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DISTRIBUTION OF CARBON MONIXIDE IN ALMATY CITY DEPENDING ON THE DISTANCE FROM THERMAL POWER PLANTS - 2

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ABSTRACT: *In recent years, according to experts, the emissions change clearly shows that urban air pollution has increased as a whole, as opposed to an overall emissions reduction in countries. In hundreds of cities of the world average air pollution levels exceed the sanitary standards. So in Almaty city thermal power plants are the largest stationary sources that contribute to air pollution.*

The article deals with laws of modern spatial and temporal distribution of carbon monoxide in the air basin of Almaty city, depending on the distance from TPP – 2 (thermal power plants). In particular, research shows that there is a direct relationship between the level of air pollution and wind conditions of the city.

KEYWORDS: *air basin, pollution sources, pollutants, the level and extent of contamination, оксидуглерода.*

Introduction

APC energy sources (TPP-1, TPP-2 and boiler rooms of APC) provide about 70% of the heat consumption in Almaty, but they contribute most to air pollution among available stationary sources. A significant impact on the overall air pollution emissions is caused by thermal power complex TPP-2, located near the western border of Almaty city.

Until recently, the main fuel source was the Ekibastuz coal with an ash content of 34.4 percent. According to statistics at total emissions of 39.5 thousand tons / year up to 15642 tons / year of pollutants are transferred into the city with winds of northern and western direction, which exceeds the amount of emissions from stationary sources of thermal power plant and industry, located directly on the urban area [1].

While usual combustion is incomplete, the combustion of solid fuel in TPP boilers creates a large amount of ash, carcinogens, which according to A. Stepanovskikh pollute the environment and affect all components of nature [7].

Methodology

The object of study is the state of air pollution in Almaty city by pollutant such as carbon monoxide. The main research methods were physical-statistical, comparative - analytical, mathematical processing of empirical data.

As the initial data we used meteorological materials, data on air pollution in Almaty during years 2010 -2013and data from automatic monitoring stations № 5 and 29.

Results and Discussion

Monitoring the air quality was conducted mainly in two stationary posts, the data was received by ground-based automated posts, [4] distant from the main subject of pollution TPP-2. Namely we used post № 5, located in the south-east of TPP-2 at a distance of 13km and post № 29, located in the north - east direction from the source of pollution at approximately the same distance as the post № 5.

Posts were chosen on the basis of distance from the TPP-2 and patterns of wind regime in the direction of the city center and to the north. In accordance with Table 1 we can see the following pattern of harmful impurities' distribution in the surface layer of the atmosphere with increasing distance from TPP-2.

Table 1.Observations of carbon monoxide concentration produced by ground-based automated posts for years 2010, 2013.

Research period	Post number	Average concentration		Maximal concentration	
		mg/m^3	Value in excess of MAC	mg/m^3	Value in excess of MAC
winter - 2010	5	0.459	0.2	6.161	1.2
	29	2.148	0.7	19.09	3.8
summer - 2010	5	0.30	0.10	6.9	0.0
	29	1.495	0.5	7.01	1.4
Total in2010	5	2.333	0.78	28.994	5.8
	29	7.857	2.6	59.209	11.8
winter - 2013	5	0.30	0.10	2.56	0.5
	29	1.4	0.5	3.9	0.8
summer - 2013	5	0.5	0.2	1.1	0.2
	29	0.2	0.1	2.4	0.5
Total in 2013	5	0.3	0.1	2.6	0.5
	29	0.9	0.3	8.3	1.7

We can see that post № 29, located 13 km from the power plant is subject to greater pollution in terms of 2010. The annual level of atmospheric pollution by carbon monoxide exceeds the MAC by 2.6 times and is 7.857 mg / m^3, while the post №5 located at the same distance from the source, but only in a south-

eastern direction has mean concentration of 2.333 mg / m^3, which exceed the MPC only 0.78 times.

Particularly appreciable is difference between the level of air pollution in the posts, as maximal one time concentrations. So at the post №29 the maximum single concentrations can reach up to 11.8 times exceeding MPC, while at post №5 they make up 5.8 MAC. Quite a different picture emerges in 2013, where the concentration of carbon dioxide is much lower. This can be explained by the fact that the program for reducing emissions from TPP - 2, has been launched after partial reconstruction of the power plant and change of its technological characteristics, which explains a steady decline in emissions. Thus, according to the statistics, TPP-2 last year completely run on gas and its emissions amounted to 3000 tons, instead of 6000, emitted when working with liquid fuels [5].

If we consider the level of pollution in the city at the posts by seasons, it can be seen that the level of contamination is much lower in summer, when the heating season ends. But the difference between the posts 5 and 29 is quite high at any season of the year. This regularity in the distribution of the level of contamination at two positions can be explained by the following reasons.Firstly it is the wind pattern of the city and the wind speed at different seasons of the year. Many authors use long-term statistical data for the construction of different models [8].

Aldabergenov S. revealed that throughout the year in Almaty prevailing wind speeds are up to 2 m / s (88% of cases). Strong winds (15 m / s or more) in Almaty arerarely observed, and in average they occur 15 days per year [3]. In winter, according to H. Ahmetzhanov strong wind occurs 1-3 days in 10 years, in summer for 2-3 days each year, mostly in the afternoon, and often has the character of squalls, accompanied by dust storms [2].

If we take into consideration the wind conditions we can see the prevalence of winds of north-west and west directions but this prevalence is not significant from the total number of all directions (Fig. 1, 2). These statements were made by the author and were processed over a five year period (2007 - 2011).

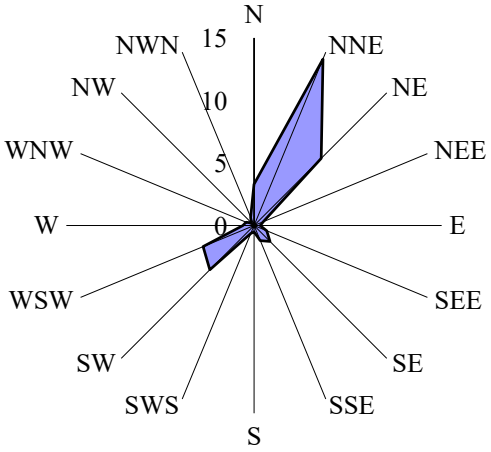

Figure 1 - Windrose in January in Almaty during the study period

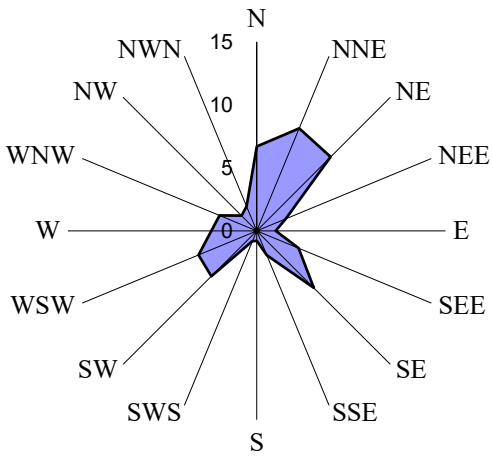

Figure 2 - Windrose in July in Almaty during the study period

The repeatability number of winds of the north-western direction is somewhat less that is why the post №5 located in the south-east of the TPP-2 accounts for less than major pollutants. Winds of south -western direction occur more often as a percentage and they are responsible for bringing pollution into the northern part of the city.

According to SchwerTs. the stagnant air conditions in the northern parts of the city account for high contamination potential, characterized by high occurrence of elevated and ground inversions at low wind speeds less than 0-1 m / s [6].

The reason for such a feature in distribution of surface inversions occurrence is greater nighttime cooling of the earth's surface, since the northern part of the city is much lower than the southern by the altitude above the sea level.

Conclusion

All research posts have exceeded MAC by carbon monoxide. Mainly polluted are northern parts of the city, where occurs the high potential for the accumulation of impurities in the surface layer of air, as a result of special climatic characteristics, i.e., wind conditions, opportunities for relocation and dispersion of impurities, repeatability of surface and elevated inversions at a wind speed of 0-1 m / s. As you can see, the level of air pollution with carbon monoxide, under the torch and under adverse weather conditions in winter increase appreciably.

Reducing the environmental stress from power plant complex of the city may be achieved by using more environmentally friendly fuel, such as natural gas.

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