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Review article

MEASURING PARTICLES PM10 AND PM2.5 AND IMPACT OF HUMAN HEALTH IN THE CITY OF TETOVO

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Abstract

Air pollution is a global problem due to the presence of particles called PM 10 and PM 2.5, which affect the air quality and also affect human health and cause cardiopulmonary, respiratory, nervous, lung cancer and other diseases. Air pollution comprises all provinces whether urban or urban, rural, all age groups. The work is multicentric and retrospective, and is carried out by the team of the Faculty of Natural Sciences and Mathematics, as well as doctors from the internist service, and the Department of Hygiene at Tetovo Clinical Hospital. The aim is to study the air quality in the town of Tetovo in North Macedonia as well as the presence of PM10 and PM2.5 particles, Chemical analysis of heavy metals of these PM10 particles were carried out with SEM-EDX.
Air samples were taken from six locations in Tetovo. The PPM equipment "Espoo" was used in the period from 23 January and 05 to 13 February were collected PM2.5 and PM10 particles. At the same time two types of nitrocellulose filters with adequate pore size were used for PM2.5 particles and PM10 particles. The chemical analysis results from SEM have shown that PM2.5 particles are composed of Oxygen, Calcium, Iron, Silicon, Carbon Fluoride, and less of Circone, Sulfur, Barium andTitanium. The rest of the paper deals with the effects of these particles in respiratory, cardiovascular, nerve, and lung carcinoma diseases. Data were collected from the Statistical Office of the Public Health Institute in Tetovo and from the Internal Ward in the Clinical Hospital in Tetovo from hospitalized patients for the above-mentioned diseases in the period 2014-2019.

Keywords: PM10, PM2.5, air pollution, Ca pulmonic, SEM

1. Introduction

Physics and other sciences have given humanity the knowledge, technique and the technology, with the application of which we extract large quantities of raw material such as minerals (fossil fuel, construction material), which are then processed to satisfy the needs of the population. Based on the data provided by the Metering Stations of the Ministry of Environment and Physical Planning, it shows that the high concentrations of carcinogenic airborne particles worry the citizens in many cities of the country, but not the authorities. In Skopje, Kumanovo, Tetovo, Veles and Bitola the PM10 and PM 2.5 particles concentrations are several times higher than the permissible quantities [1,2].

The research paper is multicentric and retrospective. It was carried out by the team of the Departmentof Physics and Chemistry in Tetovo, as well as doctors from the Internist Service, and the Hygiene Department at the Clinical Hospital of Tetovo. This paper aims to study the air quality in the City of Tetovo in North Macedonia, as well as the presence of PM10 and PM2.5 particles.

The air samples were taken from six locations in Tetovo. With the help of PPM equipment, Espoo, the PM2.5 and PM10 particles were collected in the period 05-13 February. At the same time two types of Nitrocellulose filters with adequate pore size were used, so that PM2.5 particles were collected in one filter and PM10 particles in the other. The results of chemical analysis by SEM

have shown that PM2.5 particles are composed of Oxygen, Iron, Calcium, Silicon, Fluorine, Carbon, and less of Circon, Sulfur, Barium, and Titanium. The results of these measurements do not differ from the results of local authors and the Ministry of Ecology in this regard [3,4].

2. Measurement method

The representation of the methodological approach for recording the amount of dust -suspension of particles with 10 micrometers and 2.5 micrometers in the air of Tetovo.
The instrument is located at some reference location points in the city of Tetovo (Figure 1), where the instrument has been stationary from 4 to 8 hours, during this time it sucked the air constantly and then we analyzed the filters inside the instrument for particles.

Figure 1. Reference points for measuring particles PM10 and PM2.5 in the city of Tetova

The instrument used in to analyze the particles is the PPM system, Espoo, Finland, was used in according to EN 12341-1998 (Figure 2).

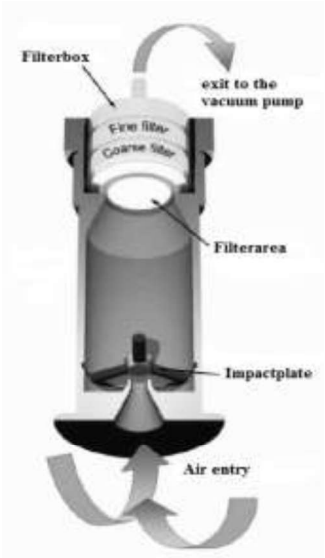


Figure 2. Sample analysis illustration with a 10 μm diameter and 2.5 μm diameter

3. Results and discussion

The results of these measurements do not differ from the results of local authors and the Ministry of Ecology in this regard.
The data we have measured are from 23 January to 13 February 2018/2019 in the city of Tetovo (Republic of Northern Macedonia) and exact positions are shown in Figure 1.
Since large part of the households use firewood as heating material in winter time and therefore, they contribute significantly to the total CO2 emission and our concern was to determine just this contribution. A further goal was to collect data for the particulate matter emission. Car traffic is also a significant contributor to the total air pollution. This proportion is already known from various sources for different seasons [5,6].
The data we measured was compared with the data from the Ministry of Environment (see Table 1). The difference is noticeable for almost the entire measurement period. It can also be seen that the Ministry of the Environment presented different measured values for particulate matter for almost the same measurement locations. The exact measurement data are clearly shown again in Figure 3.

Table 1. The concentration levels of PM10 by Ministry of Ecology of North Republic of Macedonia and our team at various location points in Tetovo, February 2018

Data	Position	Concentration by Minstry of Ecology of Nord Republic Macedonia of PM10 / μg m^{-3}	Measurements from our team Concentration of PM10 / μg m^{-3}	Avarage concetration
08.02.2018	1	103	50	25-50
09.02.2018	2	53	53	25-50
09.02.2018	3	113	16	25-50
09.02.2018	4	83	71	25-50
09.02.2018	5	110	94	25-50
23.01.2018	6	65	50	25-50

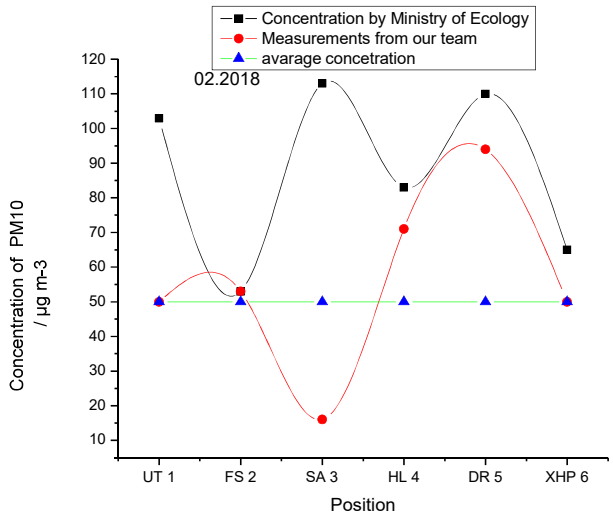


Figure 3. Graphic presentation of PM10 concentration by the Ministry of Ecology of the North Republic of Macedonia and our team at various locations in Tetovo, January, February 2018

The same procedure for determining emissions and the fine dust (PM10, PM2,5) concentration was also carried out for the 2019 calendar year. The measured data are shown in Table 2 and in Figure 4. It is also evident that the data for the fine dust concentration (PM2.5) show a difference between our measured data and those from the Ministry of the Environment. It can also be seen that there is a constant difference between our measurement data for (PM10 and PM2.5) and the data from the Ministry of Environment. What these constant values are due to, we could not draw a precise conclusion from the amount of data collected.

Table 2. The concentration levels of PM2.5 and PM10 by Ministry of Ecology of North Republic of Macedonia and our team at various location points in Tetovo, January-February 2019

Data	Position	Concentration by Ministry of Ecology of the Republic of North Macedonia of PM10 µg m^{-3}	PM2.5 µg m^{-3}	Measurements from our team Concentration of PM10 µg m^{-3}	PM2.5 µg m^{-3}	Avaragec oncetratio n PM2.5	Avarage concetratio n PM10
05-06.02.2019	1 **FSHMN**	**31.11**	**52.16**	**58.09**	**50.74**	30-55	50-90
06-07.02.2019	2 **ST.AUT**	**29.28**	**30.39**	**31.95**	**26.15**	30-55	50-90
07-08.02.2019	3 **REK.**	**63.26**	**57.65**	**35.62**	**33.87**	30-55	50-90
10-11.02.2019	4 **CENT.**	**71.81**	**65.62**	**41.10**	**40.76**	30-55	50-90
11-12.02.2019	5 **ZH. P.**	**20.03**	**16.74**	**47**	**31.08**	30-55	50-90
12-13.01.2019	6 **DRE.**	**70.68**	**17.46**	**73.78**	**38.99**	30-55	50-90

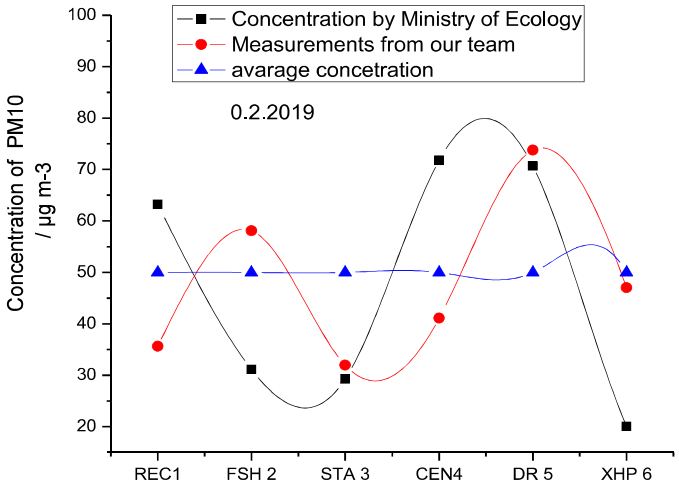
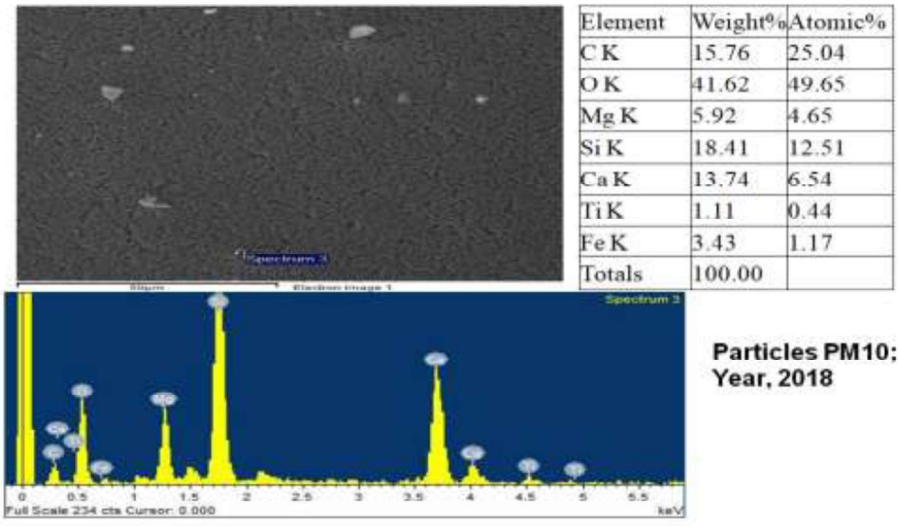


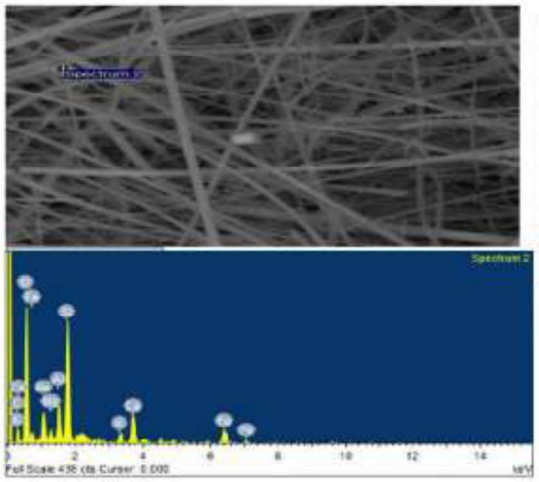
Figure 4. Graphic presentation of PM10 concentration by the Ministry of Ecology of the Northern Republic of Macedonia and our team at various locations in Tetovo, January, February 2019

The main interest in this work was to detect the fine dust particles with the help of suitable filters and then to analyze them qualitatively and quantitatively. Of greatest interest was to determine the fine dust particles chemically. For this purpose, the particles were analyzed with the help of the SEM-EDX method. The results are shown in Figure5 and Figure 6. The main constituents of PM10 particles are carbon, oxygen, silicon and iron. The minor constituents are titanium, calcium and magnesium. It is appreciated that these particles do not contain carcinogenic heavy metals. Thesmallest particles PM2.5 contain other lighter elements such as: aluminium, potassium and sodium. The same chemical compositions for fine dust particles (PM2.5 and PM10) are also found for the year 2019.



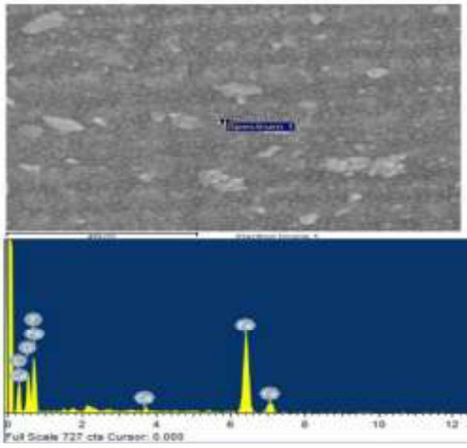
Element	Weight%	Atomic%
C K	15.76	25.04
O K	41.62	49.65
Mg K	5.92	4.65
Si K	18.41	12.51
Ca K	13.74	6.54
Ti K	1.11	0.44
Fe K	3.43	1.17
Totals	100.00	

Figure 5. Particle analysis of PM10 with SEM-EDX in 2018



Element	Weight%	Atomic%
C K	17.80	25.80
O K	53.23	57.90
Na K	4.31	3.26
Mg K	1.06	0.76
Al K	3.28	2.11
Si K	10.47	6.49
K K	1.18	0.52
Ca K	3.67	1.59
Fe K	5.01	1.56
Totals	100.00	

Particles PM 2.5; Year, 2019



Element	Weight%	Atomic%
C K	22.82	39.34
O K	16.58	21.46
F K	23.12	25.21
Ca K	0.63	0.33
Fe K	36.85	13.67
Totals	100.00	

Particles PM 10; Year, 2019

Figure 6. Particle analysis of PM10 and PM2.5 with SEM-EDX in 2019

Data from the internal service in Clinical Hospital in Tetovo for hospitalized patients with lung carcinoma in the period 2013-2019.

The rest of the paper deals with the effects of these particles on diseases of the respiratory system, cardiovascular, nervous system, lung carcinoma and comorbidities.

In our paper we used the reports obtained from the Statistical Office on the morbidity and mortality of the population in the years 2013-2019, as well as statistics of hospitalized in the internal ward at the Clinical Hospital of Tetova in the last four years for respiratory diseases, cardiovascular, respiratory, bronchial asthma and Ca pulmonum, The analysis of the documentation was retrospective and we analyzed the histories of these patients where the methods used were in line with laboratory standards, Ecg, thoracic radiography, CT thorax, tumor markers and others [7].

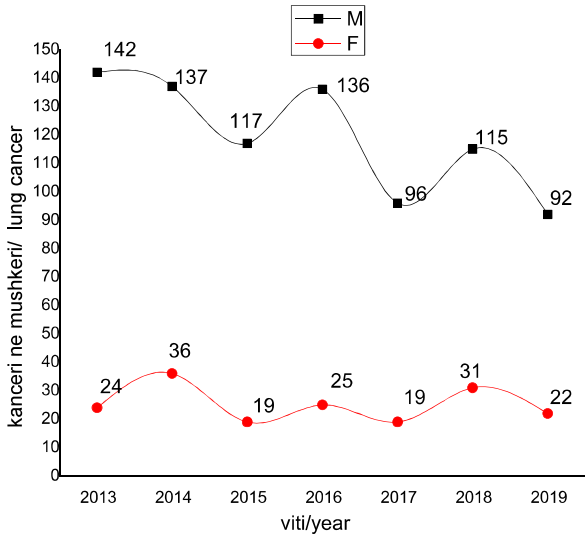


Figure 7. Data from the internal service at the Clinical Hospital of Tetova for patients who died of lung cancer at the Hospital of Tetovo in the period 2013-2019

Based on statistics in the internal ward for 2019, 29211 patients were controlled, morbidity, respectively mortality for one year was 146 subjects in 2018, respectively 136 subjects for 2015. As a precaution, periodically to improve the monitoring programs for PM 2.5 and PM 10 particles based on scientific data, as well as redefine the regulations and limit values for respiratory particles in the environmental air. If we confirm air pollution in a certain region, urgent measures are foreseen. In developed countries and in our country, there are written regulations regarding the maximum concentration of PM particles and plans on how to reduce them [8,9].

4. Conclusion

In the second table, we notice a difference with respect to the PM10 particulate concentrations measured in six comparative points. As a comparative point we have taken the city center of Tetovo: Rectorate of the University of Tetovo (1), Faculty of Natural Sciences and Mathematics (2), Tetovo bus station (3), Hotel Liraku (4), Tetovo city stadium (5), Zito Polog Tetovo companies (6). The same values are shown once again in the diagram below, Table 2, we notice that the PM10 concentration in the center of Tetovo (1) and the city stadium (2) is slightly higher compared with the lower values in the other reference points. This value contradicts the values given by the ministry of ecology, as they are higher, and these values are given by an instrument placed in a position that indicates the value for a landmark. With regard to this change, even atmospheric conditions, current air pressures, geographic position (plateau or pit) and wind speed can influence these values, as the PM10 particles are always in motion, and the vertical height that can be displaced can be two meters, these particles always move and are very close to the surface of the earth.
We conclude that environmental pollution with PM10 particles, PM2.5 is relative.
Diseases of the respiratory organs, due to air pollution in the living environment by PM10 and PM2.5 particles are factors relevant to the negative impact on human health.
We do not have large and permanent environmental pollutants in Tetovo and the surrounding area.

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