

## DYNAMICS OF POLLUTANTS AND GREENHOUSE GASES IN THE ATMOSPHERE OF ZHYTOMYR REGION

In recent years concerns about man's effect on environment have gathered pace. Air protection is one of the most pressing problems in the world. Air pollution poses major threats—climate change as a result of global warming, ozone depletion, poor air quality, damage from acid rain. Concern about atmospheric pollution around the world has led to increasingly stringent legislation to protect both human health and the environment. Ukraine also has developed policies and regulations to protect the environment against air pollution from industry and other sources. In 1992, Ukraine adopted the Law "On Protection of Atmospheric Air", which provides for protection measures to reduce air pollution. The level of contaminants in air must be continuously measured and monitored. In the course of our study we use reporting data from the Zhytomyr Region Statistical Yearbook.

The purpose of our investigation was to determine the dynamics of pollutants and greenhouse gases emissions into the atmosphere as well as to estimate the effectiveness of air protection measures in the Zhytomyr region. To realize the objectives of the study we set the following tasks: to analyze statistical data from 1990 to 2013; to identify the main pollutants of the atmosphere and the most polluted areas in the Zhytomyr region; to establish the main sources of air pollution; to investigate the effectiveness of air protection measures.

In our research we analyzed statistical data obtained in 1990–2013 years. The data covered emissions from various sources: industrial enterprises emissions from 1990 to 2000; industrial enterprises and motor vehicles emissions from 2000 to 2005; emissions from industrial enterprises, vehicles, aircraft, railway and water transport from 2005 to 2010; emissions from industrial enterprises, vehicles, aircraft, railway and water transport, as well as production equipment emissions from 2010 to 2013.

During this period a general reduction in emissions of air pollutants was observed. There was, however, a slight increase between 2005 and 2010 followed by a steady reduction in pollutants emissions into the atmosphere.

Among pollutants under study are carbon dioxide and methane, identified as the major greenhouse gases. Due to the growing amounts of these gases in the atmosphere, they become the culprits of the greenhouse effect, heating up the earth at the increasing rate. The table below shows the yearly increases of these pollutants in the atmosphere of the Zhytomyr region.

*Dynamics of immisions and carbon dioxide*

Immisions	Volumes of emissions per year (tons)					
	1990	2000	2010	2011	2012	2013
Total amount (thousand tons)	277259	61824	87492	86808	85736	85123
Sulphur dioxide	28260	2659	2084	2186	2299	2838
Nitrogen dioxide	4970	5374	16765	17245	17961	19102
Nitric oxide	...	...	191	177	166	157
Carbonmon oxide	15778	43367	105242	102246	101186	115514
Methane	2014	7267	10484	10983	10611	9785
Non-methane volatile organic compounds	2138	469	16391	15897	15443	15192
Soot	...	478	1831	1962	2072	2123
Carbon dioxide	...	...	159650	156120	164350	166000

We can see that the concentration of carbon dioxide in the atmosphere rose dramatically between 2005 and 2013 when it reached one hundred and sixty thousand tons. Now the amount of its emissions is constantly increasing and accumulating in the atmosphere contributing to the greenhouse effect.

The largest stationary sources of carbon dioxide emissions in the Zhytomyr region are companies distributing electric power, gas and water supply. In 2012, they emitted 328,784 tons of carbon dioxide into the atmosphere of the region. Next come processing industries, especially processing enterprises manufacturing non-metallic mineral products such as building materials, glassware, etc. The largest emissions of carbon dioxide are observed in Zhytomyr and Novograd-Volynsk. The major sources of carbon dioxide emissions are ME «Zhytomyr teplokomunenergo» (111,4 thousand tons that is 23,1 % of the total regional volume), Berdychiv Subsidiary Company of «Kyiv-transgaz» (87 thousand tons that is 18,1 % of total regional volume), LLC «Tseranit-Invest» (36 thousand tons that is 7,5 % of the total regional volume), Korosten Utility (26 thousand tons that is 5,4 % of the total regional volume), ME «Berdychivteplokomunenergo» (21,7 thousand tons that is 4,5 % of the total regional volume).

The most widespread air pollutant is carbon monoxide CO, a very toxic gas. The amounts of its emissions are constantly increasing and accumulating in the air. The sources of carbon monoxide pollution are emissions from motor vehicles, power plants and ferrous metallurgy.

According to the Statistical Yearbook of the Zhytomyr Region in 2012 21 % of all air pollutants came into the atmosphere from stationary pollution sources and 79 % were released by mobile sources. The most polluted areas in our region are located in the Ovruch district and in Zhytomyr (due to heavy traffic and industrial emissions). In the Ovruch district there are eighteen industrial enterprises. The biggest of them are JSC GZK QUARTZITE, JSC «Ovruch Dairy Plant» and the Crushed Stone Plant.

In 2013, the largest sources of pollution in the region were: Berdychiv Subsidiary Company of «Kyiv-transgaz» (amount of its emissions was 3800,2 tons, i.e. 29,5 % of the total region volume); Novograd-Volynsk Subsidiary Company of «Lviv-transgaz» (amount of its emissions was 3706,1 tons, i.e. 28,8 % of the total volume); JSC «Korosten Plant MDF» (amount of its emissions was 599,4 tons, i.e. 4,7 % of the total volume); Zhytomyr Subsidiary Company of LLC «OBIO» (amount of its emissions was 303,4 tons, i.e. 2,4 % of the total region volume); «Irshansk GZK» of PC «Krymtitan» (amount of its emissions was 234,1 tons, i.e. 1,8 % of the total volume).

Since 2012, a number of measures have been taken to improve the air quality in the region. They involved improvement in technological processes, construction and introduction of modern gas purifying installations and facilities, modernization and reconstruction of the available equipment, liquidation of all pollution sources. To implement these tasks about three million hryvnias were invested in this programme. These measures resulted in a significant reduction in air pollutants in the Zhytomyr region.

We can conclude that there was a steady reduction in air pollution from 1990 to 2013. According to our calculations since 1990 there has been a threefold decrease in the volume of air pollutants in the region.