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# DETERMINATION OF SETTLEABLE PARTICLES FROM THE AIR IN CITY OF HUNEDOARA

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**Abstract:** Air is the main element necessary to maintain life, so it is imperative to keep his natural quality, even if urbanization and industrialization increase the risk of polluting the atmosphere. One of the indicators for assessing air quality is the quantity of settleable particulate material from the atmosphere. This paper aims to determine the concentration of settleable particles produced by multiple sources such as road traffic, industrial activities, etc. The sampling was done for a 4 months period (from the middle of February until the middle of June, 2018) in 5 sampling points from Hunedoara. The maximum concentration of settleable particles of 15.4445 g/m<sup>2</sup>month was obtain in Peștișu Mare in April/May, while the minimum value obtained of 1.6273 g/m<sup>2</sup>month was in May/June on Tudor Vladimirescu Street.

**Keywords:** settleable particles, collecting container, air quality, pollution

## 1. INTRODUCTION

Air pollution, especially in the urban areas, can have negative effects both on the environment [1] and on human health [2,3]. Therefore, in order to maintain and improve the quality of ambient air, indicators have been set that are being monitored, the maximum admissible concentrations being specified in Law 104 of 15 June 2011.

Generally the sources that can pollute the atmosphere are either anthropic or natural. While natural sources only causes exceptionally major atmospheric pollution, the anthropic ones are much more important, in this category being included most of the activities of man made towards the progress of society [2]. One of the groups of atmospheric pollutants is solid particles, that can be produced by various industrial activities, road traffic, agriculture, burning the bio mass, etc. [3,4].

The settleable particulates material represents the part of dust that deposits on the ground (dustfall), while the suspended particles remain in the atmosphere. Regarding the particles size, the settleable particles are larger than 10 μm and are characterized by low air stability [5], while suspended particles have dimensions ≤ 10 μm and are characterized by higher air stability [2].

The deposition (sedimentation) process is actually a phenomenon of self-purification of the air [2], because it leads to the decrease of dust concentration from the atmosphere, but on the other hand the solid particles that deposits on vegetation affect plants different, according to the physical and chemical characteristics of dust [6]. The self-purification process is influenced by the characteristics of emissions (nature and volume of pollutant emissions), the meteorological factors (air temperature, air humidity, precipitation, air currents), the geographic factors (relief, vegetation) and the urbanistic factors (street ventilation) [2].

The aim of this paper is to determine the concentration of settleable particles produced by multiple sources at 5 sampling points from Hunedoara. The method consists in collecting settleable dusts from the atmosphere in containers, within a set time interval and their gravimetric determination. The values obtained are compared with the maximum permitted concentration according to the regulations.

## 2. MATERIAL AND METHODS

The collection of settleable particles from the atmosphere was performed on the basis of the recommendations from STAS 10195-75. The sampling was done between the middle February and the middle of June 2018 at the five established sampling points, their positioning being marked in Figure 1: Revolutiei Street (1), Răcăștie (2), Peștișu Mare (3), Buituri Street (4) and Tudor Vladimirescu Street (5), Hunedoara. The distance between this points varies between 0.7km and 6.5km.

Cylindrical-shaped collecting containers were positioned at a height of between 1.5 and 2 m on a device made up of a metallic support. It was considered that the distance from the sampling device to other objects in the field should be at least 4-5 m. For the experiments were used plastic containers, previously cleaned with detergents and washed thoroughly with water. At the sampling place, water was introduced into the collecting vessel so that its level was 3-4 cm from the bottom of the vessel. The exposure time of the collecting containers was 30 days [7]. During this period the vessels were controlled to be filled in, if necessary, with water.

At the end of the collection period, the sedimentation containers were brought to the laboratory to measure the amount of powder collected. First, the large particles were removed, and then the water was poured in laboratory glasses and heated to evaporate almost to dry. Then the content was quantitatively passed to a porcelain capsule. The solution in the capsule is evaporated to dryness, cooled and weighed at the analytical balance. The drying, cooling and weighing operations are repeated to constant mass. The difference between the weight of the capsule with the powder and the empty capsule weight is the total amount of dust deposited [7].

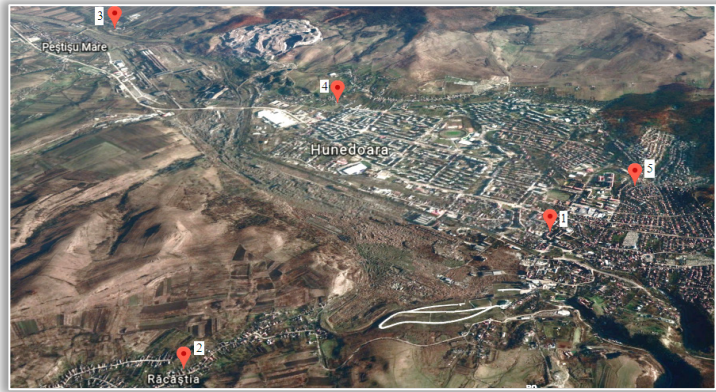


Figure 1. Sampling points in Hunedoara

### 3. RESULTS AND DISCUSSION

The dust that deposit's from the atmosphere is represented both by the particles settled under the action of gravity and by those driven by rainfall [7].

In Hunedoara, the loading of the atmosphere with solid particles can be caused by the existing industrial activity, intense traffic, but also other areas that can generate dust such as the slag heap located between 3 and 4 sampling points, respectively the area situated near sampling point 4, which is part of the old industrial platform being undergoing greening. Due to the activities carried out in order to commercialize the slag as well as the works made in the greening process, dust particles can be trained in the atmosphere and carried by wind.

Figures 2-6 presents the variation in the concentration of settleable particles ( $\text{g}/\text{m}^2\text{month}$ ) deposited from the atmosphere, during the analyzed period of the year 2018, at the 5 sampling points proposed in Hunedoara.

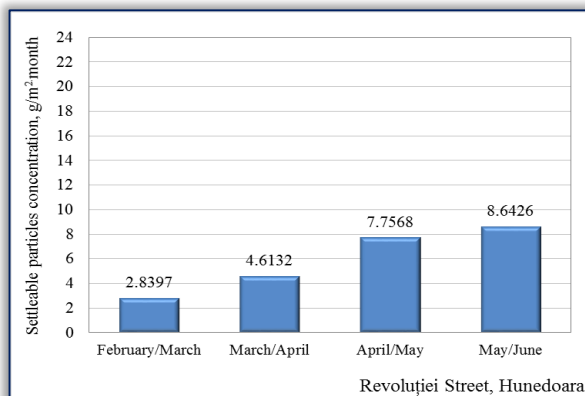


Figure 2. Settleable particles concentration on Revolution Street (1)

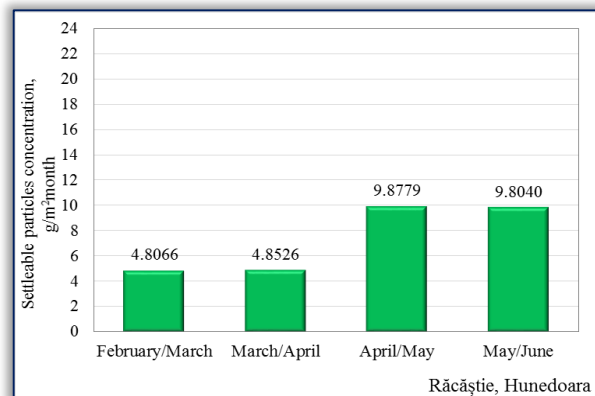


Figure 3. Settleable particles concentration in Răcăștie (2)

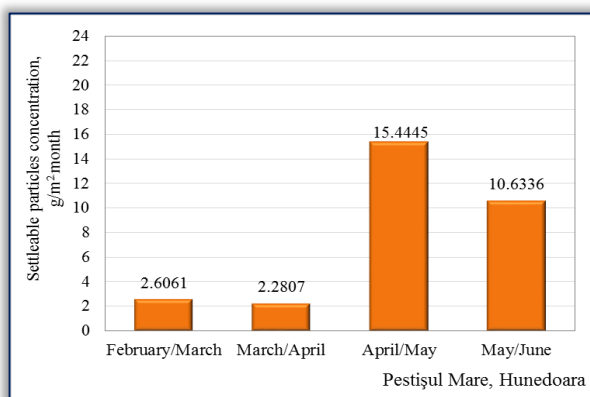


Figure 4. Settleable particles concentration in Peștișu Mare (3)

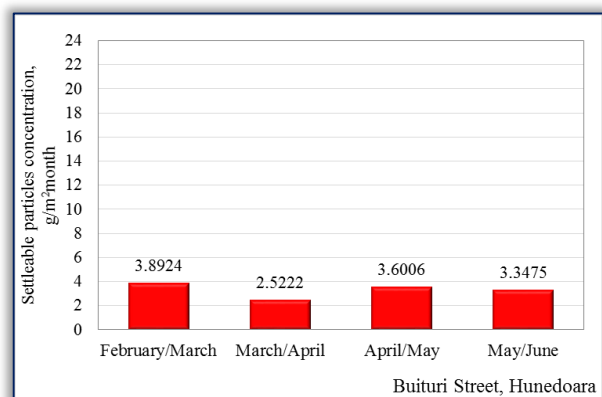


Figure 5. Settleable particles concentration on Buituri Street (4)

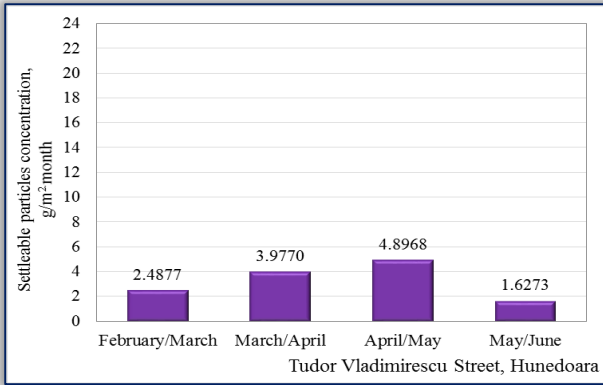


Figure 6. Settleable particles concentration on Tudor Vladimirescu Street (5)

In figures 2, 3, 4 and 6, we can observe a trend of concentration increase from February/March to April/May. At sampling point 4, the concentration has slightly varied over the 4 months analyzed.

It should be noted that the maximum admissible concentration for settleable particles is 17g/m<sup>2</sup>-month, according to STAS 12574/1987 [4,8].

Analyzing the graph in figure 7 we can conclude that during the analyzed period the highest concentration of settleable particles was recorded in April/May (15.4445 g/m<sup>2</sup>-month) at the sampling point 3 (Peștișu Mare) and the lowest concentration in May/June (1.6273 g/m<sup>2</sup>-month) at sampling point 5 (Tudor Vladimirescu Street).

On April 16-17, 2018, a wave of Saharan sand arrived in the country, so this could explain the fact that in April/May period at the 2, 3 and 5 sampling points was recorded the highest settleable particles concentration, while at the other two sampling point the concentration was close to the maximum values.

By calculating the average of monthly concentration of settleable particles obtained in different sampling point, in the studied period (4 months), it is showed that maximum value can be observed in Peștișu Mare which is of 7.7412 g/m<sup>2</sup>-month followed by Răcăștie, Revolution Street, Buituri Street and Tudor Vladimirescu Street (see figure 8).

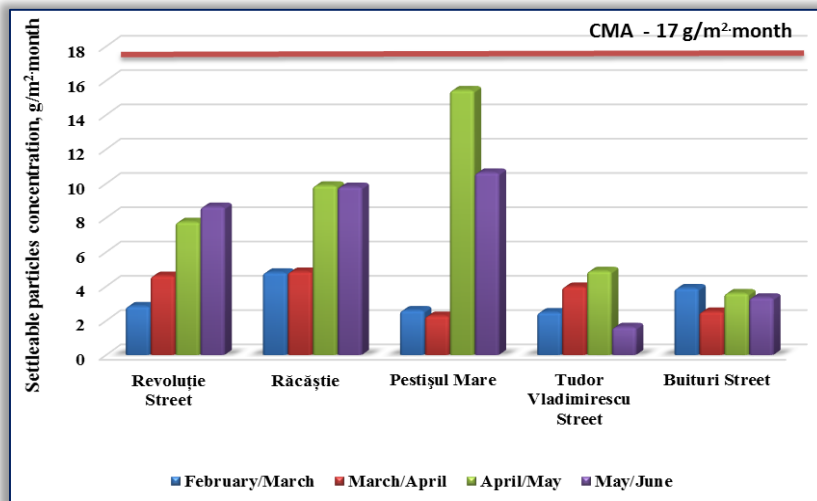


Figure 7. Settleable particles concentration in different sampling points

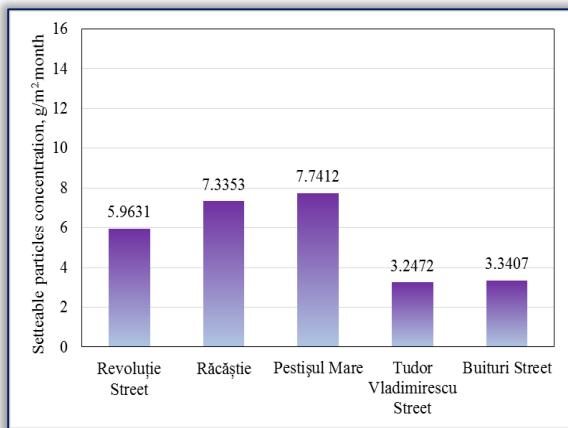


Figure 8. The average of monthly settleable particles concentration in different sampling points

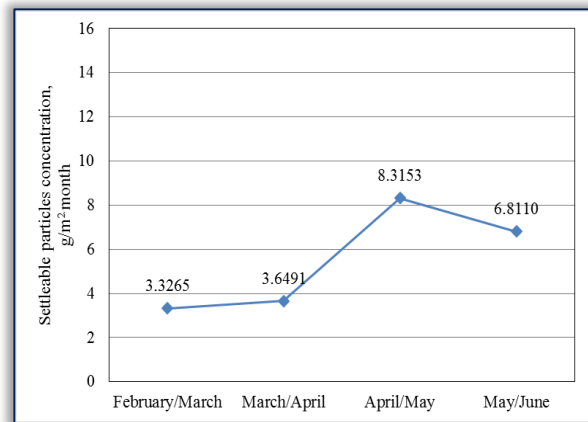


Figure 9. The average of monthly settleable particles concentration in different periods

By determining the average of monthly concentration of settleable particles obtained in the four periods (for the 5 sampling points established) can be observed that the maximum value is registered in April/May period,

which is of 8.3153 g/m<sup>2</sup>month followed by 6.8110 g/m<sup>2</sup>month, 3.6491 g/m<sup>2</sup>month, 3.3265 g/m<sup>2</sup>month respectively for May/June, March/April and February/March periods (Figure 9).

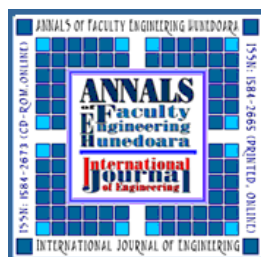
#### 4. CONCLUSIONS

Based on the study results the following can be concluded:

- The average of monthly concentration of settleable particles obtained at different sampling point, in the studied period, registered the maximum values at Peștișu Mare (7.7412 g/m<sup>2</sup>month) and Răcăștie (7.3353 g/m<sup>2</sup>month);
- In the third period (middle of April-middle of May) has been recorded the highest of the average monthly concentration of settleable dusts, which is equal to 8.3153 g/m<sup>2</sup>month;
- The concentration level of settleable particles did not exceed the maximum allowed of 17g/m<sup>2</sup>month throughout the analyzed period, at neither of the sampling points.

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