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Powder Substances Emission from Hot Mix Asphalt Manufacturing Facilities

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Abstract

In Serbia, along with the general problems of environmental pollution, the most pronounced problem is air pollution. The main causes of air pollution are traffic, heating, waste incineration and numerous industrial plants. In recent years, the construction of public roads has intensified in Serbia, which requires large quantities of natural material, as well as the organization of its transport and processing and obtaining asphalt, which forms new road structures. The paper examines the problems of emissions from hot mix asphalt (HMA) manufacturing facilities (the so-calledasphalt base). In the asphalt bases, the stone aggregate is mixed with oil derivatives (a complex mixture of different saturated and aromatic hydrocarbons, nitrogen, sulfur, and oxygen compounds). Emissions of total powder materials were measured using manual sampling and subsequent analysis of waste gas samples. The asphalt base, as a stationary emission source, works with mostly constant working conditions: three successive analyzes of the waste gas sample are performed on the emitter, ie three successive measurements at each periodic emission measurement. The results showed that all obtained values of concentrations of total powder materials are below the limit values.

Key words: air pollution, emission, powder substances, asphalt mixture, production, hot process

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1. Introduction

The environment is a complex system in which the circulation of matter and energy takes place continuously, with the aspiration to achieve the most optimal state. Man performs various energy transformations with his work. On that occasion, insufficiently clean energy sources, inadequate technology are used, and various emissions that negatively affect the protection of the environment often appear as a by-product of the energy exchange process (Hodolič et al. 2003). The ever-faster development of technology makes people's lives easier and more comfortable every day. At the same time, the development of technology has brought excessive exploitation of natural resources, increased air pollution, and environmental damage, which affects all life on Earth. There fore, environmental protection is the subject of research in numerous natural and social sciences in scientific research centers in Serbia and around the world.

During the production of asphalt mixture, there is a possibility of particle air pollution at the plant (Čuka, 2002). Particle emissions from the asphalt base most often occur:
• At the source of the technological process,
• Due to circulation of vehicles within the asphalt base area,
• While manipulating aggregate and road dust,
• Incinerating fuels in the burner of the asphalt base dryer,
• Emission from the mixer and hot asphalt tank,
• Emission when loading hot asphalt into trucks,
• Emission from a truck leaving the asphalt base.

Asphalt bases, mix gravel and sand with crude oil derivatives to make asphalt that is used to build roads, highways, parking lots, etc (Asphalt Plant Pollution, 2005). Asphalt is a naturally formed or technically produced mixture of bituminous binder and aggregate and possibly necessary additives, to ensure usability in road construction (Public Company Roads of Serbia, 2012). Asphalt bases release large amounts of air pollutants each year during production, including many cancerogenic toxic substances, such asarsenic, benzene, formaldehyde, and cadmium (Asphalt Plant Pollution, 2005), aswell as very fine suspended particles (EPA, 2000).

Particulate matter in the air can be defined as any dispersed substance whose individual aggregates is microscopic or submicroscopic in size. Particles in the air are formed by two mechanisms: particles are emitted directly into the atmosphere or are formed in the atmosphere by physical and chemical transformations of pollutants in the form of vapors or gases. The suspended particles are several micrometers in size, the most common sizes being 2.5 and 10 μm ($PM_{2.5}$ and PM_{10}). Also, there is a very high correlation between $PM_{2.5}$ and PM_{10} values (Directive 2008/50/EC), so if PM_{10} is very high, there is a huge probability that most of it is $PM_{2.5}$. Due to a large number of sources, particles can contain many different chemical substances. Fine particles may contain sulfates, nitrates, ammonium, elemental carbon, condensed organic compounds, and carcinogenic compounds, heavy metals (arsenic, selenium, zinc, and cadmium). Larger particles such as soil particles, fly ash, wood ash, soot, pollen is mainly composed of minerals: silicon, aluminum, potassium, iron, calcium, and other (Masitah and et., 2007) alkali and alkaline earth elements (Đarmati, 2007). According to Gržetić (2010), respirable particles in the atmosphere are neither physically nor chemically homogeneous. Therefore, it is important to know their quantity, as well as physico-chemical parameters. Thus, for example, in order to determine the origin of particles, data on the amount of elemental and organic carbon, silicon oxide, aluminum and iron, traces of metals, sulfates, nitrites, and ammonia, and especially toxic substances such as lead and other cancerogenic substances. Thanks to new scientific knowledge, more perfect monitoring programs are proposed, which enable redefining of regulations, including limit values for respirable particles in ambient air (US EPA, 2020). If air pollution values are found to exceed the prescribed limit values, urgent measures are needed to ensure better planning of the process that will lead to improved air quality at the local level.

It is characteristic that once they are emitted into the atmosphere, the particles completely obey the meteorological conditions. Experts emphasize that under unfavorable meteorological conditions (anticyclonic condition, temperature inversion, fog), the free diffusion of pollutants is prevented so that even measured lower concentrations of pollutants can lead to the formation of secondary pollutants that can be more toxic than primary (Ziyue et at., 2020).

The serious health effects of particulate matter are associated with its ability to penetrate the respiratory system (Masitah, 2007). Fine particles smaller than 2.5 μm can penetrate the lungs and reach the pulmonary capillaries and alveoli (Đarmati, 2007).The main difficulties in researching the impact on health are the presence of a mixture of pollutants in the air, the possible presence of unknown substances, the transformation of primary pollutants into more toxic secondary pollutants, the long latency period for most pollutants makes it difficult to connect with organisms (Directive 2004/107/EC and Directive 2008/50/EC). According to US EPA research (US EPA, 2017), 1% of lung cancers are associated with air pollution.

The subject of the paper is the problem of air pollution in the process of asphalt preparation on the example of the Asphalt base in Valjevo and the improvement of the environmental management system.

1.1 Tehcnological Procedure of Asphalt Production

The basic material for preparing asphalt mixtures by the hot process is stone material: separated and unseparated stone aggregates. Separated stone aggregates are: stone flour, sand, stone chips, crushed stone, and unseparated stone aggregates are unseparated crushed stone aggregate, unseparated gravel, and unseparated crumb. As one of the primary raw materials for the production of asphalt, stoneground flour (filler) and stone aggregate granulated in four fractions are used: 0-4 mm, 4-8 mm, 8-16 mm, 8-25 mm. The share of stone aggregate in the produced asphalt mass is 90%. The share of stone aggregate depends on the type of asphalt and on average for the fraction 0-4 mm is 38%, for the fraction 4-8 mm is 16%, for the fraction 8-16 mm is 24%, for the fraction 8-25 mm is 12% and for other fractions is 10%. The stone aggregate is stored in the area of the asphalt production plant in the planned places. Storage is organized by fractions, leaving manipulative paths for the passage of trucks with which the transport of stone aggregates is performed.

Stone ground flour is used as filler in the production of asphalt. Filler is a structural component of asphalt mass because with the organic component (bitumen) it forms the asphalt binder which glues the grains of the mineral aggregate. The contribution of fillers as a necessary component of the total mass in producing asphalt is about 3%. The filler is delivered to the plant in special trucks for the transport of powder materials which are equipped, in addition to the tank, with appropriate compressors for pneumatic transport by which the powder material is emptied from the transport truck and connected via a flexible connection to the powder tank, which is a component of the plant. The assembly of the asphalt base plant is given in Figure 1.

The technological procedure of the asphalt production process in the asphalt base facility consists of: the technological process of asphalt production in the machine plant and the accompanying technological procedures related to transport manipulative operations with raw materials. At the plant for the production of asphalt masses, the production of asphalt masses by a hot process is planned. The deposited stone aggregate of different granulations is located in the boxes in front of the predispensers and the loaders are loaded into the predispensers (Figure 1). From the filled predispensers (1) the stone aggregate fractions are discharged to the aggregate dosing conveyor belts. The amount of material fraction depends on the type of asphalt, where the fractions are in a certain weight ratio. The stone aggregate travels further by the belt conveyor to the drying drum (2). In the drum, moisture is removed by rotation and heating of the stone aggregate through the burner up to 0.5%. Gases, dust, and water vapor,

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as a product of the combustion of dried stone material, are extracted by means of a fan into the dedusting device (3).

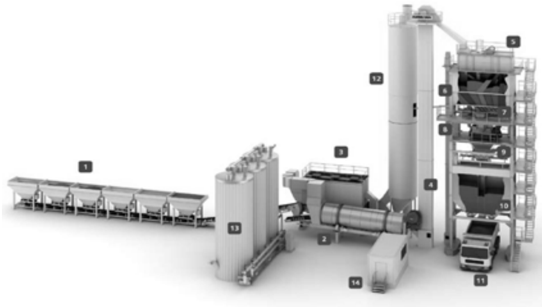

Fig. 1. Construction of asphalt base plant: 1. Predispensers with collective conveyor belt; 2. Drying and heating device (drum) with burner; 3. Dedusting system (bag filter); 4. Elevator for hot aggregate mixture; 5. Sieve system; 6. Hot aggregate silo; 7. System for weighing and mixing of grains of stone, bitumen, fillers and additives forpreparing asphalt mixtures; 8. Mixer; 9. Hot mix asphalt storage silo; 10. Silo for hot asphalt mass; 11. Direct loading by trucks; 12. Filler silo; 13. Bitumen tanks 14. Control cabin (command container with high-voltage and low-voltage electrical chambers) (AMMANN, 2010).

The device separates the filler from waste gases and water vapor. The gases, together with the dust from the rotary dryer, discharge into the dedusting system via ventilation system. The purified gases leave the dedusting system via the chimney into the surrounding area, and the separated dust collected in the filter housing is transported by appropriate screw conveyors to the silo for the filler, ie mixer. (The deduster works on the principle of creating an ideal vacuum under the drying drum). The dried stone aggregate reaches the hot aggregate elevator (4) which is transported to the sieving unit (5) to individual required fractions of the hot aggregate. Pieces whose dimensions are larger than the prescribed ones are directed towards a special metal basket from which, when a sufficient amount is collected, they are gravitationally lowered into the vehicle, which returns them to the open storage of the unit, ie for further use. The sieved aggregate goes to the hot aggregate collection unit (6) and then goes to the weighing and mixing unit (7). Here, the heated aggregate is mixed with bitumen, which is delivered by pipeline from the bitumen tank (13), and filler (12), which is delivered by a special screw conveyor to the basket of scales in which the calculated quantity is measured. It is gravitational discharged from the basket into the mixer, and mixed with bitumen. The molten bitumen ($T>1000^oC$) is pumped from the vertical tank through a pipeline to be weighed and sprayed into the inside of the mixer.The mixer must be switched on before dosing the material. Bitumen silos are two-layer, placed in an impermeable reinforced concrete tank that protects the environment from the leakage of bitumen into the environment. The mixture of aggregates and bitumen is either discharged directly into the transport vehicle or sent to the baskets for receiving the finished mixture, and then to the trucks for transport to the construction site. The entire process of asphalt mixture production is monitored by acomputer from the control cabin, in order to comply with the parameters set by the recipe. In the control cabin (14), one employee controls the entire production process. In the entire plant outside the control cabin, one worker controls the entire production process, and one loads the pre-dispenser with a stone aggregate with a loader.

1.2 Emission of powder substances from the asphalt base

Emissions of powdery substances are caused by operations of transport and movement of powdery materials in the following ways: dust captured by airflow is transferred from the pile of stored starting material to the environment; dust generated in the plant devices for treatment of mineral raw materials by operations of transport and movement of materials, and traffic within the production program. Study of the road company "Valjevo" a.d., Aurora Green (2013) which did an environmental impact assessment, emissions from the chimney of the asphalt base occur in of drying the aggregate, primarily in the form of ash with a particle size of 0.001 to 0.1 mm. The amount of ash varies significantly depending on the type of fuel as well as the combustion characteristics. As a consequence of incomplete combustion of some fuels, soot with particle dimensions of less than 0.001 mm can also appear like a product. Concentrations of dust particles at the exit from the chimney of the asphalt base depend on several factors: the nature and moisture content in the used mineral raw materials; methods of treatment of mineral raw materials in the drum; quantities and temperatures of exhaust gases. By installing quality filters, a significant reduction in the concentration of powdery substances of 10 - 50 mg/m^3 is achieved. Therefore, the emission of powdery substances strongly depends on the weather conditions (humidity, wind) (Krnić, 2018).

2. Material and methods

The production plant of the asphalt base is located within the industrial zone "Gorić", in the eastern part of Valjevo, 3.8 km from the city center. On the west and east sides, there are residential buildings, while on the north side there is a road that serves the industrial zone and is located parallel to the Belgrade - Bar railway.

Table 1. . Apllied standards, measuring procedures and types of measuring devices

Standards for ***Test parameters:***	***Test method:***	***Quantification limit***
Determination of the speed, flow and temperature of waste gas	**SRPS ISO 10780:2010** Emission from stationary sources - Measuring of speed and volumetric flow of gas currents in the channels	1 m/s; 0,3 m^3/h; 1,1 C°
Determination of the content of oxygen O_2	**SRPS EN 14789:2009** Emission from stationary sources - Determination of volume concentration of oxygen (O_2) – Reference method - Paramagnetism	0,12%
Determination of mass	**SRPS EN 15058:2009** Emission from stationary sources	1,7 ppm

concentration of carbon monoxide CO	- Determination of mass concentration of carbon monoxide (CO) – Reference method: nondispersive, infrared spectometry	(2,1 mg/m³)
Determination of mass concetration of total sulfur oxides expressed as SO_2	**SRPS ISO 7935:2010** Emission from stationary sources - Determination of mass concentration of sumpor dioxide - Performance characteristics of automated measurement methods	1,9 ppm (5,4 mg/m³)
Determination of mass concentration of powdery matter	**SRPS EN 13284-1:2017** Emission from stationary sources - Determination of powder in the range of low mass concentrations - Part 1: Manual gravimetric method	1,7 mg/m³
Determination of mass concentration of organic matter expressed as total of carbon (TOC)	**SRPS EN 12619:2013** Emission from stationary sources - Determination of mass concentration of total organic carbon as gas - Continual method of flame ionization detection	1,7 ppm (2,1 mg/m³)
Determination of concentration of carcinogenic matter class III (benzene, C_6H_6)	**SRPS CEN TS 13649:2015** Emission from stationary sources - Determination of mass concentration of individual gaseous organic compounds Sorption sampling method followed by solvent extraction or thermal desorption	/

Measurements were performed during June 2017 (first sampling period, Table 1), November 2017 (second sampling period, Table 2), and May 2018 (third sampling period, Table 3).

Table 2. Powder emission test results on the emitter of the asphalt base - June 2017

Parameter	***U***	***I.sampling period***	***II. sampling period***	***III.sampling period***	***ELV***
Waste gas temperature t_a	°C	76,5 ± 2,3%	84,1 ± 2,3%	84,5 ± 2,3%	/
Waste gas velocity v'_a	m/s	9,8 ± 1,3%	9,9 ± 1,3%	9,9 ± 1,3% /	/
Waste gas flow Q_V	m^3/h	22050 ± 2,6%	21811 ± 2,6%	21860 ± 2,6%	/
Corrected waste gas flow Q_{Vn} (O_{2ref})	Nm^3/h	32524 ± 2,6%	31626 ± 2,6%	31151 ± 2,6%	/
Measured concentrationof CO	ppm	241,4 ± 4,3%	235,9 ± 4,3%	238,9 ± 4,3%	/
Measured concentration of total sulfur oxides, expressed as SO_2	ppm	12,6 ± 4,7%	14,8 ± 4,7%	11,1 ± 4,7%	/
Concetration of carcinogenic matter, class III (C_6H_6), in sample	µg/sample	< 0,1	< 0,1	< 0,1	/
Measured concetration of carcinogenic matter, class III (C_6H_6)	mg/m^3	< 0,01	< 0,01	< 0,01	/
Measured concetration of organic matter in waste gas expressed as total carbon	ppm	23,7 ± 5,4%	20,1 ± 5,4%	22,3 ± 5,4%	/

Measured concentration of total powdery subtances	mg/m^3	6,8 ± 14,8%	6,6 ± 14,8%	7,3 ± 14,8%	/
Corrected concentration of total powdery substances	mg/Nm^3	4,6 ± 14,8%	4,6 ± 14,8%	5,1 ± 14,8%	20
Mass flow of total powdery substances	g/h	149,6±16,2%	145,5±16,2%	158,9±16,2%	/

ELV - emission limit value

Table 3. Powder emission test results on the emitter of the asphalt base - November 2017

Parameter	***U***	***I. sampling period***	***II. sampling period***	***III. sampling period***	***ELV***
Waste gas temperature t_a	°C	86,2 ± 3,4%	86,9 ± 3,4%	85,3 ± 3,4%	/
Waste gas velocity v'_a	m/s	9,5 ± 1,8%	9,7 ± 1,8%	9,7 ± 1,8%	/
Waste gas flow Q_V	m^3/h	20418 ± 3,8%	20826 ± 3,8%	20850 ± 3,8%	/
Corrected waste gas flow Q_{Vn} (O_{2ref})	Nm^3/h	29096 ± 5,3%	28115 ± 5,3%	28148 ± 5,3%	/
Measured concentration of CO	ppm	74 ± 3,5%	77 ± 3,5%	85 ± 3,5% /	/
Measured concentration of total sulfur oxides, expressed as SO_2	ppm	37 ± 11,6%	37 ± 11,6%	36 ± 11,6%	/
Concetration of carcinogenic matter, class III (C_6H_6), in sample	µg/sample	< 0,1	< 0,1	< 0,1	/
Measured concetration of carcinogenic matter, class III (C_6H_6)	mg/m^3	< 0,01	< 0,01	< 0,01	/
Measured concetration of organic matter in	ppm	19,5 ± 11,5%	18,5 ± 11,5%	18,2 ± 11,5%	/

waste gas expressed as total carbon					
Measured concentration of total powderysubtances	mg/m^3	10,2 ± 14,8%	11,1 ± 14,8%	10,6 ± 14,8%	/
Corrected concentration of total powdery substances	mg/Nm^3	7,2 ± 15,3%	8,2 ± 15,3%	7,9 ± 15,3%	20
Mass flow of total powdery substances	g/h	208,3 ± 16,2%	231,2 ± 16,2%	221,0 ± 16,2%	/

Table 4. Powder emission test results on the emitter of the asphalt base - May 2018

Parameter	***U***	***I. sampling period***	***II. sampling period***	***III. sampling period***	***ELV***
Waste gas temperature t_a	°C	82,00 ± 3,4%	78,20 ± 3,4%	78,30 ± 3,4%	/
Waste gas velocity v'_a	m/s	12,50 ± 2,1%	11,90 ± 2,1%	12,10 ± 2,1%	/
Waste gas flow Q_V	m^3/h	29894 ± 4,0%	29894 ± 4,0%	30261 ± 4,0%	/
Corrected waste gas flow Q_{Vn} (O_{2ref})	Nm^3/h	35125 ± 4,9%	29817 ± 4,9%	34044 ± 4,9%	/
Measured concentration of CO	ppm	151 ± 4,4%	157 ± 4,4%	158 ± 4,4%	/
Measured concentration of total sulfur oxides, expressed as SO_2	ppm	7 ± 11,6%	8 ± 11,6%	7 ± 11,6%	/
Concetration of carcinogenic matter, class III (C_6H_6), in sample	µg/sample	1,04	0,98	1,01	/
Measured concetration of					

carcinogenic matter, class III (C_6H_6)	mg/m^3	0,07	0,07	0,07	/
Measured concetration of organic matter in waste gas expressed as total carbon	ppm	15 ± 11,5%	14 ± 11,5%	15 ± 11,5%	/
Measured concentration of total powdery subtances	mg/m^3	16,7 ± 14,8%	15,6 ± 14,8%	16,3 ± 14,8%	/
Corrected concentration of total powdery substances	mg/Nm^3	14,2 ± 15,1%	15,6 ± 15,1%	14,5 ± 15,1%	20
Mass flow of total powdery substances	g/h	499,2 ± 15,8%	465,1 ± 15,8%	493,3 ± 15,8%	/

3. Results and Discussion

Pollution is a product of the economic activity, as well as all other goods and services, but it is harmful. However, goods and services, the production of which has caused pollution, undoubtedly, have a positive effect - benefits. It can be said that, although pollution is undesirable and harmful, it is still inevitable in the process of creating useful products of economic activity. Hence the indirect benefit of pollution. Existing technologies, no matter how much they minimize pollution, inevitably create them (Pešic, 2002). One of the national priorities for achieving sustainable development in Serbia is the protection and improvement of the environment and the rational use of natural resources. This implies the integration and harmonization of goals and measures of all sectoral policies, harmonization of national regulations with EU legislation and their full implementation. Adoption and implementation of the National Environmental Protection Program with appropriate action plans, as well as the adoption and implementation of the National Strategy for Sustainable Use of Resources and Goods are of priority importance (Ministry of Environmental Protection, 2007). Technology advancement, increasing energy efficiency, and the use of renewable energy sources will certainly have an impact on reducing the environmental pollution. The industrial energy efficiency is three times lower than the world average, and the rate of industrial waste generation per unit of product and irrational use of raw materials is disproportionately high.

Air quality in urban areas is conditioned by the increase in the number of sources of pollution as well as their type. The identified causes of the problem are:
• Non-compliance of emissions regulations with EU directives;
• Lack of waste gas treatment or low efficiency of existing treatment plants in the industrial

and energy sectors;
• Use of outdated technologies with low energy efficiency;
• Lack of incentives to reduce emissions;
• Lack of rational management of traffic systems;
• Inadequate maintenance and control of vehicles participating in traffic and poor quality of motor fuel.

The basic task is to preserve and, wherever possible, improve air quality. According to the EAPA report (EAPA is the European industry association which represents the manufacturers of bituminous mixtures, companies engaged in asphalt road), Serbia in 2015 produced 1,300,000 tons of asphalt (EAPA, 2015). Asphalt bases in the Republic of Serbia are largely air pollutants due to the technical and technological obsolescence of asphalt bases and their dedusting systems, exhaust gases from the drying process, and heating of mineral aggregates. During the production of asphalt mixture for pavement structures, there is a great possibility of serious air pollution at the plant, which can be caused by particles 2.5 - 500 µm, sulfur oxides (SO_2), nitrogen oxides (NOx), carbon oxides (CO, CO_2) and volatile organic compounds (VOCs) (Caldare and et., 2013).

Asphalt base is a plant for the production of asphalt masses (asphalt). The asphalt base mixes the stone aggregate with crude oil derivatives – bitumen.For the production of bitumen, heavy fractions of oil are used, low density according to API, rich in bitumen, which, according to the chemical composition is a mixture of different hydrocarbons with molecules of oxygen, sulfur, and nitrogen. The hydrocarbons, contained in bitumen are mainly condensed naphthenic and aromatic rings (with a small number of paraffin chains), for the production of asphalt used for the road construction, highways, airport runways, parking plateaus, factory yards, and other surfaces. The asphalt base of the manufacturer "AMMANN", type "Just Black 200", was installed in 2010 in the eastern part of Valjevo in the industrial zone. In the zone of the asphalt base, there are production plants and accompanying facilities and contents necessary for the production of hot-mix asphalt.

The production process consists of several basic operations: dosing of the stone mixture, heating, and drying, dosing of fractions in the required scale, dosing of binders, homogenization of the mixture, storage in silos for the mixture, loading into vehicles, and shipping (AMMANN, 2010).

Emissions of powdery substances are caused by operations of transport and movement of raw materials within the plant and traffic within the production program. Influential indicators of the asphalt base on the environment are: capacity of the asphalt base within the plant of 200 t/h; distance from the nearest residential buildings, because the plant is located in the industrial zone. According to the Regulation on emission limit values for air pollutants from stationary pollution sources, except for combustion plants ("Official Gazette of RS", 2015), emission limit values (ELVs) for inorganic gaseous substances are applied to the specified stationary pollution source:
• Powdered substances: 20 mg/Nm^3,
• Carbon monoxide: 500 mg/Nm^3,
• Carcinogenic substances of class III: 5 mg Nm^3,
• Organic matter expressed as total carbon: 100 mg/Nm^3,
• Sulfur oxides expressed as SO_2: 350 mg/Nm^3 for a mass flow rate of 1800 g/h and higher.

Considering that the stationary emission source in question works with mostly unchanging working conditions, three successive analyzes of the waste gas sample are performed at the emitter, ie three successive measurements at each periodic emission measurement. When comparing the measured values of the emission limits, it was established that the stationary source of pollution complies with the requirements given in the regulation regarding the emission of particulate pollutants, if the highest value of pollutant emission measurement reduced by measurement uncertainty is less than or equal to the prescribed limit value .

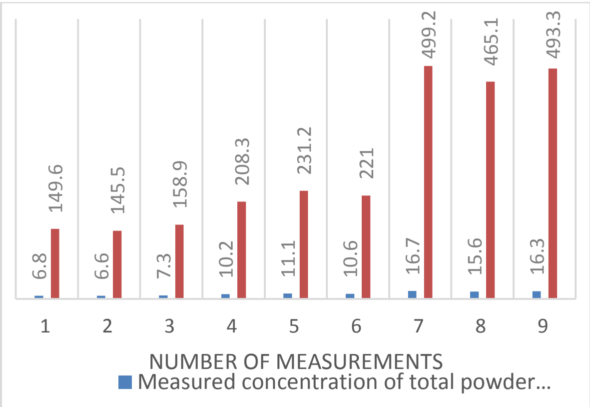

Fig.2. Diagram of dependence of concentration and flow of total powdery substances

Based on the diagram from Figure 2, an increase in the mass flow of total powdery substances as a function of the concentration of total powdery substances is evident; this also depended on the microclimatic conditions (anticyclonic state, temperature inversion, and fog) during theexperiment.

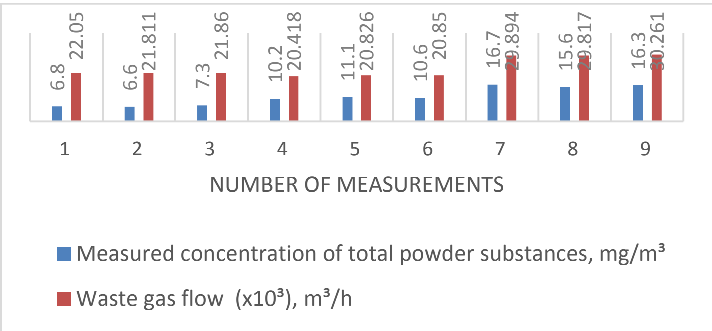

Fig. 3. Diagram of the dependence of the total powdery substance concentrations and the waste gas flow

From the diagram presented in Figure 3, the dependence on the total powdery substance concentrations and the flow of waste gas, an almost linear dependence is noticeable, given that a higher flow of waste gas carries a large amount of pollutants, and thus total powdery substances .

4. Conclusions

Air pollution affects human health and the entire ecosystem in various ways. Ambient air samples collected during 2017 and 2018 in the production of asphalt base and analyzed for the content of particulate air pollution. The results of air pollution monitoring at the asphalt base of Valjevo show that the current state of the environment at the asphalt base location are satisfactory and that the limit values prescribed by the Decree on limit values for air pollutant emissions from stationary pollution sources, except for combustion plants, for powdery substances in the examined period. By comparing the average annual concentration of particulate fraction of asphalt production of Valjevo of 11.24 mg/m^3, it was concluded that the levels of pollutants are within the recommended values, which is expected because purification filters are used. The problem is the increase in the concentration of orgaic matter and the introduction of devices for their reduction and removal must be considered. Although studies on population exposure and health risks have shown that it is large, only a few countries have defined the values of the maximum pollution in ambient air. Recently, companies in Serbia are procuring new asphalt bases of the most modern dedustingsystems, which is a big step forward in the fight for cleaner technology, considering that the condition of road structures of the country is in a very bad condition (old and damaged roads).

DECLARATIONS

Competing interests

The authors declare that they have no competing interests.

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