

THE LEVEL OF AIR POLLUTION WITH SUSPENDED PARTICULATE MATTER IN BIHOR COUNTY BETWEEN 2019 AND 2021

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RESEARCH ARTICLE

Abstract

This paper studies the degree of pollution with suspended particulate matter in Bihor County for a period of three years (2019, 2020, 2021). We used data from the Bihor Oradea Environmental Protection Agency, which deals with air pollution monitoring in Bihor County. Four air sampling stations are located in Bihor County. Of which two are located in Oradea, one at the headquarters of A.P.M. Bihor, BH₁ this being an urban station, and the second one is in Water Lily, near McDonalds- drive BH₃ being a traffic station. The other two are industrial stations BH₂ is located in the Episcopia Bihor, and BH₄ is located in Țețchea.

Keywords: maximum permissible concentration, monitoring, sampling points, suspended particulate matter.
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INTRODUCTION

Suspended particulate matter are formed from a complex mixture of very small particles and liquid droplets, they are formed in the atmosphere as a result of complex reactions of chemicals.

These particles can be very dangerous, and they can affect our health in the long run. Suspended particulate matter PM₁₀ is 10 micrometer in diameter (Köteles, 2011). Particulate matter can be of two natural and anthropogenic kinds.

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Natural sources are volcanic eruptions, rock erosion, sandstorms, pollen dispersion, etc. These particles in some cases may contain carbon particles, heavy metals, or more severely toxic pollutants, iron oxides, sulfates (Pereș, 2011).

MATERIAL AND METHOD

For this study we used data from the Environmental Protection Agency of Bihor Oradea. In Bihor county area there are 4 sampling stations that ensure the monitoring of air quality in Bihor County. The 4 sampling stations are strategically located, the first BH₁ is located in the A.P.M. Bihor Oradea headquarters, Dacia Boulevard nr. 25/A being an urban station. The second BH₂ station is

located in Episcopia Bihor, street Matei Corvin nr.106/A and is an industrial station. The third BH₃ station is located in the Nufăru Quarter, near McDonalds-drive being a traffic station. And the fourth BH₄ station is located in Țețchea, being an industrial station (www.apmbh.ro).

1. The monitoring and supervision of air pollution with particulate matter is carried out by the Environmental Protection Agency of Bihor Oradea (www.calitateair.ro).

In this paper we studied the variations, the level of pollution with suspended particulate matter, over a period of three years (2019 - 2021) (Köteles & Pereș, 2019). The limit value for suspended particulate matter PM₁₀, according to Law no. 104/2011 on ambient air quality is the average daily value of 50 µg/m³ (STAS 12574/1987).

RESULTS AND DISCUSSIONS

1. Annual evolution of suspended particulate matter

For 2019, the highest level of concentrations of suspended particulate matter was recorded in Episcopia Bihor BH₂ with a value of 20.499 µg/m³, followed by BH₁ in Oradea with 18.148 µg/m³. The value less than 4.825 µg/m³ was determined in BH₃ of Nufăru.

In 2020, the highest value was recorded in Oradea at BH₁ of 18.281 µg/m³, of 17.517 µg/m³ at the BH₃ station, followed by BH₄ in Țețchea with 15.861 µg/m³. The higher value

for 2021 was determined at the BH2 sampling point being 24.783 $\mu\text{g}/\text{m}^3$. Close values were also determined at BH1 (21.754 $\mu\text{g}/\text{m}^3$), BH4

(13.428 $\mu\text{g}/\text{m}^3$) and BH3 (10.805 $\mu\text{g}/\text{m}^3$) (Figure 1)

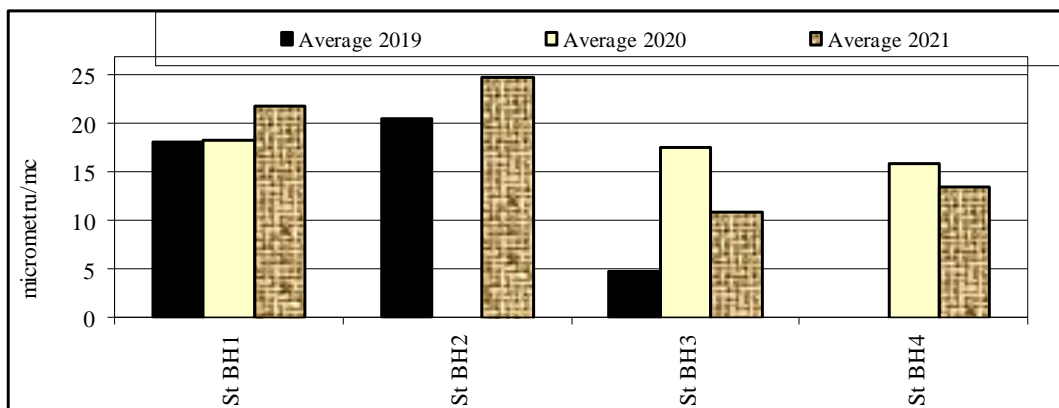


Figure 1 The evolution of suspended particulate matter average concentrations in Bihor county, 2019 – 2021

Following the analysis of the three years studied, the evolution of the multiannual average concentrations shows that the highest level was determined at the BH2 station 22.141 $\mu\text{g}/\text{m}^3$, followed by the stations BH1 with

19.394 $\mu\text{g}/\text{m}^3$, BH4 with 14.645 $\mu\text{g}/\text{m}^3$ and BH3 with 11.049 $\mu\text{g}/\text{m}^3$ (Figure 2).

From these data we can find that the maximum permissible concentration has not been exceeded.

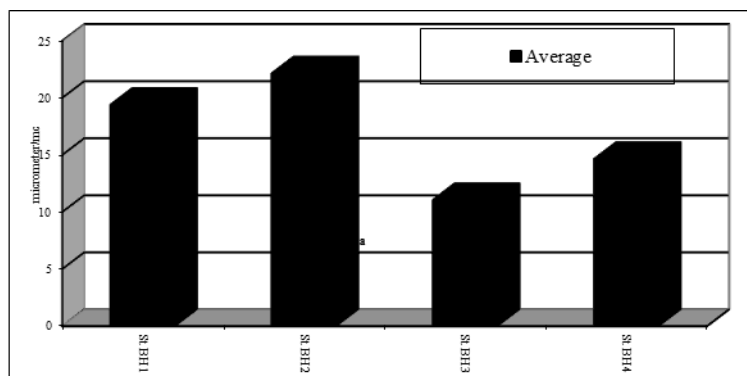


Figure 2. Evolution of the multiannual average concentrations (2019 – 2021) of suspended particulate matter at the 4 monitoring points in Bihor county

2. Monthly evolution of suspended particulate matter

From the average concentration of the four sampling points during the period considered (2019 - 2021), for 2019 it appears that the highest value was recorded in January a value of 26.435 $\mu\text{g}/\text{m}^3$, of 25.596 $\mu\text{g}/\text{m}^3$ in October and of 23.925 $\mu\text{g}/\text{m}^3$ in February. The lowest value was determined in May at 9.708 $\mu\text{g}/\text{m}^3$.

During 2020, the highest values were recorded in February of 30.188 $\mu\text{g}/\text{m}^3$, November of 26.597 $\mu\text{g}/\text{m}^3$ and 24.705 $\mu\text{g}/\text{m}^3$ in December. The lowest value was recorded in March being 7.123 $\mu\text{g}/\text{m}^3$.

The highest values for 2021 were determined in February at 28.712 $\mu\text{g}/\text{m}^3$, followed by November (25.727 $\mu\text{g}/\text{m}^3$) and December (22.520 $\mu\text{g}/\text{m}^3$) (Figure 3).

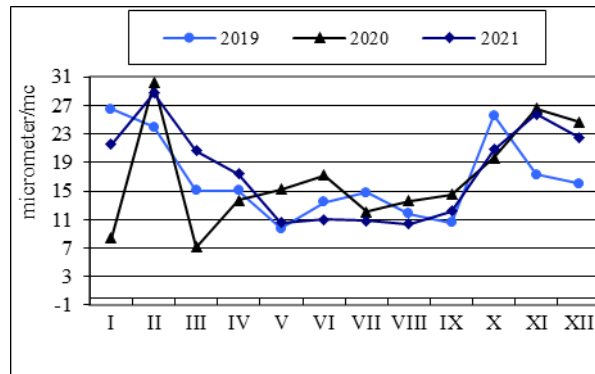


Figure 3. Monthly pattern of suspended particulate matter in Bihor county (the average of the 4 sampling points)

The analysis of the evolution of the multiannual monthly average concentrations of the level of suspended particulate matter pollution for the studied period shows that the highest concentrations were determined in the

month of January $24.489 \mu\text{g}/\text{m}^3$, November $24.132 \mu\text{g}/\text{m}^3$ and December $21.818 \mu\text{g}/\text{m}^3$. And the lowest values were determined in July $10.379 \mu\text{g}/\text{m}^3$, June $10.61 \mu\text{g}/\text{m}^3$ and August $11.206 \mu\text{g}/\text{m}^3$ (Figure 4).

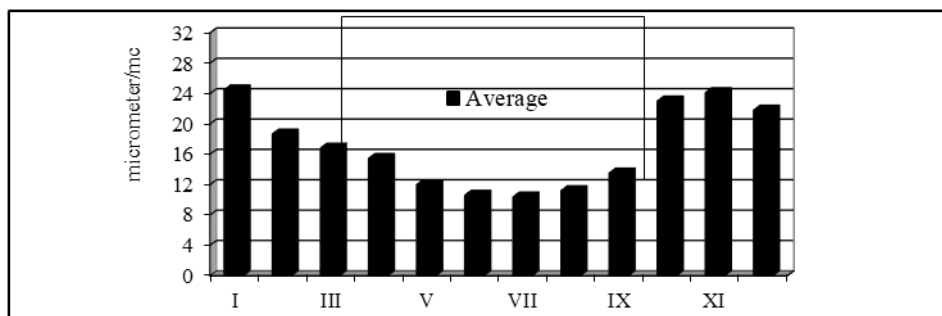


Figure 4. The evolution of multiannual monthly average concentrations of suspended particulate matter in Bihor (the average of the 4 sampling points)

3. Evolution of particulate matter pollution at sampling points

Following the analysis of the pollution level, at the BH1 sampling station that is located in Oradea at the A.P.M. Bihor headquarters, it results that the highest value in 2019 was determined in January $38.981 \mu\text{g}/\text{m}^3$, followed

by February $36.910 \mu\text{g}/\text{m}^3$ and October $23.886 \mu\text{g}/\text{m}^3$ (Figure 5).

In 2020, the highest values were recorded in December $31.607 \mu\text{g}/\text{m}^3$ and January $23.755 \mu\text{g}/\text{m}^3$. The highest values determined in 2021 were in February ($34.116 \mu\text{g}/\text{m}^3$) and December ($31.115 \mu\text{g}/\text{m}^3$).

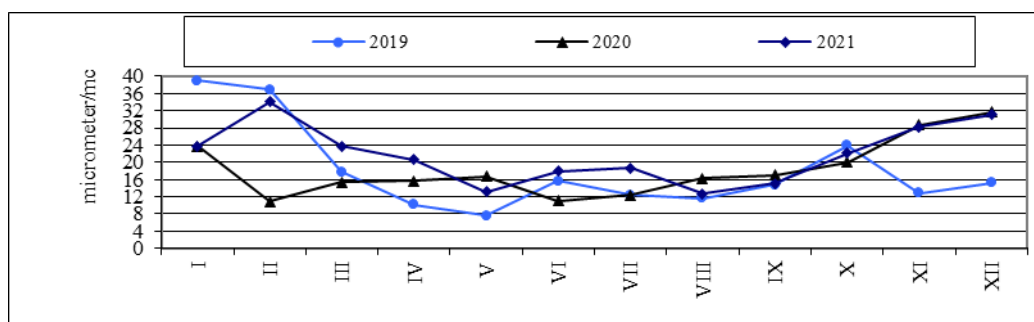


Figure 5 Monthly evolution of suspended particulate matter at sampling point BH₁

At sampling point BH1 in 2019, there were 10 exceedances of the maximum permissible concentration of 50 µg/m³. These exceedances were in January 4 overshoots, February 3

overshoots and October 3 overshoots. In 2020 there were 2 overshoots, and in 2021 also 2 exceedances (Table 1).

Table 1

Values of overshoots at the sampling station BH₁

Sampling point	Year	Month	Day	The values µg/m ³
BH ₁	2019	January	10	61.510
			20	55.460
			24	53.540
			26	64.490
		February	8	51.490
			10	52.930
			16	60.510
		October	17	70.810
			18	62.130
	25		57.720	
	2020	November	7	56.060
			16	53.470
2021	December	15	69.820	
		16	67.450	

At the BH₁ sampling station in the Episcopia Bihor locality, for 2019, higher values were determined in October 30.74 µg/m³ and in July 28.647 µg/m³. Close values were also recorded in 2020 in the months of November

(34.139 µg/m³) and December (30.032 µg/m³). In 2021 the determined values were higher, in November 41.848 µg/m³ and February 39.818 µg/m³ (Figure 6).

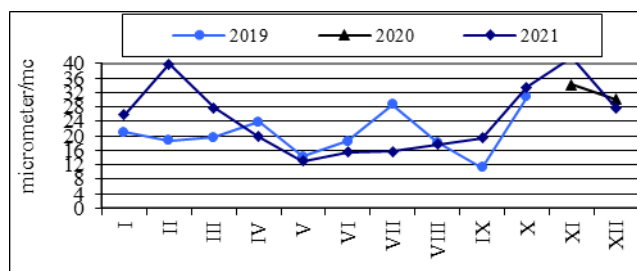


Figure 6 Monthly evolution of suspended particulate matter at sampling points BH₂

At the BH₂ monitoring point, 24 exceedances of the maximum permissible concentration of 50 µg/m³ occurred. In 2019,

there were 2 exceedances, but in 2021 there were 22 exceedances (Table 2).

Table 2

Values of overshoots at the sampling station BH₂

Sampling point	Year	Month	Day	The values µg/m ³	Sampling point	Year	Month	Day	The values µg/m ³	
BH ₂	2021	October	26	57.270	BH ₂	2021				
			27	56.730						
	2021	February	18	65.640				November	12	66.360
			19	51.090					13	59.820
			22	66.360					15	90.360
			23	66.730					16	75.450
			24	82.36					17	67.450
			25	88.180					18	65.450
			26	96.730					December	9
		March	26	56.360				14		53.090
			October	27				62.730		15
		28		66.000						
	29	75.450								
	30	65.090								
			31	50.730						

The concentration level of particulate matter at the BH₃ monitoring station, for the years studied, shows that in 2019 the highest concentration was in October 22.162 $\mu\text{g}/\text{m}^3$, followed by November 21.701 $\mu\text{g}/\text{m}^3$. In 2020,

the highest values were also in October 21.165 $\mu\text{g}/\text{m}^3$ and November 20.378 $\mu\text{g}/\text{m}^3$. In 2021, the highest values were in February 18,819 $\mu\text{g}/\text{m}^3$ and January 18,088 $\mu\text{g}/\text{m}^3$. (Figure 7)

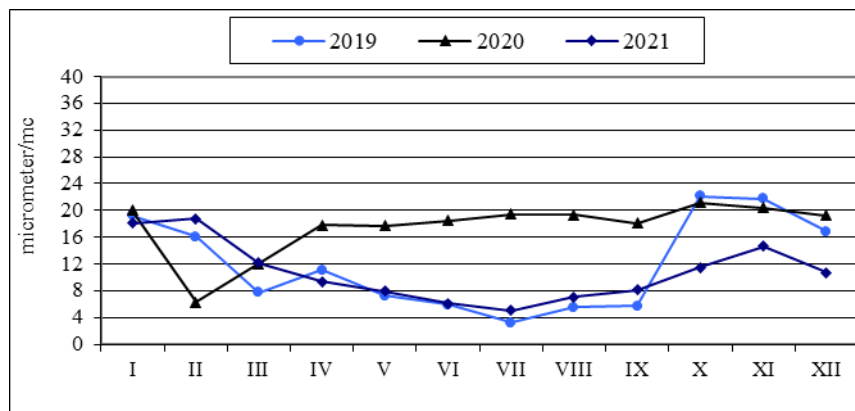


Figure 7 Monthly evolution of suspended particulate matter at sampling point BH₃

At the BH₃ monitoring point, there were 2 exceedances of the maximum permissible concentration in 2019 on 5 December 65.290 $\mu\text{g}/\text{m}^3$ and on 7 December 62.050 $\mu\text{g}/\text{m}^3$.

No determinations were made at the BH₄ sampling point in 2019. In 2020 the highest level was in January 46.829 $\mu\text{g}/\text{m}^3$ as of October 28.883 $\mu\text{g}/\text{m}^3$. And in 2021, the highest value was in January 22.096 $\mu\text{g}/\text{m}^3$ (Figure 8).

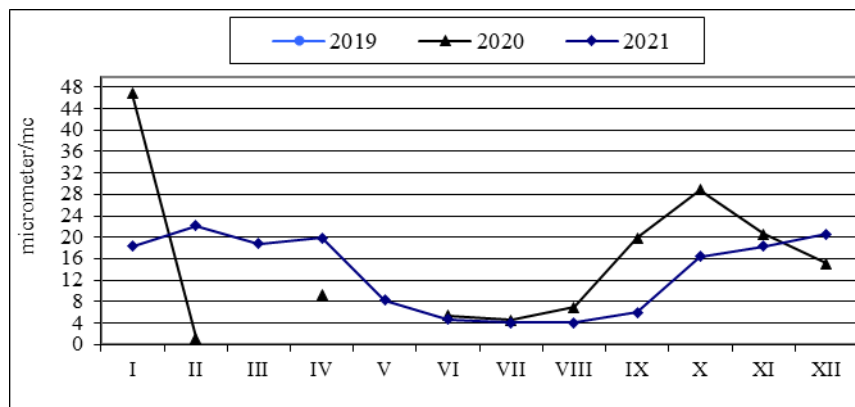


Figure 8 Monthly evolution of suspended particulate matter at sampling point BH₄

In 2020 the highest level was in January 46.829 $\mu\text{g}/\text{m}^3$ as of October 28.883 $\mu\text{g}/\text{m}^3$.

And in 2021, the highest value was in January 22.098 $\mu\text{g}/\text{m}^3$ (Table 3).

Table 3

Values of overshoots at the sampling station BH ₄				
Sampling point	Year	Month	Day	The values $\mu\text{g}/\text{m}^3$
BH ₄	2020	January	8	50.30
			10	67.18
			11	81.54
			12	64.69
			14	67.20
			17	78.39
			18	65.96
			20	60.12
			21	53.29

CONCLUSIONS

From the analysis of the pollution level of particulate matter, for the period 2019 - 2021, at the 4 sampling stations it results that from the evolution of the average and multiannual concentrations as well as, annual and multiannual monthly averages, the maximum permissible concentration of 50 $\mu\text{g}/\text{m}^3$ has not been exceeded.

But from the daily measurements made at the 4 sampling stations were 45 days when the maximum permissible concentration was exceeded.

It was found that these exceedances were mostly in the cold period of the year, because during this period the houses in Bihor County are heated with wood.

Chimneys evacuate large amounts of particulate matter into the atmosphere, which in the absence of precipitation can remain long in the atmospheric air.

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