipment: Model BH1217B weak α/βdetector; Model CLB-104 low background α/β detector; Model MPC-

9604 low background α/β counter. Applying saturated thickness relative measuring method. α standard source: ^{241}Am standard powder source; β standard source: KCl standard powder source; both of which are purchased from National Institute of Metrology of China. The chemical recovery rate is 90%.

Sample collection: Collect 10L water from Xiaoqing River in the second and fourth quarter every year. Before collection, flush the cleaned container using Xiaoqing River water several times. After collection, add small amount of nitride Acid to prevent the adsorption of radioactive elements onto container.

Analytical methods: Samples are prepared according to HJ/T61-2001 technical criteria for radiation environmental monitoring;[1] Samples are measured according to EJ/T1075-1998 water quality-determination of gross alpha activity-thick source method,[2] and EJ/T900-94 Water quality-determination of gross beta activity-evaporation method.[3]

Quality control: In order to ensure the correctness of the analytical results, all instruments used are calibrated by Shandong Institute of Metrology and East China National Metrology Testing Center every two years. Instruments long-term and short-term stability tests are conducted every year. The instruments participated in the 2009-2010 National Radioactivity Measurement Comparison.

RESULTS

The gross α & gross β radioactivity levels of Xiaoqing River in 2008~2015 are listed in Table 1.

Table 1: Gross α & gross β radioactivity levels of Xiaoqing River in 2008~2015 (Bq/L).

Time period	Gross α	Gross β
Second Quarter 2008	0.03	0.11
Fourth Quarter 2008	0.04	0.16
Second Quarter 2009	0.03	0.19
Fourth Quarter 2009	0.05	0.22
Second Quarter 2010	0.06	0.23
Fourth Quarter 2010	0.17	0.12
Second Quarter 2011	0.03	0.09
Fourth Quarter 2011	0.06	0.12
Second Quarter 2012	0.04	0.17
Fourth Quarter 2012	0.04	0.13
Second Quarter 2013	0.03	0.15
Fourth Quarter 2013	0.03	0.14
Second Quarter 2014	0.05	0.12
Fourth Quarter 2014	0.05	0.13
Second Quarter 2015	0.05	0.10
Range	0.02~0.17	0.09~0.23
Average	0.05	0.15

Gross α radioactivity level

From Table 1, the gross α radioactivity concentration of the water in Xiaoqing River ranges from 0.02 to 0.17 Bq/L with an average value of 0.05 Bq/L, which is lower than the specified gross α radioactivity level limit of 0.5 Bq/L according to GB5749-2006 Standards for drinking water quality.[4]

Gross β radioactivity level

From Table 1, the gross β radioactivity concentration of the water in Xiaoqing River ranges from 0.09 to 0.23 Bq/L with an average value of 0.15 Bq/L, which is lower than the specified gross β radioactivity level limit of 1.0 Bq/L according to GB5749-2006 Standards for drinking water quality.[4]

DISCUSSION

The measured gross α and gross β radioactivity concentrations of the water in Xiaoqing River from 2008 to 2015 are lower than the specified gross α radioactivity level limit of 0.5 Bq/L and gross β radioactivity level limit of 1.0 Bq/L according to GB5749-2006 Standards for drinking water quality.[4] Therefore, this investigation of shows that the gross α & β radioactivity levels of the water in Xiaoqing River are within the normal background level range. The water in Xiaoqing River is not contaminated by artificial radioactive nuclides.

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Ethical approval: Not required

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