Short communication

The study of the elemental composition of snow and morbidity of the population in industrial cities of the Irkutsk Region

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ABSTRACT. This work presents the study of the elemental composition in the soluble fraction of snow from industrial cities of the Irkutsk Region (Angarsk, Irkutsk and Shelekhov). We detected tracer elements typical of snow in each of the cities. We also analysed morbidity in recent years and indicated the effect of air pollution on public health.

Keywords: snow, elemental composition, morbidity, Irkutsk Region

For several decades, some cities of the Irkutsk Region, including Angarsk, Irkutsk and Shelekhov, have been in the Priority List of the Russian cities with the highest air pollution. The List includes cities with a very high level of air pollution, which have air quality index of 14 or higher. This index characterises the level of chronic long-lasting air pollution. The share of the Irkutsk Region in air emissions is 10% of the total emissions from the Siberian Federal District and 3% of the emissions from Russia in general. Almost all industrial production, fossil fuel combustion, vehicles and other types of human activity lead to the anthropogenic dispersion of elements and heavy metals in the environment (Saet et al., 1990; Wiseman and Zerein, 2009).

Assessing the impact of environmental pollution on public health is one of the most relevant issues for environmental research. According to the World Health Organization (WHO), 91% of the world's population lives in areas where air quality exceeds permissible WHO pollution levels.

We studied snow in three cities of the Irkutsk Region (Angarsk, Irkutsk and Shelekhov) as a total air quality index. Long-term studies have revealed that the general trend in the distribution of elemental concentrations in the snow of these cities remains (Fig.). This characterises the common sources in the formation of the elemental composition of the snow in the cities, e.g. fuel combustion (primarily coal) and motor vehicles. However, some elements showed significant differences in concentrations.

The snow from Shelekhov had elevated concentrations of lithium, beryllium, aluminium, nickel, and antimony. The long-term average concentration of aluminium in Shelekhov was 5569 µg/dm³, which is an order of magnitude higher than the

concentrations in Angarsk of 570 µg/dm³ and Irkutsk of 108 µg/dm³. The high aluminium concentration in the snow from Shelekhov is due to atmospheric emissions from aluminium production. The snow from Angarsk had elevated concentrations of boron, chromium, manganese, iron, zinc, arsenic, selenium, strontium, molybdenum, cadmium, tungsten, and uranium. In Irkutsk, there were high concentrations of copper, barium, lead, and thorium. The high level of air pollution in the studied cities is one of the negative factors affecting public health (Table).

Angarsk is leading in the number of oncological diseases, and only in 2014, the incidence in Shelekhov was higher than in Angarsk. From 2010 to 2018, the malignancy rate increased by 18% in all studied cities. The incidence of cancer in the studied cities is higher by 30% than average in Russia. The petrochemical industry with high air emissions of a large number of pollutants is developed in Angarsk, which leads to a high malignancy rate. Aluminium and its compounds
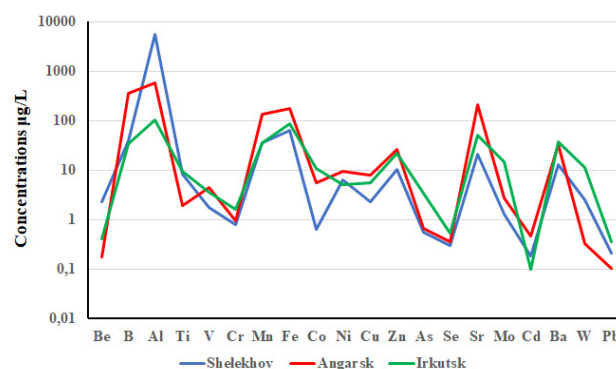

Fig. Elemental composition in the soluble fraction of snow from the cities of the Irkutsk Region in 2010-2018

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Table. Morbidity of the population in Irkutsk, Angarsk and Shelekhov in 2010-2018

City	Morbidity by disease categories per 100 thousand people								
	Malignant neoplasms								
	2010	2011	2012	2013	2014	2015	2016	2017	2018
Angarsk	**470.5**	**508.1**	**466.0**	**481.4**	476.1	**529.3**	**537.9**	**544.2**	**558.0**
Irkutsk	446.4	459.5	463.7	459.5	463.2	482.7	495.3	515.9	533.1
Shelekhov	422.7	433.8	381.4	388.4	**497.6**	513.4	500.9	498.3	522.7
	Rheumatism								
Angarsk	97.4	93.6	91.2	96.5	79.8	50.1	66.1	70.9	62.6
Irkutsk	141.7	153.0	156.2	160.5	103.6	96.3	195.7	200.1	191.4
Shelekhov	**255.2**	**168.5**	**210.0**	**221.1**	**295.1**	**177.3**	**258.2**	**246.1**	**253.1**
	Asthma								
Angarsk	1312.4	1189.6	**1374.7**	1283.1	1121.4	952.9	941.9	850.3	795.0
Irkutsk	**1793.0**	**1892.6**	1365.7	**2079.9**	**2122.9**	**2147.9**	**2141.4**	**2301.5**	**2283.5**
Shelekhov	976.9	1087.0	1222.1	1369.0	1488.2	1404.7	1528.8	1640.0	1541.1
	Diseases of the nervous system								
Angarsk	5415.1	5144.6	6263.3	6825.4	7358.6	7888.2	6419.7	6533.1	3990.3
Irkutsk	8005.6	8605.5	8719.3	9213.4	**10210.4**	**10450.6**	**10750.3**	**10976.9**	**10931.1**
Shelekhov	**8684.0**	**8583.8**	**15718.7**	**9342.8**	9615.4	3474.4	7002.6	6432.9	6108.8

are highly toxic compounds (toxicity class III), whose critical organs and systems are the central nervous system, the skeletal system and the respiratory system. One of the main signs of aluminium intoxication is a violation of the skeletal system (Shugaley et al., 2012). The incidence of rheumatism in Shelekhov is two times higher than in Angarsk in recent years and 1.2-1.3 times higher than Irkutsk. Until 2014, the cerebrovascular disease was high in Angarsk. After 2014, its high incidence is observed in Shelekhov. In Irkutsk, there is a high incidence of asthma and diseases of the nervous system.

Conclusion

Air pollution in the studied cities is one of the negative factors affecting public morbidity. The study of the elemental composition of snow revealed some toxic elements affecting public health. In all cities, there is a high malignancy rate, which is higher by 30% than in Russia as a whole.

References

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