Ambient Air Quality Assessment and Management in Batumi

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Abstract

Protection of ambient air from pollution caused by anthropogenic factors is considered as an important task all over the world, because air is the most essential resource for living organisms.

We were determined Concentrations of following air pollutants: Sulphur Oxides, Nitrogen Oxide, Carbon Monoxide and Dust In resent time the average concentrations of dust, sulphur oxides and nitrogen dioxide in some areas of Batumi is slightly exceeded norms, while the level of carbon monoxide decreased.

In Batumi ambient air is mostly polluted by emissions from motor transport and energy facilities. Moreover, vehicles are the basic urban polluters. The greatest part of pollutants emitted in Batumi comes just to the transportation sector.

Law of Georgia on Protection of Atmospheric Air regulates protection of the atmospheric air from adverse anthropogenic impact within whole Georgian territory.

In order to decrease emissions, form the transport sector levels joint actions from several authorities are necessary. These include measures such as: traffic optimization; establishment an age limit for imported cars; the gradual phasing in of stricter motor fuel quality and vehicle emission requirements in combination with enforcement of these requirements; and initiatives such as the development of electric transport systems.

Key words: Ambient air, pollution, Batumi, motor transport, pollutants.

Introduction:

One of the greatest problem that the world is facing today is that of environmental pollution, increasing with every passing year and causing grave and irreparable damage to the earth. Although pollution had been known to exist for a very long time (at least since people started using fire thousands of years ago), it had seen the growth of truly global proportions only since the onset of the industrial revolution during the 19th century.

The industrial revolution brought with it technological progress such as discovery of oil and its virtually universal use throughout different industries. At the same time, development of natural sciences led to the better understanding of negative effects produced by pollution on the environment.

Environmental pollution is a problem both developed and developing countries. Factors such as population growth and urbanization invariably place greater demands on the planet and stretch the use of natural resources to the maximum.

Air pollution is one of the main types of pollution of the environment. It has become an actual problem with Industrial development over the world. Amount of harmful exhausts in the atmosphere increases as a result of technological progress and the concentrations of certain components significantly exceed their permissible thresholds.

Air pollution is the introduction of particulates, biological molecules, or other harmful materials into the Earth's atmosphere, possibly causing disease, death to humans, damage to other living organisms such as food crops, or the natural or built environment.

According to the 2014 WHO report, in 2012 the air pollution caused the deaths of around 7 million people worldwide [7].

In many European cities, air quality is a concern and it is therefore monitored around the clock. In most cities, industrial air pollution is, or tends to be replaced by traffic related air pollution. Air quality is therefore a common problem to almost all major cities. Consequently, it is also a major problem in cities of Georgia, such as Tbilisi, Kutaisi, Rustavi, Zestafoni and Batumi. Thus, the importance of assessments and protection of atmospheric air from pollution becomes evident.

The aims: Our Research aims were to investigate the air quality and the main source of pollution in the years 2005-2013 in the city Batumi.

Material and Methods:

In Georgia the National Environmental Agency under the Ministry of Environment conducts the State Monitoring programme for Air Quality. Air quality is measured three times a day on weekdays (Sample It is not automated). In Batumi is defined the following polluting substances: Dust (Total Suspended Particulates –TSP), carbon monoxide, sulfur and nitrogen dioxides. There is only one the ambient air quality monitoring observation station in Batumi (located on Abuseridze street). The emissions pollutant concentrations determined by Wet Chemistry method. Dust concentrations are determined by weight (Gravimetrical) Method. A method for determining the concentration of total suspended solids Based on the drawdown of special filter for 20 minutes and subsequently Gravimetrical its analysis. Air samples were taken in ФПП-15-type filters.

The carbon monoxide concentration determined by electrochemical Method (gazoanalizator "Paladi"). 0.3% solution of hydrogen peroxide is used for absorbing sulfur dioxide, and nitrogen dioxide absorber - potassium iodide with sodium Arsenide.

Legal base

Air protection related issues are regulated by Law of Georgia on Protection of Ambient Air and by 15 subordinate regulations adopted according to the provisions of the Law.

Legislation of Georgia defines maximum permissible concentrations of harmful substances for the air protection purpose, given in Table 1 together with WHO (World Health Organization) and EU standards [1].

Calculation and determination of emission norms for air polluting industries is based on the maximum permissible concentrations of harmful substances. Such norms are defined individually for all air polluting industries which are subject to permitting in the issued environmental permits, while the rest of small enterprises, including motor transport, are regulated by the specially developed technical regulations.

Content of different harmful admixtures in benzene and diesel fuel (lead content in benzene, sulphur content in diesel, and etc.,) is regulated by decrees of Government of Georgia.

Table 1. Maximum Permissible Concentrations (MPC) of harmful substances defined by the Georgian legislation; ambient air quality norms set by WHO and the European Community

Harmful substances	Maximum Permissible Concentrations, MPC (mg/m^3)			
	MAC according to EU Georgian legislation	Standards recommended by WHO	Norms set by legislation	Concentration averaging period
Nitrogen dioxide (NO2)	-	0.2	0.2	1 hour
	-	0.04	0.4	1 year
	0.04	-	-	24 hours
	0.085	-	-	30 minutes
Sulphur dioxide (SO2)	-	0.5	-	10 minutes
	-	-	0.35	1 hour
	-	0.05	-	1 year
	0.05	0.02	0.125	24 hours
	0.5	-	-	30 minutes
Carbon monoxide (CO)	-	100	-	10 minutes
	-	10	10	8 hours
	-	30	-	1 hour
	5	60	-	30 minutes
	3	-		24 hours
Lead compounds	-	0.0005	0.0005	1 year
	0.0003	-	-	24 hours
	0.001	-	-	30 minutes
Ground level ozone	-	0.12	0.12	8 hours
	0.03	-	-	24 hours
	0.16	-	-	30 minutes

Source: State of the Environment Report for Georgia 2007-2009 [3].
http://soegeorgia.blogspot.com/p/english-version.html

Results

Air Quality in Batumi

Ajara region is situated on the South-Western Black Sea littoral of Georgia. Its southern border coincides with the Turkish-Georgian frontier; its northern and eastern borders consist of greenish mountains whereas to the west it is surrounded by the Black Sea.

Batumi is an administrative center of Ajara Autonomous Republic. It is situated by the Black Sea, on the lowland of Khakhaberi, 2-3 meters above the sea level and has a form of the half-moon. The city is stretched from the north-east to the south-west about 7 kilometers.

Its territory is 19 sq. km. The seaside part of Adjara is mainly a plain lowland, characterized with mild subtropical climate. The climate of Batumi is influenced by the black sea onshore flow and the nearby hills and mountains.

Since the Soviet period the ambient air quality observations in Georgia have been conducted by measuring of the following main pollutants: Maximum one-time concentrations (measured within 20 -30 min, mg/m3) and Mean daily and annual concentrations (mg/m3).

Air quality is assessed by comparison of measured concentrations with the adopted standards. In particular, mean monthly and mean annual concentration values determined by factual measurements normally are compared to maximum permitted level of mean daily concentration, and concentrations measured within 20 min period – are compared to 30 min maximum permissible concentration values (to the so called one-time maximum permissible concentration).

National Environmental Agency under the Ministry of Environment conducts the State Monitoring on Air Quality. The following pollutants are observed in Batumi: dust (Total suspended particulates –TSP), nitrogen and sulphur dioxides and carbon monoxide.

Table 2 and Figures 1-4 show the last 9 years (2005-2013) dynamics of changes in ambient air pollution with harmful substances in Batumi. Evaluations were made based on data obtained by the observation stations. As it was mentioned above, only one station was operating in city and the given data do not reflect air quality of a whole town, but only of it's one certain district.

Table 2. Ambient Air Quality Dynamics (2005-2013)

Harmful substances	Y E A R S									Maximum permissible concentration mg/m^3
	Concentration of harmful substances, mg/m^3									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	
Dust (TSP)	0.18	0.29	-	0.56	0.55	0.9	0.60	0.49	0.45	0.15
Carbon Dioxide, CO	2	2	4.5	4.6	4	3.8	2.8	3.1	2.34	3.0
Sulfur Dioxide SO_2	0.12	0.12	0.12	0.11	0.1	0.07	0.07	0.111	0.13	0.05
Nitrogen Dioxide NO_2	0.05	0.05	0.05	0.05	0.04	0.1	0.13	0.141	0.14	0.04

Solid particulates, often called dust, gets into the ambient air as a result of various processes, such as: fuel combustion (coal and oil) and cement production. Inhaling solid particulates suspended in the ambient atmosphere may cause irritation of the respiratory tract (bronchial tubes, lungs). According to some data, they can cause malignant tumours of the respiratory system.

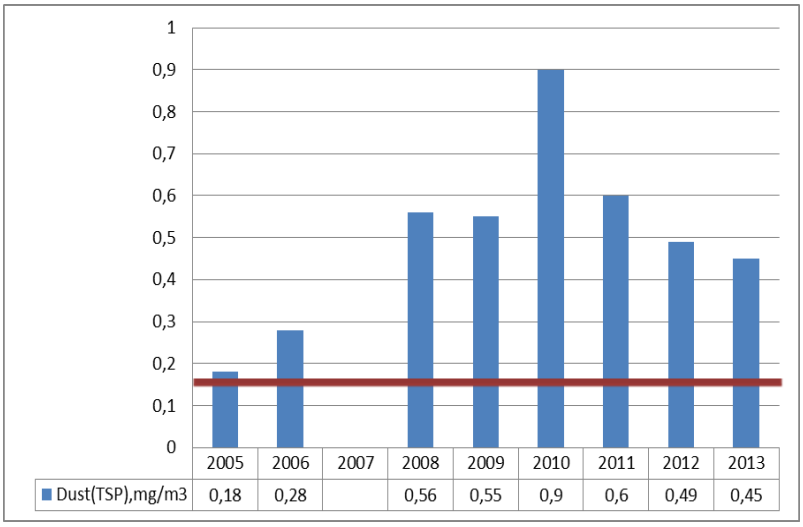

Figure 1. *Annual concentration of dust in Batumi.*
Maximum permissible concentration (MPC) in Georgia, 0.15 mg/m³.

Sulphur dioxide gets into ambient air due to combustion of sulphur containing fuel. Main sources are power stations working on coal, or masut, boiler rooms, metallurgical plants, and motor vehicles working on diesel. Sulphur dioxide when in higher

concentration than it is permissible irritates upper airways of the respiratory tract - nasopharynx and mucous membrane.

Figure 2. Mean annual concentration of Sulphur dioxide in Batumi. MPC in Georgia - 0.05 mg/m³

Carbon oxide is a product of incomplete combustion. Its main source is exhaustions of motor vehicles (generated in the process of incomplete combustion due to insufficient temperature, or due to malfunction of air supply system of the internal combustion engine), oil and coal combustion, and metallurgical industry. It suppresses transportation of oxygen by blood.

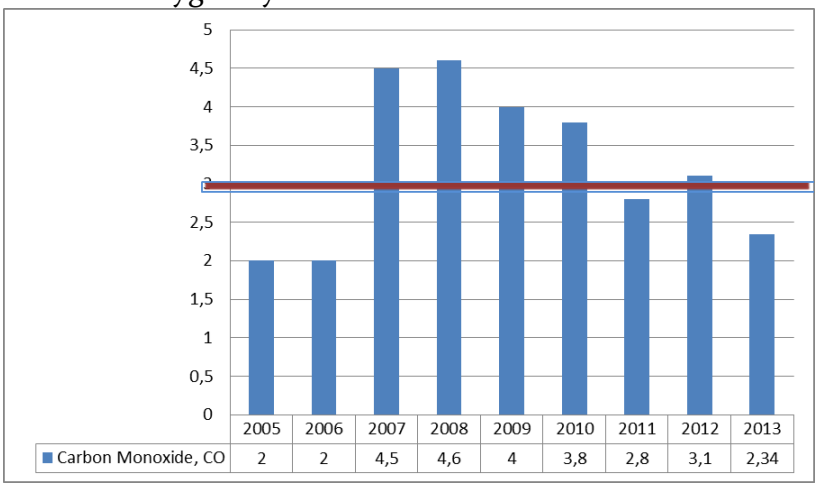

Figure 3. Mean annual concentration of carbon monoxide in Batumi. MPC in Georgia - 3 mg/m³

Nitrogen dioxide is the products of fuel combustion at a very high temperature in abundance of oxygen. Main sources are motor vehicle exhaust, natural gas soot, power stations exhaust and solid waste combustion smoke. Nitrogen dioxide existing in ambient air irritates lower airways of the respiratory tract, especially lungs.

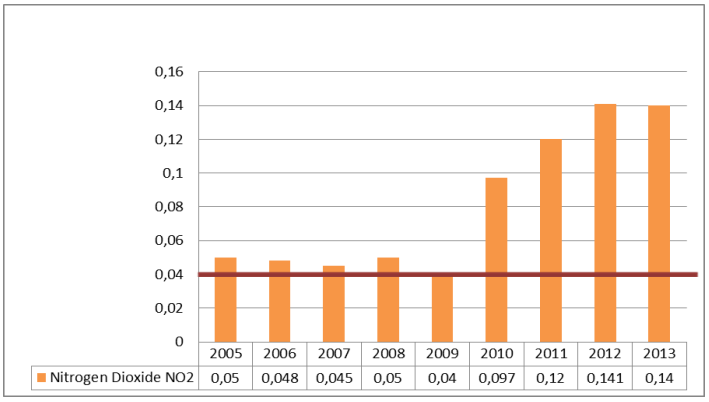

Figure 4. Mean annual concentration of nitrogen dioxide in Batumi. MPC) in - 0.04 mg/m³

Figures show that during the last nine years (2005-2013) the concentrations of harmful substances in ambient air of the mentioned location in Batumi exceeded the permissible levels. Dust, nitrogen and sulphur dioxide concentrations are above the maximum permissible level in Batumi. In last three years is observed decrease of the mean annual concentration substantially of carbon monoxide in ambient air.

Also the one monitoring station does not provide for an adequate assessment of air quality within the entire area of this city. Therefore, in order to have real picture of the air quality in Batumi, further expansion and modernization of the air monitoring network is required. This will allow for improved assessment of the population affected by poor air quality and in determining the measures for their protection.

Causes:

Ambient air pollution is caused by emissions from motor vehicles, energy sector, agricultural and industrial sectors. It is estimated that the main source in Georgia ambient air is mostly polluted by emissions from motor transport, industrial and energy facilities. Moreover, vehicles are the basic urban polluters[5].

It should be noted that during the last years, fuel consumption by motor transport has been increasing, and consequently, emissions of harmful substances into air have been also increasing.

Energy sector (high capacity thermoelectric power stations) in Georgia is represented by 3 big
plants working mainly on natural gas.

Since the municipal power companies have been annulled (since 90th), the energy supply systems in big towns and other settlements have been virtually disappeared. People now use individual heating facilities working mostly on gas and wood. Carbohydrates, or volatile organic compounds, carbon monoxide and solid particulates (dust) are the main pollutants in energy sector. Quantitative alterations of emissions in this sector are provided by quantitative alterations of the consumed energy resources (coal, kerosene, mazut, natural and liquid gas, and etc.).

Industry Sector. Before the crises of the 90s Ajara used to be an industrial and agricultural region with well-developed industrial sectors (mechanical engineering, petrochemical industry, power energy, light and food industry, production of construction materials, and etc).

Currently there are 90 medium and large pollutants of atmospheric air, out of which significant is the Batumi Oil Terminal Ltd., Batumi Marine Harbor Ltd., Asphalt and Concrete Plants and Batoil Ltd., but their role in ambient air pollution is very small.

Agriculture. Within this sector air is mostly polluted from live stock and poultry breeding branches. After liquidation of large live stock and poultry breeding farms and due to creation of small enterprises air pollution from this sector become more local and has less impact to compare with other sectors.

Motor transport is the main air polluter in Georgia and in Batumi. Main emission source of nitrogen oxides (NOx) and sulphur dioxide is (SO2) at the country scale is the motor transport, and accordingly, in the areas of intensive traffic the emission

level is higher –in big towns, at the transit routes. The most acute situation is observed in Batumi summer time – tourist season, when number of motor transport have been doubled.

Emission intensity of motor transport depends on: purification filters, fuel quality, working regime of a vehicle (for instance, how often it has to stop in traffic jams), and etc. Increased number of personal vehicles is provoked by lack of public transport.

Thus, Ambient air pollution is mainly caused by emissions from motor vehicles, the energy and industrial sectors. The main source of pollution in Batumi is undoubtedly motor transport.

Ambient Air Protection Policy in Georgia

Today Georgia has no current, officially adopted state policy or program in the sphere of environmental protection, including ambient air protection. The only environmental program, which was developed by the Georgian Government during its independence and which was officially approved by the President of Georgia in 2000, envisaged certain measures for a period of 2000-2004 [5]. Following this period, although with donor support, the draft of the Second National Environmental Action Plan of Georgia was prepared twice, the Georgian Government failed to discuss, agree and approve this document. One of the drafts was being prepared in 2006-2007 with the support of the UN Development Programme. The second draft was being prepared in 2009-2010 with the support of the Dutch Government. In November 2010 a draft [4] was prepared, which was discussed during 2011 and is still being discussed by various state agencies of Georgia. However, the Government has failed to finalize and approve the draft so far.

In 2000 the National Environmental Action Plan of Georgia [3] discussed ambient air pollution in the cities -that was mostly related to pollution from vehicles - as one of the environmental priorities and with respect to this problem, the Plan envisaged the implementation of the following measures:

- To increase a share of public transport, especially electric transport, and to improve its work;
- To improve the system of control of exhaust gas emissions from vehicles;
- To strengthen control of fuel quality;
- To introduce new norms on fuel quality and on harmful exhaust gases from vehicles; in a longterm perspective, to harmonize these norms with the EU norms and standards;
- To settle and optimize automobile movement, to observe the rules of movement, to organize parking sites rationally.

Fourteen years after adopting the first and, so far, the last National Environmental Action Plan [5], ambient air pollution in some cities of Georgia (including Batumi), still remains a serious problem. Moreover, it can be said based on the existing monitoring data that for example, in Batumi ambient air pollution has increased during past years that is mostly related to the increase in the movement of vehicles. Despite it, neither Georgia, nor its any city has a strategy on improvement of ambient air quality. The majority of measures envisaged by the 2000 National Environmental Action [4] Plan remained unfulfilled and their implementation is still very important.

The Law of Georgia on Ambient Air Protection [6] envisages the use of a number of environmental mechanisms with the purpose of air management. Out of these mechanisms some have been put into practice, while others remained inactive because of the failure to adopt relevant laws or bylaws, as well as because of absence of appropriate technical, financial and human resources in the country. A number of so called environmental instruments, which are

widely used in the leading countries, has not been either envisaged by legislation or put into practice.

In order to decrease emissions, form the transport sector levels joint actions from several authorities are necessary. These include measures such as traffic optimisation; establishmenting an age limit for imported cars; the gradual phasing in of stricter motor fuel quality and vehicle emission requirements in combination with enforcement of these requirements; and initiatives such as the development of electric transport systems.

Conclusion:

During the last nine years (2005-2013) the concentrations of harmful substances in ambient air of the mentioned location in Batumi exceeded the permissible levels. Dust, nitrogen and sulphur dioxide concentrations are above the maximum permissible level in Batumi. In last three years Is observed decrease of the mean annual concentration substantially of carbon monoxide in ambient air.

Ambient air pollution is mainly caused by emissions from motor vehicles, the energy and industrial sectors. The main source of pollution in Batumi is undoubtedly motor transport.

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