

Monitoring of atmospheric air pollution in the samarkand region under the influence of vehicles

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Abstract. This article examines the influence of road transport on air pollution in the city of Samarkand, Republic of Uzbekistan. Based on the results of an analysis of the city map, five streets were identified with the largest number of vehicles. As part of the study, the volumes of emissions of harmful gases emitted by vehicles were measured, for this purpose 2 stationary and 2 mobile environmental control posts were used. Based on the results of measurements, it was revealed that road transport accounts for about 30.7 percent of the volume of emissions of pollutants into the air from all emissions in the city of Samarkand. Based on the results of the studies, appropriate conclusions were drawn and recommendations were made to reduce the impact of road transport on the city's environment.

1 Introduction

To this day and now, the number and scale of man-made and anthropogenic objects that actively pollute the environment are increasing over time. Especially, based on the concentration of pollutants emitted into the atmosphere by the flow of vehicles moving along the internal roads of large cities, determining the optimal values for the number of pollution sources and the amount of waste they contain per unit specific length of roads is one of the urgent problems.

2 Literature review

In the Republic of Uzbekistan, a lot is being done to solve the environmental crisis and prevent it. The first president of our republic, I.A. Karimov, in his book "Uzbekistan on the threshold of the 21st century, security threats, conditions of stability and guarantees of development" studied environmental problems in our republic and wrote that it is not too late to prevent them. In his work, he mentioned that the level of air pollution in the regions and large cities - Tashkent, Samarkand and Namangan is in the first place, and indicated various recommendations for its reduction [1].

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A. Tokhtaev expressed his opinion on a comprehensive study of the level of air pollution. He clearly described the toxic gases emitted by gasoline and diesel vehicles. It is argued that the main sources of atmospheric air pollution from motor vehicles are CO₂ gases, hydrocarbons, nitrogen oxides, aldehydes, ketones, lead elements, etc., which in most cases are harmful from a hygienic point of view. It has been studied that toxic gases emitted from a vehicle into the atmosphere correspond to photochemical changes under metrological conditions [9].

Nitrogen dioxide breaks down, turns into nitric oxide, and eventually turns into atomic oxygen. Aldehydes and ketones lead to the formation of radicals. The content of lead compounds in emissions from internal combustion engines ranges from 1-2 mg to 4-6 mg per 1 m³ of atmospheric air. Air pollution varies depending on the operating mode of transport. The literature indicates the amount of lead in 1 m³ of air: in the regions it is 0.1–0.5 µg, and in large cities and towns this amount reaches from 1 µg to 5 µg [10]. It is known that there is a peculiar organic relationship between toxic lead and carcinogenic substances; an increase in the amount of one of them shows that it depends on an increase in the other.

Theoretical knowledge about environmental research methods is presented in the book by A. Ergashev [6]. R. Egamberdiev, R. Eshchanov described the influence of the atmosphere and sources of pollution on climate, soil, water and the living world [7]. A. Rakhmatullaev and A. Rakhmatullaev, Kh. Khusainov, M. Rakhmatullaeva in their dissertations “Ecological state of the air of the city of Samarkand” and “Ecological state of the city of Samarkand” stated that cars emit about 70%-80% of harmful gases into the air of the city of Samarkand. According to the state traffic inspectorate, it was noted that in 1997 there were more than 75,000 private cars, and more than 100,000 together with government cars [8].

Researchers took air samples twice at four operating stations to determine the composition of atmospheric air and found that in 1996 the amount of CO in city air exceeded the maximum permissible concentration by 1.5-2.0 times, and on the streets - by 3.0-3.5 times, NO -1.5-1.8, formaldehyde -1.6-2.

To reduce emissions, they proposed the following:

- Use of gas fuel for cars.
- Planting a large number of plants, reducing the traffic load in densely populated areas, increasing the number of non-intersecting roads [5]. T.D. Jumaboev pointed out that in the city of Samarkand, pollution from motor vehicles is more than 70%, and pollution will be relatively reduced if cars switch to running on gas in order to reduce vehicle emissions [11]. The amount of CO₂ and NO₂ gases was lower in summer at 8 a.m. compared to 4 p.m., which was caused by the wind blowing in the morning. At a wind speed of 2.5 m/sec, the pollution level was 2 times lower [5].

Road transport is the most dangerous of all artificial sources of air pollution. There were 11,000 cars in the world in 1900, 48 million in 1950, 181 million in 1970, 330 million in 1982, and now 500 million. They burn hundreds of millions of tons of non-renewable petroleum products. Car exhaust contains about 280 harmful components. Road transport is becoming one of the main sources of environmental pollution. In a number of foreign countries (France, USA, Germany) road transport results in more than 50-60% of air pollution.

It is known that any large city consists of a number of highways and a number of main and secondary roads adjacent to it and branching off from it. In accordance with the geographical position of the city, roads and streets connecting all its districts can be located in any direction relative to the cardinal points. The migration of pollutants emitted by vehicles from one road section to another mainly depends on geographical, climatic and meteorological conditions and can have different values over a certain period of time. As a result of a thorough study of the internal traffic flow map of the city of Samarkand, there

are five main branches with very active traffic and another eleven auxiliary roads leading to these main roads, a total of ten six road sections were selected. as objects of study. The solution of the problem is solved by determining the amount of pollutants emitted from sources on each section of the road that do not exceed the permissible concentration limit of pollutants in the atmospheric air. The amount of pollutants on each section of the road is assumed to be mi. The upper permissible limit of the concentration of pollutants is determined by the state standard. So, regardless of the amount of pollutants, at a certain time, gaseous emissions emitted from polluting sources of vehicles moving along all sections of roads are completely absorbed and added to the atmospheric air.

3 Materials and methods

In 2021-2023, together with traffic police officers and employees of the environmental committee, we marked various points on the busiest streets of the city of Samarkand to monitor air quality. We monitored the level of atmospheric air pollution with gases, mainly CO, from various passing vehicles, counted the number of cars on busy streets, and measured the percentage of CO, CH₄, CO₂, O₂ gases emitted by cars using ecolab and infracap gas analyzers. The work was carried out according to the following plan.

- Determining the level of air pollution on a street with a large number of cars and its intersections;
- Work was carried out to determine gases and substances emitted into the atmosphere by moving vehicles in the city of Samarkand, and an assessment of the level of pollution was carried out.

Together with the environmental pollution monitoring department, we conducted studies taken from 603 points at 291 enterprises; in total, 1307 emissions analyzes were made, mainly carbon oxides, nitrogen oxides, and dust. As a result of our analyses, we have not identified a single enterprise that emits waste that exceeds the MPC norm.

Work to monitor the amount of harmful gases and smoke emitted by moving vehicles in the region was carried out jointly with the regional Ministry of Internal Affairs and the regional road safety department. During the I-II stages of the “Clean Air” campaign, harmful gases and smoke emitted by vehicles were checked. The regional department of ecology and environmental protection, the regional department of internal affairs, the regional department of sanitary-epidemiological service and health care jointly organized the “Clean Air” campaign, which was carried out in two stages: the first was held from April 10 to May 10, 2023, and the second stage - from August 10 to September 10, 2023

In total, during the I-II stage of the “Clean Air” campaign, 33,099 vehicles were checked at two stationary and two mobile environmental checkpoints on the roads of the region in cooperation with employees of the Ministry of Internal Affairs and the State Traffic Inspectorate, of which 552 vehicles were found to have excess levels of harmful substances emissions in excess of the established standard. 7,597 vehicles were checked on the roads with stationary sensors.

At the entrances and exits of automobile enterprises, 25,502 vehicles were inspected, of which 335 vehicles were found to have excess pollution in excess of the established standard. During the I-II stages of the action, an administrative fine in the amount of 78,705,000 soums was collected from 552 citizens. During the I-II stages of the “Clean Air” campaign, as a result of converting 204 vehicles to liquefied natural gas and 201 to compressed natural gas, emissions of harmful substances into the atmosphere were reduced by 69.19 tons.

Two factors have an effective influence on the migration and distribution of pollutants in the atmosphere. 1. Natural factors: characteristics of the periodic mode of natural air circulation; repeated repetition of this mode; vertical air resistance; repetition of the period

of stagnation of air; fog duration; thermal stability of the atmosphere; the level of humidity in the air. 2. Artificial, that is, man-made factors: the volume and rate of release of harmful substances; the level of technogenic territories; the size of the zone of distribution of hazardous waste. But in internal combustion engines, an ideal chemical reaction does not occur in real processes associated with the combustion of organic substances. Because, firstly, the fuel-air mixture burns out more slowly, and secondly, due to the presence of various additives and natural components in the composition of fuel and motor oils and in the atmospheric air, harmful substances are synthesized in the composition of combustion products.

4 Results and Discussion

There are 1097 enterprises and organizations in the Samarkand region that have an impact on the atmospheric air and are under control, of which 734 enterprises are transport enterprises. There are 266 motor transport enterprises, 250 car repair shops, 355 gas stations, of which 32 belong to category I of environmental impact (high level of danger), 167 belong to category II of environmental impact (medium level of danger), 898 belong to category III (low level of danger) and 10 are category IV (local effects).

The main part (89%) of pollutants emitted into the atmosphere without purification are gaseous substances: sulfur oxides, carbon oxides, nitrogen oxides, hydrocarbons and VOCs. The rest (11%) were solid particles (dust..., soot, etc.) formed during the production process.

Based on moving sources, work to check the amount of harmful gases and smoke emitted by vehicles in the region was carried out jointly with the Ministry of Internal Affairs and Communications of the region. Checks of harmful gases and smoke from vehicles were carried out during the I-II stages of the "Clean Air" campaign.

Department of Ecology and Environmental Protection, Regional Department of Road Safety ATC, employees of the Regional Department of Sanitary and Epidemiological Safety and Public Health, in cooperation with Stage I from April 10 to May 10 and Stage II from August 10 to September 10 this year in our region "Clean Air" campaign was carried out.

In total, during the I-II stages of the "Clean Air" campaign, 32656 vehicles were inspected on the roads of the region at 2 stationary and 2 mobile environmental control posts, together with employees of the Traffic Safety Department of the Internal Affairs Directorate, of which 548 vehicles did not meet the established standard. Of these, 7593 vehicles were checked on the roads and stationary posts. 25063 vehicles were inspected at the entrance and exit from the automobile enterprise, 333 vehicles exceeded the established norm. At stages I-II, administrative fines in the amount of 7130000 soums were applied to 548 citizens. As a result of the conversion of 193 vehicles to liquefied natural gas and 139 to compressed natural gas, 57.96 tons of harmful gases were emitted into the atmosphere during stages I-II of the "Clean Air" campaign (Table 1).

Table 1. Information about enterprises and organizations that affect the atmospheric air and are under control.

No.	Name	Number of enterprises and organizations	Note
	TOTAL	1097	
	including:	363	
	Manufacturing enterprises and organizations	363	
1.	Chemical industry	3	
2.	Oil and gas industry	4	
3.	Energy industry	3	
4.	Construction industry	75	
5.	Engineering industry	3	
5.1.	Metallurgical industry	4	
6.	Enterprises owned by "Uzbekistan Temir Yollari" JSC.	6	
7.	Food industry	43	
8.	Cotton industry	12	
9.	Light industry	52	
10.	Airports	1	
	including:	734	
	Transport companies	734	
1.	Motor transport companies	109	
2.	car repair plants	157	
3.		0	
4.	Car service branches	10	
5.		250	
6.	Petrol stations for cars	0	
7.	Gas stations for cars	355	

According to the regional department of ecology and environmental protection, the total number of cars in the Samarkand region is 370590 units, of which 303436 cars run on gas, 31422 cars run on diesel fuel and 35732 cars run on gasoline. The transition of vehicles from gasoline fuel to gas fuel is the most important within the framework of ongoing measures to reduce the amount of gases and emissions emitted by vehicles into the atmosphere of the Samarkand region (Table 2).

Table 2. Information about the vehicles used.

Name	Total	In the private sector	In the public sector
Petrol	35732	25536	10196
of which:			
Buses	138	0	138
Trucks	1105	33	1072
Cars	34489	25503	8986
Diesel fuel	31422	28379	3043
of which:			
Buses	1360	187	1173
Trucks	7408	5624	1784
Cars	22654	22568	86
Gas fuel	303436	290555	12881
of which:			
Buses	2147	721	1426
Trucks	20302	14319	5983
Cars	280987	275515	5472
Total:	370590	344470	26120

Analyzing the data presented in the above table, the amount of harmful substances emitted into the atmosphere from transport and industry was the highest in Samarkand. Emissions of harmful substances from vehicles amounted to 20,323 thousand/t.

In the following places, Pastdargom, Samarkand and Urgut regions, Kushrabit region suffered the least, that is, 1.18 thousand /t. For industrial enterprises, the Narpay region amounted to 17,328, as well as the city of Samarkand, 15,878 thousand / t. The lowest limit is 0.096 thousand/t in the Payaryk region. From this we can conclude that the city of Samarkand is polluted by 30.7%, given that the damage both on a transport and industrial scale is 36,201 thousand / t. (Table 3).

Table 3. The amount of harmful substances emitted into the atmosphere (on the scale of cities and regions) (thousand/tons).

s/n	Number of cities and districts	Year prior to reporting year			Reporting year		
		tran-sport	industry	total	tran-sport	industry	total
1	Samarkand city	20.323	15.878	36.201	20.415	15.827	36.242
2	Dzhambay region	4.45	0.561	5.011	4.53	0.358	4.888
3	Taylyak region	4.458	0.503	4.961	4.411	0.497	4.908
4	Samarkand region	5.683	0.477	6.16	5.661	0.471	6.132
5	Nurabad region	1.636	0.571	2.207	1.631	0.569	2.2
6	Urgut region	5.192	0.605	5.797	5.176	0.621	5.797
7	Pastdargam region	6.02	1.683	7.703	6.108	1.685	7.793
8	Kattakurgan region	3.908	0.34	4.248	3.911	0.338	4.249
9	Narpay region	3.125	17.328	23.08	3.126	17.325	23.08
10	Pakhtachi region	2.765	0.542	3.307	2.766	0.544	3.31
11	Kushrabit region	1.18	0.216	1.396	1.181	0.214	1.395
12	Payaryk region	5.65	0.096	5.746	5.652	0.116	5.768
13	Ishtykhan region	2.956	0.136	3.092	2.957	0.144	3.101
14	Akdarya region	2.842	0.325	3.167	2.843	0.328	3.171
15	Bulungur region	3.532	0.293	3.825	3.533	0.291	3.824
16	Kattakurgan city	3.96	0.338	4.298	3.961	0.341	4.302
	Total	77.68	39.892	117.572	77.862	39.669	117.531

*until the 20 th with the end of each event

In the Samarkand region in 2020, in cooperation with the State Committee for Ecology, the Ministry of Internal Affairs and the Ministry of Health, during the “Clean Air” campaign, a total of 32656 vehicles were inspected and the number of vehicles was temporarily stopped until they were brought to the established regulatory requirements, there were 548 of them, and imposed on drivers fines amounted to 67130 thousand soums (Table 4).

Table 4. Information about the campaign “Clean Air” in 2020, which was implemented jointly with the State Committee for Ecology, the Ministry of Internal Affairs and the Ministry of Health, in order to reduce emissions of harmful substances from vehicles into the atmosphere.

No.	Number of checked cars		The number of vehicles temporarily stopped to comply with the requirements of the established standard	Cars exceeding the established norms, %	Driver fines*	
	total	of them exceeding the established norms			human	thousand soums
	5	6	7	8	9	10
1	32656	548	548	0.0	548	67130.0

* it is introduced that fines are applied by inspectors of the Department of Road Traffic Safety of the Internal Affairs Directorate

The number of appeals related to atmospheric air pollution was 27, 25 appeals were considered within the competence (Table 5).

Table 5. Information on appeals related to atmospheric air pollution and their implementation.

s/n	Number of requests received	Considered within the limits of authority, number	Of them			Note
			Satisfied	An explanation has been given	Measures have been taken	
	27	25	25	7	3	
	Total:					

5 Conclusion

- In conclusion, it should be said that the “Clean Air” measures implemented jointly with the State Committee for Ecology, the Ministry of Internal Affairs and the Ministry of Health are of great importance in solving the pressing problems of our time.
- As a result of the conversion of 193 cars to liquefied natural gas and 139 to compressed natural gas, 57.96 tons of harmful gases were emitted into the atmosphere during stages I-II of the “Clean Air” campaign.
- Considering that the damage to the city of Samarkand is 36,201 thousand/ton both on a transport and industrial scale, this is 30.7% of pollution.

References

1. O. Abdullaev, Z. Toshmatov, Ecology of Uzbekistan today and tomorrow, Tashkent, 80 (1992)
2. O.K. Adilov, Sh.E. Islamov, Sh.A. Suvonkulov, Monitoring service in the control system to determine the amount of harmful substances emitted from vehicles, TAYI newsletter, **3** (2015)
3. P. Baratov, Nature Protection, Uchitel, Tashkent, 254 (1991)
4. Decree of the President of the Republic of Uzbekistan dated July 18, 2019 "On additional measures for the rapid development of the automotive industry of the Republic of Uzbekistan" DP No. **4394** (2019)
5. R. Egamberdiev, R. Yeschanov, Fundamentals of ecology, ZAR QALAM, Tashkent, 225 (2004)

6. A. Fozilov, S. Kholikulov, The dynamics of the Akhangaran basin's groundwater level in relation to physical-geographical and anthropogenic factors. In E3S Web of Conferences, **431**, 04016 (2023) <https://doi.org/10.1051/e3sconf/202343104016>
7. A. Fozilov, Z. Ganiyev, R. Mamajanov, D. Jurakulova, O. Abdurayimova, The effect of the Almalyk-Akhangaran industrial zone on changes in the groundwater level of the Ahangaran river basin. In E3S Web of Conferences, **494**, 01014 (2024) DOI: <https://doi.org/10.1051/e3sconf/202449401014>
8. H.U. Khalbekova, Amino acid composition of species of the genus *Atriplex* L. growing in the Aral Sea (Uzbekistan). In E3S Web of Conferences, **411**, 02063 (2023) <https://doi.org/10.1051/e3sconf/202341102063> APEC-VI-2023
9. M.Z. Musadzhanov, Fundamentals of designing car service enterprises, Tamaddun publishing house, Tashkent, 336 (2017)
10. E.V. Nikitina, E. Ortikov, N.Y. Beshko, K.U. Khalbekova, Molecular authentication of some rare *Iris* (Iridaceae) species from Uzbekistan (2023) <https://doi.org/10.14719/pst.2596>
11. E. Nikitina, K. Khalbekova, Species diversity and phylogenetic relationships within the tribe Mentheae (Lamiaceae) in Uzbekistan using ITS sequence data, In IOP Conference Series: Earth and Environmental Science, **1068**, **1**, 012043 (2022) IOP Publishing. <https://doi:10.1088/1755-1315/1068/1/012043>
12. Z.T. Nazarovna, D.F. Azamkulovich, I.L. Ziyadullayevich, Divorcing procedures in Uzbekistan and its territorial features. International Journal of Scientific and Technology Research, **9**, **1**, 4096-4100 (2020)
13. O.B. Niyazova, G. Ismatova, Samarqand viloyati tuproqlarini makrofauna yordamida bioindikatsiyalash, Oriental Journal of Geography SJIF, **5**, **646**, 16-21 (2022) DOI: <https://doi.org/10.5281/zenodo.7481671>
14. S. Sherimbetov, K. Khalbekova, D. Matchanova, V. Nurmuxamedova, Molecular phylogeny of the endemic species *Atriplex pratovii* Sukhor. (Chenopodiaceae). Plant Cell Biotechnology and Molecular Biology, **21**, **71-72**, 41-49 (2020)
15. Z. Tojiyeva, L. Ibragimov, Labour market and employment in Uzbekistan, Geographical journal, **73**, **4**, 359-374 (2021) DOI: <https://doi.org/10.31577/geogrcas.2021.73.4.19>