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Air Quality in Riga and Its Improvement Options

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***Abstract* – Air quality in the city of Riga is evaluated from direct monitoring results and from accounting registered air pollutants in the city. It is concluded that from all air polluting substances listed in the European Commission directives, only nitrogen dioxide NO_2 and particulate matter PM_{10} exceed the limits. In assessing the projected measures to improve air quality in Riga, it can be concluded that the implementation of cleaner fuels and improvements in energy efficiency of household and industrial sectors will decrease particle pollution, but measures in the transport sector will also contribute to reducing air pollution from nitrogen oxides.**

***Keywords* – Air quality, PM_{10}, actions to improve air quality**

I. Introduction

Good air quality in the urban environment is an important issue for a city's sustainable development and the prosperity of its population. Riga is the largest city in Latvia with high economic activity – industry, building, sea port and dense traffic flow. Various air pollutants (nitrogen oxides, sulfur oxides, hydrocarbons, particulates, etc.) are emitted into the atmosphere from traffic and boiler stacks (including households), industrial processes. Nitrogen and sulfur oxides in the air can form acid rain and thus contribute to soil acidity increases. NO_2 irritates the respiratory system and lowers the body's resistance to disease [1]. Smaller dust particles (with a diameter of 10 μm (PM_{10}) and smaller $PM_{2.5}$ and $PM_{1.0}$) can penetrate deep into the lungs, causing a variety of lung diseases. Asthma patients and children are especially sensitive to the presence of contaminants in the atmosphere [2].

To assess the level of air pollution in Riga, the most important air pollutants [the targets and thresholds of which are defined in Regulations [3] of the Cabinet of Ministers of the Republic of Latvia (harmonized with European Union directives 1999/30/EC and 2008/50/EC) on air quality] are monitored. Currently, monitoring of air quality in Riga is provided by a network consisting of 3 municipal monitoring stations, 3 stations of national monitoring network (Latvian Environment Geology and Meteorology Centre - LEGMC), and two special purpose air quality monitoring stations (AQMS) located in the Freeport of Riga [4]. Assessment of air quality in Riga indicates that the defined thresholds are exceeded for nitrogen dioxide NO_2 and particulate matter PM_{10} since 2005 (at urban traffic stations at Kr.Valdemara 18 and Brivibas 73) [5].

To improve air quality and reduce pollution in Riga, an action program (2004-2009) was implemented which included different measures [6]. For example, a zoning map of Riga for pollution with NO_2 was made accordingly and the Riga City Council Regulation was issued, which determines the need to prevent establishing new stationary sources of air pollution in areas where current air pollution exceeds the air quality standards. The Riga Development Plan 2006-2018 includes detailed information on measures that will improve air quality in Riga according to the action program on air quality improvement [7]. According to Latvian regulations and EU directives, the action program must be reviewed at least every five years; therefore, the second action program (2011-2015) was elaborated in 2010. Nevertheless, due to non-compliance with air quality standards, on 28 January 2010 Latvia received the European Commission's formal notice of the infringement procedure (Case No. 2008/2195), which indicates that the submitted air quality assessments of 2007 and 2008 show that the agglomeration of Riga has exceeded the threshold for human health for particulate matter PM_{10} - the annual limit value (40 $\mu g/m^3$) and the daily limit (50 $\mu g/m^3$ of the calendar year may not be exceeded more than 35 times). This suggests that the first action program was not effective enough to ensure that air quality thresholds are met in Riga [8], and further improvement options have to be identified these are summarized hereinafter in this article.

II. Air Quality In Riga From Monitoring Results

A. *Particulate matter concentrations (PM_{10} and $PM_{2.5}$)*

Particles PM_{10} include both fine ($PM_{2.5}$) and course ($PM_{2.5-10}$) fractions and are often determined by the source of origin [9]. Fine particles are associated primarily with combustion from different stationary and mobile sources: vehicle exhausts, household or industrial chimneys/stacks, particularly in the case of biomass fuels. Burning of branches and leaves in private gardens in spring and autumn seasons, as well as burning of dry grass around Riga in spring also increases urban background pollution with particulate matter [5,9]. Coarse particle fraction originates mainly from rough-wheel dust on the streets, various construction works, heavy cargo transport and handling in the port (coal, mineral fertilizers) [10]. To evaluate particle concentrations in the city centre, we used data from three different measuring instruments located within a short distance (300-500 m): Thermo ESM Andersen FH 62I-R measures PM_{10} concentrations on Kr.Valdemara iela, SM200 ADAM (Atmosperic Dust Automatic Monitor, Opsis AB) measures PM_{10} and PM2.5 concentrations on Brivibas iela, and Grim Environmental Dust Monitor EDM 165 measures PM_{10}, $PM_{2.5}$ and $PM_{1.0}$ concentrations on Kr.Valdemara iela 48 (Air Quality Monitoring Station of Faculty of Chemistry of University of Latvia (UL)).

Within the period of 2005 - 2010, the PM_{10} concentrations in Riga exceeded the annual average concentration of 40 $\mu g/m^3$

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only on densely congested traffic streets – Brivibas and Kr. Valdemara, while the city background was well below the threshold value [5] (Table 1).

TABLE I
PARTICULATE MATTER PM_{10} ANNUAL AVERAGE CONCENTRATIONS IN RIGA 2005- 2010 YEARS [5].

Air Quality Monitoring Station	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Brivibas Street 73	54.1	54.4	53.2	48.5	38.6	38.9
Kr.Valdemara Street 18	48.4	51.8	46.0	43.9	39.9	41.9
Viestura Prospect			33.6	23.8	20.2	
Tvaika Street (Free Port AQMS)	32.0	35.0	28.7	25.0	20.4	24.5

According to the Latvian Cabinet of Ministers' Regulation [3], the daily average of particulate matter PM_{10} concentration must not exceed 50 μg/m^3 more than 35 calendar days per year. However, measurements in the air quality monitoring stations (Brivibas and Kr.Valdemara) located in places with heavy traffic load indicate exceeding of this requirement noticeably (Figure 1).

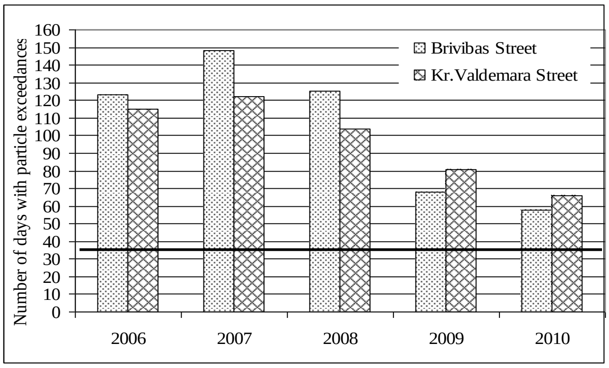

Fig. 1. The number of dusty days in the city centre streets (bold line in Figure – number of allowed 35 days per year) [5].

Analyzing the average daily PM_{10} concentration measured in three stations, the dependence of the season is observed. Thus, for example, in winter (January 2010) the average daily PM_{10} concentrations measured in all three stations were changing very similarly (Figure 2), but in spring (April 2010) the measured PM_{10} concentrations were sometimes even showing an opposite trend (Figure 3).

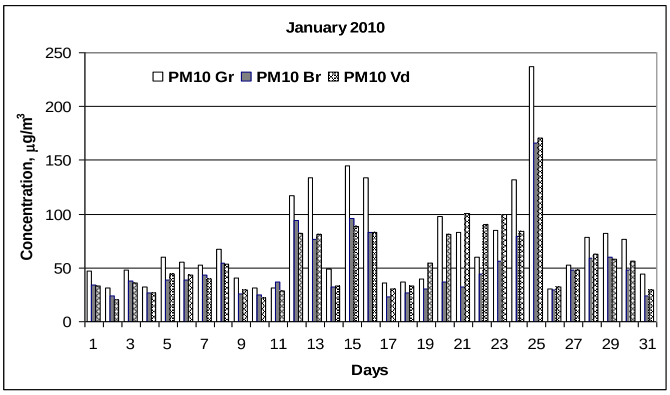

Fig. 2. Average daily PM_{10} concentrations in January 2010.

In Figure 3 the data are from – Kr.Valdemara 48 (PM10Gr); Brivibas Street 73 (PM10Br) and from Kr.Valdemara 18 (PM10Vd) (Riga City Council, LEGMC, UL).

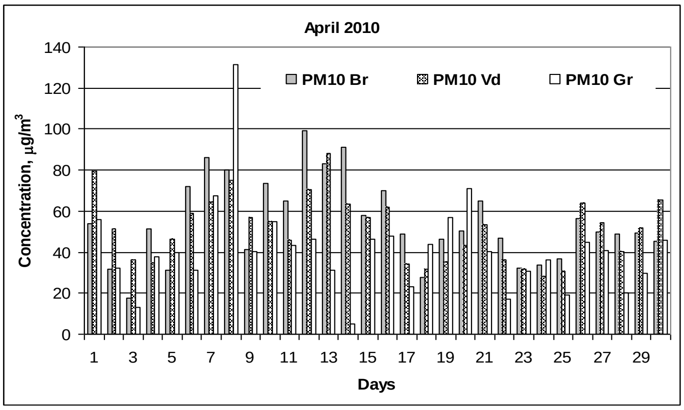

Fig. 3. Average daily PM_{10} concentrations in April 2010 (PM10Gr – Kr.Valdemara 48; PM10Br – Brivibas Street 73; PM10Vd – Kr.Valdemara 18; data from Riga City Council, LEGMC, UL).

This suggests that in the winter season, when air temperatures are low and humidity high (the probability of aerosols to form is also high), the air pollution in the Riga centre is similar in different places and is determined mainly by urban background pollution, which consists of various, both stationary and mobile, emission sources. In the spring and summer seasons, however, air pollution in each local street develops differently, determined mainly by local emission sources at each site.

From 2010 the target value for human health protection is set for fine particles $PM_{2.5}$ – the annual average concentration 25 μg/m^3 [3]. Monitoring data in Riga shows [11] that measured concentrations on Brivibas were within the range of 27-30 μg/m^3. Analyzing the contribution of coarse particles to measured PM_{10} concentrations, it can be noticed that there is a greater contribution from fine particles in the winter season– Figure 4 (data from Grim Environmental Dust Monitor EDM 165 – Kr.Valdemara 48, compiled from two years (2010: January-September and 2009: October-December)).

The European Commission has issued a guidance in order to assess the coarse fraction (PM_{10}-$PM_{2.5}$) in recorded PM_{10} values which exceed the guideline level for average daily concentration (50 μg/m^3), arising from salt and sand spreading on the street in winter [12]. The calculation procedure is based on three main conditions:

- Street is strewn with salt and sand;

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- The road surface is dry;
- The relationship between $PM_{2.5}/PM_{10} \leq 0.5$.

As observed in Figure 4, the coarse fraction (PM_{10}-$PM_{2.5}$) in average monthly PM_{10} concentrations does not exceed 50%.

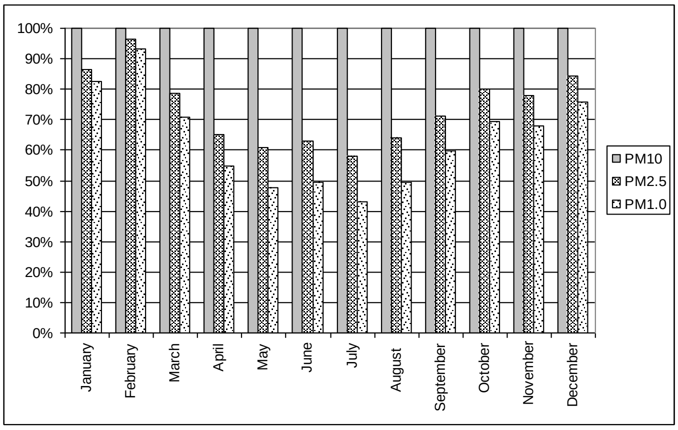

Fig. 4. Average monthly concentrations of particles $PM_{1.0}$, $PM_{2.5}$, PM_{10} (proportionally to PM10=100%) on Kr.Valdemara 48 in Riga (data for 2010 (January-September) and for 2009 (October-December) from UL).

However, when looking at average PM_{10} daily concentrations of individual winter months, it can be noticed that there are at least 1-3 days per month, when the quantity of coarse fraction in PM_{10} is more than 50% (for example, see January 2010, Figure 5).

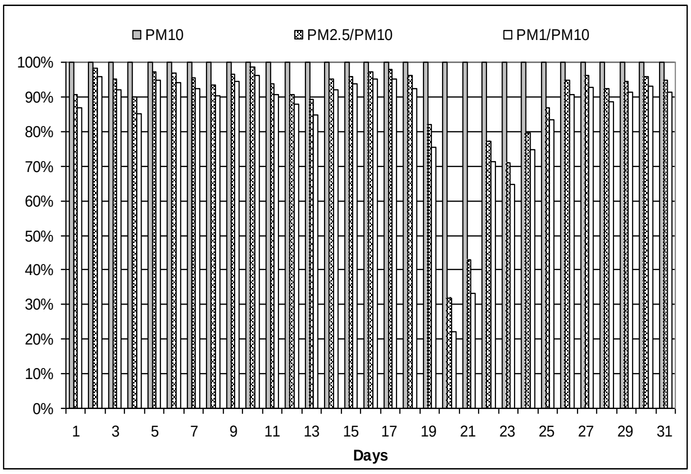

Fig. 5. Average daily concentrations of particles $PM_{1.0}$, $PM_{2.5}$, PM_{10} (PM_{10}=100%) on Kr.Valdemara 48 in Riga (data for 2010 January from UL).

It should be noted that the above described results are obtained from the measurements using one instrument based on a laser beam scattering effect (Grim Environmental Dust Monitor EDM 165 – Kr.Valdemara 48). Officially reported PM_{10} and $PM_{2.5}$ concentrations [11] are measured with two different SM200 ADAM (OPSIS) instruments in AQMS at Brivibas 73 with different air sampling flows (PM_{10} sampling with 1 m^3/h, $PM_{2.5}$ sampling with 2.3 m^3/h). Using measurement data from this monitoring station, it is estimated [11], that the salt and sanding effect can be attributed to 12 days in 2010, when exceedance of the average daily PM_{10} concentrations were recorded.

A report [11] also estimates that when taking into account the spreading of salt and sand on the street in winter, as well as natural factors on the PM_{10} daily average concentrations, the number of days when the concentration exceeds 50 $\mu g/m^3$ is significantly lower on AQMS at Brivibas 73. However, the number of the exceedance in both AQMS (Kr.Valdemara 18 and Brivibas 73) was still above the guideline - 35 days a year.

B. Nitrogen oxides and other pollutants

The main source of nitrogen oxides in the air are heat power plants and residential heating stoves, as well as internal combustion engines in vehicles. During burning at higher temperatures in the air atmosphere (above 650^{o}C), nitrogen is combined with oxygen forming various oxides, of which the most significant air pollutant is nitrogen dioxide [13]. Vehicle emissions account for approximately 80-85% of the recorded nitrogen dioxide (NO_2) concentrations in Riga [5]. The air quality monitoring data within 2005-2010 at the Brivibas and Kr.Valdemara streets are often above the guideline – the annual average concentration is 40 $\mu g/m^3$ (Figure 6).

The concentration of sulfur dioxide (SO_2) in Riga depends on the season – it is higher during the heating season (autumn, winter) [5].

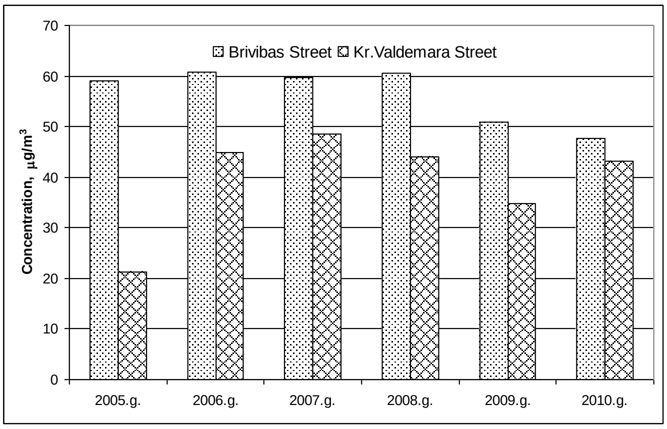

Fig. 6. Nitrogen dioxide annual average concentrations in Riga 2005-2010 years (data from the Riga City Council AQMS).

Sulfur dioxide belongs to those emissions, which can be carried far from the place of emission, so some contamination has been brought to the city centre from different districts of Riga by wind. The concentration of sulfur dioxide measured in background and street level air monitoring stations in Riga during 2004-2009 does not exceed the thresholds [the hourly limit value for human health - 350 $\mu g/m^3$ (not to exceed more than 24 times a calendar year), and the daily limit for human health - 125 $\mu g/m^3$ (not to exceed more than three times per calendar year)]. Slightly higher levels of sulfur dioxide concentrations are observed in the Sarkandaugava and Vecmilgravis districts of Riga, where the main source of pollution are companies from the Freeport of Riga, because oil and coal tankers use diesel fuel with high sulfur content (according to the EU and Latvian legislation, the sulfur

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content in fuel is limited, but tankers typically are not registered in Latvia, or even in Europe, therefore Latvian legislation does not apply them).

Carbon monoxide (CO) in Riga originates mainly from combustion processes in internal combustion engines of vehicles and in heat production plants, boilers, which burn gas, oil, wood briquettes, chips or peat. As it is shown by measurements, the carbon monoxide concentration in Riga does not exceed the guideline (8 hour limit value for human health - 10000 μg/m^3) for the period from 2004 to 2010 [5].

III. The Nature And Assessment Of Air Pollution In Riga

Air quality in Riga is affected by pollution from stationary, mobile sources, as well as transboundary pollution. Pollutant concentrations in urban areas are also affected by climatic factors, such as the strength and direction of wind, as well as rainfall. During combustion of fuels, different pollutants are emitted in the atmosphere, while the quantity and chemical composition depends on the fuel quantity and type used. The largest source of particulate emissions in Latvia is heat and energy production, including the household sector [5,9] – Figure 7. It is estimated that wood (biomass) burning is contributing up to 43% of the total particulate emissions [14].

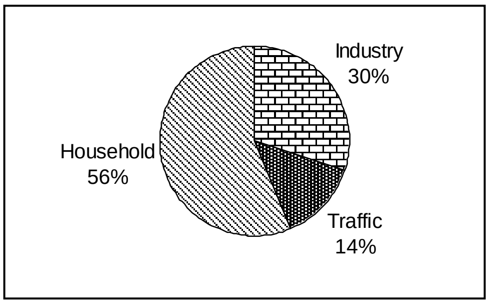

Fig. 7. Emissions of particulate matter PM_{10} in Riga by sector breakdown of the 2009 [5].

Natural gas (imported from Russia) is the most widely used source in Latvia to produce heat and electricity; oil products and coal are used in relatively small quantities [9]. Compared with other co-generation forms that are used to produce heat and electricity, the burning of natural gas produces small particle emissions, while exhausts from the combustion of oil products and coal consist of both fine and coarse particles and their precursors [9]. The biomass (wood) usage rate in Riga might increase in the next years and, therefore, air pollution with particulate matter will increase. In accordance with the objectives of fuel diversification from fossil to renewable (scheduled in EU directives and in the Riga District Heating Development Concept 2006-2016 (JSC Rigas Siltums), the share of woodchips in Riga will reach around 10% in 2015 [15]. Nevertheless, the energy policy in Latvia, in general, and the support mechanisms for renewable energy sources, in particular, have suffered from inconsistencies and, despite public interest in these issues and the EU’s legal requirements, have been of interest to businessmen involved in politics [16]. Exhausts form fuel combustion in vehicles contain particles (fine and ultra-fine fraction), as well as carbon oxides, nitrogen oxides, hydrocarbons. These emissions are dependent on the age of the vehicle and the fuel used. Black carbon (BC) or soot constituent in PM_{10} concentrations measured on Kr.Valdemara [17] showed that the main source of BC pollution is road transport and BC concentrations are directly proportional to the intensity of traffic flow on the street. It can be estimated that vehicles give an average of 15% from the observed PM_{10} concentrations. To reduce this part of pollution, it is recommended to use alternative vehicles – with cleaner fuel (biogas), electric (hydrogen) vehicles or to reduce the number of cars on the streets.

IV. Actions To Improve Air Quality In Riga

Riga’s second action program to improve air quality was developed and approved by the Riga City Council on 6 June 2011 and will be available for download from the webpage of Riga City Development Department [18]. A short discussion about the main measures in this program is given below.

Reduction of traffic intensity in the city is one of the most significant potential measures to reduce concentrations of particles and nitrogen oxides, therefore improving air quality by the relevant thresholds. Complex planning is necessary because the total number of vehicles in Riga is predicted to grow within the next years (Riga and the greater Riga Mobility Plan RPMP [19]). This should be taken into account in the medium and long-term planning in order to avoid the so-called "rebound" effect to the consequences of taken air quality improvement measures. In this case, the planning of traffic flow optimization needs stronger measures, such as a rush-hour tax for driving into the centre at certain times. Experience from the Riga’s first action program to improve air quality showed that the average number of vehicles crossing Vanšu Bridge per day decreased by 8% when a new bridge (Dienvidu Bridge) was opened (data from 2009). It is expected that implementation of other large traffic infrastructure projects in Riga (Austrumu trunk road to the sea port, Brivibas substitute road, North crossing of the River Daugava, etc.) will reduce the amount of traffic in Riga’s city centre [19].

The next important task is the promotion of infrastructure for low or zero-emission vehicles in Riga. Possible measures to be implemented are:

1) Identify and apply a more favorable parking policy and tax for electric, hybrid and hydrogen vehicles in Riga municipal parking places;
2) Develop a special support program (national or municipal) to promote zero-emission vehicle usage in Riga;
3) Tax relief legislation for low- or zero-emission vehicles in Riga (Latvia);
4) Equip vehicle parking facilities with charging points for electric/hybrid cars;
5) Continue work on the development of planned bicycle roads and opening of bicycle rental points according to the measures of RPMP [18];
6) Update Riga City public transport bus parks with zero-emission buses to gradually replace internal combustion

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engine buses with zero-emission hydrogen buses; create a hydrogen filling station network in Riga.

Specific measures are suggested to improve the cleanliness of streets in Riga: regular street cleaning by using dust-absorbing machines (especially in the spring season); spraying of streets during longer periods of dry weather; research on technologies for processing the surface of streets with specific binding solutions to capture particulate matter, and the possibilities to implement this technology in Riga; promote the usage of non-cleat winter tires during the winter season in Riga.

Accordingly, to respect air quality aspects related to the choice of fuel for heat production in Riga, the following proposals are suggested:

- Replace coal for heating with cleaner fuels to reduce emissions of air polluting substances;
- Examine the possibility to replace lower quality biomass fuels with higher quality grade fuel for heat and combined heat/electricity production units;
- Promote technologies of heat recovery from flue gas;
- Implement measures to reduce heat loss in heat transfer pipes and buildings;
- Take actions to increase the energy efficiency of multi-apartment buildings;
- Formulation of proposals for amendments to existing legislation in order to reduce air pollution from heating boilers used in individual houses;
- Develop special policies to promote access to the centralized heating network in the centre of Riga;
- Raise awareness to inhabitants of Riga about the quality of wood fuel used to produce heat in relation to the impact on air pollution;
- Promote the implementation of heat pumps and solar collectors for heat and hot water supply in individual houses and municipal houses/offices.

An important task is the involvement of general public and non-governmental organizations to participate in the creation of an interactive information exchange system about air pollution topics in Riga.

V. Conclusions

When assessing the projected measures to improve air quality in Riga, it can be concluded that the implementation of cleaner fuels and improvements in energy efficiency of household and industrial sectors will give greater effect to decrease air pollution by particles, but the planned measures in the transport sector will contribute to reducing air pollution from nitrogen oxides.

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Jānis Kleperis, Gunārs Bajārs, Ingrīda Brēmere, Mārtiņš.Menniks, Arturs Vīksna, Agnese Osīte, Dmitrijs Pavļičuks. Gaisa Kvalitāte Rīgā un Tās Uzlabošanas Risinājumi
Latvijas Republika ir saņēmusi Eiropas Komisijas formālo paziņojumu pārkāpuma procedūras lietā Nr. 2008/2195 (2010.g. 28. janvāris), kurā norādīts, ka Latvijas Republikas iesniegtie ziņojumi par gaisa kvalitātes novērtējumu 2007. un 2008.gadā liecina, ka Rīgas aglomerācijā ir pārsniegti Padomes 1999.gada 22.aprīļa Direktīvā 1999/30/EK un Eiropas Parlamenta un Padomes 2008.gada 21.maija Direktīvā 2008/50/EK par gaisa kvalitāti un tīrāku gaisu Eiropai daļiņām PM_{10} noteiktie robežlielumi cilvēka veselības aizsardzībai - gada robežlielums (40 $\mu g/m^3$) un diennakts robežlielums (50 $\mu g/m^3$, ko kalendāra gada laikā nedrīkst pārsniegt vairāk kā 35 reizes). Tāpēc svarīgi ir izvērtēt gan PM_{10} rašanās avotus, gan to relatīvo īpatsvaru kopējā piesārņojuma radīšanā.
Rakstā izvērtētas Rīgā reģistrētās smalko daļiņu PM_{10} koncentrācijas un analizētas dienas, kad veidojušies normatīvu pārsniegumi, cenšoties identificēt lokālo piesārņotāju, atmosfēras apstākļu un arī piesārņojuma pārneses ietekmes. Gaisa kvalitātes novērtējumam izmantoti dati, kas iegūti tiešo mērījumu ceļā pilsētas teritorijā izvietotajās monitoringa stacijās (Rīgas domei piederošajās gaisa monitoringa stacijās Kr. Valdemāra ielā 18 un Brīvības ielā 73), kā arī Latvijas Universitātes Ķīmijas fakultātes veiktais smalko daļiņu monitorings Kr.Valdemāra ielā 48.
PM_{10} gada vidējo koncentrāciju izvērtējums Rīgā visās monitoringa stacijās, kas kontrolē PM_{10} piesārņojumu liecina, ka tikai stacijās, kas atrodas ielās ar intensīvu transporta satiksmi (Brīvības iela, Kr,Valdemāra iela) vērojami šī robežlieluma pārsniegumi, kas gan pēdējos piecos gados uzrāda tendenci samazināties vidēji par 2% gadā. Divus pēdējos gadus Brīvības ielā PM_{10} gada vidējā koncentrācija pat nepārsniedz robežlielumu, savukārt Kr.Valdemāra ielā 2009.g. tā bija zem normatīva, bet 2010.g. drusku pārsniedza to. Līdzīgi smalko daļiņu PM_{10} diennakts vidējā koncentrācijas pārsniedz 50 $\mu g/m^3$.vairāk kā 35 kalendāra dienas gadā tikai gaisa monitoringa stacijas, kas Rīgā atrodas intensīvas transporta satiksmes zonā (uz tipiskām kanjona ielām ar intensīvu transporta satiksmi Kr.Valdemāra ielā 18 un Brīvības ielā 73). Gaisa monitoringa stacijas Kr.Valdemāra ielā dati rāda, ka PM_{10} diennakts koncentrāciju pārsniegumiem ir tendence samazināties – vidēji par 9 % gadā, un, ja saglabāsies esošā tendence, tad 2015. gadā pārsniegumu vairs nebūs.

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Tādēļ, plānojot rīcības PM_{10} piesārņojuma mazināšanai Rīgā, galvenā uzmanība pievērsta transporta intensitātes samazināšanai pilsētas centra kanjona tipa ielās. Viens no galvenajiem pasākumiem būs transporta plūsmu optimizēšana un transporta izplūdes gāzu samazināšana, jo tieši intensīva automašīnu noslodze uz ielām paaugstina piesārņojumu ar smalkajām daļiņām, slāpekļa oksīdiem, tvana gāzi un ogļūdeņražiem. Plānots pilnībā novirzīt smago transportlīdzekļu plūsmu no centra maģistrālēm, pabeidzot Austrumu maģistrāli un izbūvējot Ziemeļu šķērsojumu. Ielu tīrīšana un ielu mazgāšana ir būtiska, sevišķi smilšu un putekļu savākšana no visām vietām, kur tika kaisītas smiltis ziemā, turklāt pavasara un vasaras sausajās un karstajās dienās ielas var laistīt speciālu šķīdumu, kas saista smalkās daļiņas pie ielas seguma. Uzsvars tiek likts arī uz nulles emisiju autotransporta (elektriskie un ūdeņraža auto) atbalsta pasākumiem pilsētas satiksmē un centra autostāvvietās.

Янис Клеперис, Гунарс Баярс, Ингрида Бремере, Мартинш Менникс, Артурс Виксна, Агнесе Осите, Дмитрий Паличукс. Качество воздуха в Риге и решения по его улучшению

Латвийская Республика получила официальное сообщение Европейской комиссии по процедуре нарушения в деле Nr. 2008/2195 (28 января 2010 года), где говорится, что предоставленные Латвийской Республикой данные по мониторингу качества воздуха за 2007 и 2008 год позволяют сделать вывод, что в Риге и ее окрестностях превышены нормы для частиц PM_{10}, указанных в директивах 1999/30/EK от 22 апреля 1999 года Совета Европы и 2008/50/EK от 21 мая 2008 года Европейского Парламента и Совета. Поэтому важно оценить влияние и вклад в общее загрязнения частицами PM_{10} различных источников.

В статье проанализированы данные по концентрации частиц PM_{10} и особое внимание уделено дням, когда концентрация превышала нормы, пытаясь выявить источник загрязнения, природные условия и влияние переноса частиц. Для этого использовались данные 2 станций мониторинга (на улицах Бривибас и Кр.Валдемара), принадлежащих Рижской думе, и мониторинг частиц, проводимый на Химическом факультете Латвийского университета (так же на улице Кр.Валдемара).

Результаты измерений указывают, что превышение норм концентрации частиц происходило на улицах с интенсивным движением, но даже там за последние годы наблюдается снижение концентраций в среднем на 2% в год. По результатам мониторинга на улице Бривибас последние два года концентрация не превышала критического значения, на улице Кр.Валдемара в 2009 г. норма не была превышена, а в 2010 г. немного превышена. Превышение критического значения среднесуточной концентрации в 50 мкг/м^3 более чем 35 дней в году наблюдалось так же на улицах каньонного типа с интенсивным движением. Однако этот показатель так же снижается, в среднем на 9%; при сохранении такой тенденции к 2015 году превышений нормы не будет.

Таким образом, планируя меры по снижению загрязнения частицами PM_{10} необходимо уделить наибольшее внимание улицам каньонного типа с интенсивным движением транспорта. Одним из наиболее эффективных мероприятий является оптимизирование транспортного потока и снижение выбросов, т.к. именно автомобильное движение является причиной загрязнения воздуха как мелкими частицами, так и оксидами азота, угарным газом и углеводородами. Планируется перевести тяжелый транспорт на окружные дороги в обход центра, закончив строительство Восточной магистрали и построив Северную развязку. Также важна уборка улиц, особенно после обработки их зимой, и их полив в сухие дни весной и летом специальным составом, позволяющим привязать мелкие частицы к покрытию дорог. Также необходимо проводить мероприятия, стимулирующие переход на автотранспорт с нулевой эмиссией (электрический и водородный).