Defining the rate of air emissions fee

M P Ivanova\(^1\) and T O Tagaeva\(^2\)

\(^1\) National Research Tomsk Polytechnic University, Tomsk, Russia
\(^2\) Novosibirsk State University, Novosibirsk, Russia

E-mail: margo-sea@yandex.ru, to-tagaeva@rambler.ru

Abstract. Industrial production disturbs the balance of an already delicate environment, and there is a negative impact on the microclimate in the area that is imposed due to cross-regional pollution. The essence of the problem is the movement of hazardous air pollutants throughout the atmosphere over long distances, and the issue of government control over the air emissions acquires cross-regional significance. Additionally, particular attention should be paid to the question of payment for air emissions. Today, the economic instruments to reduce the negative environmental impact and to ensure compliance with the environmental regulations are only partially applied. All mentioned above underline the need for consideration of the given problem, which can be solved by the additional method. Therefore, the authors of the present paper suggest a method to define the rate of air emissions fee (currently there are no rates applied). Besides, it should be stressed that this method would allow for effective calculation of payments for harmful pollutant discharge into air. The research outcomes can be used to further develop environmental regulations.

1. Introduction

The issues of sustainable natural resource management and environmental protection remain urgent at national and global levels, and air protection is not an exception. However, the negative environmental impact is still imposed in the course of natural resource exploitation. For example, particular technological processes cause hazardous air emissions [1, 2].

The quality of air is deteriorating in many regions of the Russian Federation; therefore, national environmental agencies control the situation. Thus, in Tomsk air emissions are continuously observed and recorded. The results of this research are disseminated in annual reports “Environmental Conditions and Protection in Tomsk Oblast…”

In these reports, there is information about the state and quality of the environment in Tomsk Oblast (pollutant discharges in terms of industries; hazardous substance concentration in the air; information on air monitoring stations; pollutant emission from vehicles; total volumes of hazardous substance emission into the atmosphere, etc.).

Although over the past five years the total volumes of hazardous substance emissions from the stationary sources decrease in Tomsk Oblast (in 2015 – 293.081 thousand tons, and in 2019 – 129.32 thousand tons), the decrease occurs gradually. In some years, there was an increase in emissions (in 2015 – up to 293.081 thousand tons, and in 2016 – 301.36 thousand tons). Furthermore, vehicle emission grows (in 2015 – 127.268 thousand tons, and in 2019 – 129.32 thousand tons), whereas some emissions were insignificant (in 2017 – 228.29 thousand tons, and in 2016 – 153.126 thousand tons).
Moreover, the overall composition (sulfur dioxide, hydrogen oxide, NOx, solids, and CH) of pollutant emissions from vehicles have increased in Tomsk Oblast over the past five years:

- emissions of NOx have increased from 35,936 thousand tons to 37771 thousand tons,
- emissions of CH have increased from 15,506 thousand tons to almost 15,953 thousand tons,
- solid emissions have increased from 0.985 thousand tons to 1.001 thousand tonnes.

Carbon oxide emissions generally did not change, but in some years, there was their growth (in 2016 – 120.87 thousand tons, and in 2017 – 108.235 thousand tons).

Based on the material presented in the environmental state reports of Tomsk Oblast, the monitoring is performed at seven stations of Government Environmental Monitoring and Complex Laboratory of Environmental Pollution Monitoring (Tomsk Center of Hydrometeorology and Environmental Monitoring [3-7]).

These stations are classified in terms of their location [3-7]:

- “industrial”, located in the vicinity of large emission accumulations in all districts of the Tomsk city (stations Nos 5, 11, 13) and station No 12 located in the Svetly settlement;
- “auto” (station No 2 and station No 15), located in the vicinity of highways and regions with heavy traffic;
- “urban background” (station No 14), located in the residential area of Oktyabrskiy District of the Tomsk city.

During the research, air composition monitoring is performed for 13 substances [3-7]: hydrogen chloride (HCl), methyl alcohol (CH₃OH), dust, carbon oxide (CO), nitrogen oxide (NO), hydrogen sulfide (HS), benzpyrene (C₂₀H₁₂), sulfur dioxide (SO₂), hydroxybenzene (C₆H₅OH), hydrogen nitrite (NH₃), formaldehyde (HCHO), soot, nitrogen dioxide (NO₂).

During such observations, the exceedance of the maximum permissible concentration (MPC) of hazardous air pollutants is assessed.

According to the data provided in the documents [3-7], over the past five years, there has been an exceedance of the MPC for HAPs (figure 1) from both stationary and mobile sources of emissions. The graph shows the increased annual average concentrations of the following pollutants:

- from 0.104 MPC to 0.6 MPC for suspended substances (SS);
- from 0.014 MPC to 0.8 MPC for formaldehyde (HCHO) (in 2017 increased to 1.5 MPC);
- from 0.045 MPC to 0.7 MPC for nitrogen dioxide (NO₂);
- from 0.063MPC to 0.8 MPC for hydrogen chloride (HCl).

The annual average concentration of phenol (C₆H₅OH) has reduced by a factor of five (though in 2015 there was an increase to 1.1 MPC), and the annual average concentration of methanol (CH₃OH) has decreased by a factor of three (however, in 2016 and 2017 there were increases to 1.1 MPC).

Figure 1. Hazardous air emissions over the period from 2015 to 2019.
Air is obviously one of the essential components in the environment; therefore, minimizing hazardous air emissions is one of the main protection instruments.

Due to anthropogenic impact on the environment, pollutants are emitted into the atmosphere, and after that, they are settled on buildings and water sources. In this case, weather conditions have a direct effect on the level of atmospheric pollution because there is a global migration of these hazardous substances over large distances. Therefore, the problem of air pollution is transboundary [1]. An adequate methodology to define the rate of air emissions fee and the rates appropriately applied can resolve this problem [8].

2. Models and methods
To improve the system of payment for the negative environmental impact, the methods of comparison, analysis and generalization were used in the study. The statistical data was obtained from the regulatory documents and health-based exposure limits developed for environmental protection.

The equation to calculate the rates of air emission fee was used as a model, which allows defining the rates without significant expenses and taking into account MPCs of hazardous substances.

3. Results and discussion
It is common knowledge that the concept of payment for the negative environmental impact is one of the financial instruments to ensure optimal natural resource management. Therefore, there is a direct correlation between the careful development of the above-mentioned concept and the quality of the environment in general. Above all, the attention to this issue is due to fact that quality of the environment is not possible to consider in a simple way: on the one hand, characteristics and composition of air should be taken into account; on the other hand, it is necessary to analyze the existing standards of its quality.

To standardize the components of air, Hygienic Standards 2.1.6.3492-17 “Maximum Permissible Concentrations of Pollutants in the Atmosphere of Urban and Rural Areas” (with recent amendments of 31 May 2018) are used [9]. These standards reflect the maximum permissible concentrations of chemicals and their compounds in the environment in general, which over the long term and daily exposure do not have a negative effect on the human body.

To charge payments for negative impact on the environment, namely, pollutant discharge into the air by stationary sources, the Resolution of the Government of the RF [10] “On Payment Rates for Negative Impact on the Environment and Additional Coefficients (with recent amendments of 24 January 2020) is used.

Having looked through the regulatory documents and health-based exposure limits in terms of MPCs for hazardous air pollutants, we have identified some controversies. For example, according to the Resolution of the Government of the RF dated 13 September 2016 No 913 “On the rates of fees for the negative environmental impact and additional coefficients” [10], it is impossible to define the rates of fees for some pollutants because, in this document, there are only 159 air pollutants. However, according to the hygienic normative standards [9], MPCs are given for 658 pollutants. Hence, the normative instruments in the sphere of payments for negative consequences of air pollution do not regulate payment rates for the discharge of pollutants into atmosphere with regard to almost eighty per cent of potentially hazardous substances.

Consequently, we suggest considering a supplementary method to define the rate of air emissions fee, taking into account MPC, which indicates the actual environmental threat.

To develop the method, we considered maximum one-time MPCs [9] for hazardous air pollutants detected in cities and countryside [10] as well as fee rates for more than 50 pollutants produced by stationary sources. The linear graph fails to provide a clear visual aid; therefore, the figure below shows the common logarithms of the correspondent values (figure 2).

Figure 3 illustrates the correlation between the available data on fee rates and maximum concentrations allowed for emissions of air pollutants.
We experimentally deduced the formula that is most perfectly corresponds to MPC values and fee rates per 1 ton of pollutants established by the legislation.

The following function describes the line in figure 3:

\[
\lg Y = -0.8369 \times \lg X + 1.3324, 
\]

where \( Y \) – fee rate per 1 ton of air pollutants; \( X \) – maximum one-time MPC of pollutants.

According to formula 1, the equation to calculate the non-existing fee rate for emissions of air pollutants is as follows:

\[
Y = 10^{1.3324 - 0.8369 \times \lg X},
\]

where \( Y \) – maximum fee rate per 1 ton of air pollutants, \( X \) – maximum one-time MPC of pollutants.

The equation was obtained using the regression analysis of the existing emission fee rates and maximum allowable concentrations. It allows defining the fee rates for the pollutants which are not registered in the legal and regulatory documents.

4. Conclusion

The analytical study of the statistical data obtained from legal and regulatory documents has revealed some discrepancies between the presented data and the opportunity to calculate a fee rate for adverse environmental effects resulted from harmful emissions into the air. Values of payment rates for pollutant discharge into the air from stationary sources are four times lower than the values recorded in the existing hygienic standards in terms of maximum permissible concentrations of pollutants in the air of urban and rural areas).

Defining specific features of MPC and payments for a negative impact on the environment is the foundation for developing all research aspects. Based on the conducted study, we have proposed a supplementary technique to calculate the fee rate for emissions of air pollutants. It relies on the linear equation that includes MPC for pollutants in the air. The equation allows assessing the cost of air pollutant in a simple and rapid way.

The use of the proposed method would contribute to eliminating the drawbacks of environmental protection management.
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