Study of the dispersed composition of dust particles on the leaves of apricot trees (Prúnus armeníaca) in the residential area

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Abstract. The authors investigate and analyze the dispersion composition of dust particles on the leaves of apricot trees (Prúnus armeníaca) in the residential area of the Sredneakhtubinsky district of the Volgograd region near industrial enterprises in comparison with the dispersed composition of dust on the leaves of apricot trees (Prúnus armeníaca) growing on the territory in a conditionally clean zone (control) in the absence of anthropogenic pressure from industrial complexes in the SNT "Oroshenets" (Volgograd, Sovetsky district). The research points in the residential area were taken on the territory of social facilities (boarding school, hospital, kindergarten) and low-rise residential areas. The research material is the leaves of apricot trees (Prúnus armeníaca) in the residential area of the Sredneakhtubinsky district of the Volgograd region and in the SNT Oroshenets, Volgograd, Sovetsky district (conditionally clean zone, (control). Research methods: washing off dust from leaf blades into a glass with distilled water, filtering the suspension through an AFA-VP filter, obtaining a filtrate, natural drying of the filtrate at a temperature not higher than 30-40 ° C, placing the dried filtrate on a glass slide of an optical microscope, making measurements of dust particles, dust processing, study of the dispersed composition of dust (according to GOST R 56929-2016). Areas of environmental risk have been identified, these are the territories of a kindergarten, a hospital and other low-rise residential buildings, as well as places that are safe for the population (boarding school, etc.). These studies indicate environmental pollution, in the future, it is required to determine the chemical composition of dust particles and identify sources of pollution and take environmental measures.

Introduction
The study of the dispersed composition of dust in the atmospheric air of urban agglomerations makes it possible to predict the real ecological situation and, if necessary, develop a number of measures to improve the quality of life and reduce the risk of morbidity among the population. Until recently, it was believed that "dust particles larger than 5 microns do not pose a threat to human health, they are easily retained in the nasal cavity and do not pass into the body, while dust smaller than 5 microns is most dangerous for humans" [1], [2]. However, as shown by numerous studies of recent years, carried out by scientists in different countries of the world, both PM 2.5 and PM10 are sources of various kinds of human diseases. So, Wu RS; Zhong LJ; Huang XL; Xu HB and others found an association between fine dust (PM 2.5, PM 10) and mortality at age 65 from cardiovascular disease and respiratory diseases in China [3]. G. Cesar, A. Cristina, L. Nascimento demonstrated the effect of PM10 on hospitalization...
of children due to respiratory diseases [4]. Mehdi Mokhtari, Mohammad Miri, Hassan Khorsandi [etc.] and others noted high rates of premature mortality from cardiovascular and respiratory diseases associated with PM 10 and PM 2.5 in Yazd (Iran) [5]. T. Y. Kim, Tae-Young, H. Kim, S. Yi [etc.] have also confirmed the short-term impact of PM 2.5 and PM 2.5-10 on mortality among the population in large cities in South Korea [6].

R. Rumi, S. Ghosh, P.K. Padhy and others confirmed changes in hematological parameters as well as oxidative stress in rural women from tribal areas in northeastern India exposed to PM 10 and PM 2.5 [7]. G. Meng, B. Gufran, S. Shaojie [etc.] calculated annual changes in population mortality and life expectancy depending on the province due to the emissions of pollutants from power generation that generate PM2.5 into the environment [8]. T. Chan, Z. Zhang, B. Lin [etc.] investigated the relationship between long-term exposure to PM2.5 in the environment and chronic kidney disease in the population [9]. ZI Andersen, M. Pedersen, G. Weinmayr [etc.] found compelling evidence for a link between long-term exposure to PM2.5 absorption from the ambient air, which is caused by traffic and the development of malignant brain tumors among urban populations in several European countries (Holland, Sweden, Italy, Austria, Denmark, etc.) [10].

Based on the analyzed works, the particle size has an important effect on the health of the population, therefore, the study of the dispersed composition of dust particles in the urban environment is undoubtedly an important and relevant topic. Monitoring of dust in the atmospheric air of urban areas is carried out traditionally by taking atmospheric air for a certain period of time and identifying fine dust and pollutants in air samples. Along with the traditional method of studying dust particles in the atmospheric air of an urban environment, there is a large number of experimental studies devoted to phytomonitoring of urban areas, namely, the study of dust particles and their characteristics collected on plant leaves. Analysis of works on phytomonitoring by domestic and foreign authors allows us to conclude that plant leaves are excellent indicators and passive biomonitors of fine dust in the atmospheric air of urban areas. Absorbing daily a large amount of dust-like particles floating in the atmospheric air, leaf blades of plants reflect the real ecological situation in the investigated area, since they have the property of accumulating dust on their surface over a certain period of time. The study of the dispersed composition of dust on plant leaves (for example, the leaves of apricot trees (Prúnus armeníaca)) can give an objective picture of the ecological situation in the residential area. The hypothesis of this scientific study is the following: the study of the dispersed composition on the leaves of trees (for example, the leaves of apricot trees (Prúnus armeníaca) of the residential zone in the Sredneakhtubinsky district of the Volgograd region) will identify areas of environmental risk and safe places to live in the residential zone.

The aim of the work is: to study the dispersion composition of dust particles on plant leaves (using the example of apricot trees (Prúnus armeníaca)) growing in the residential area of the Sredneakhtubinsky district of the Volgograd region in comparison with the conditionally clean zone (control) in the SNT Oroshenets.

Research objectives:
1) selection of the territory of the residential area, determination of sampling points and research material
2) collection of leaves from apricot trees (Prúnus armeníaca) in the residential area at the selected sampling points and in the conditionally clean area (control) in the SNT “Oroshenets”, Sovetsky district of Volgograd
3) extraction of dust-like particles from leaves of apricot trees (Prúnus armeníaca) and study of the dispersed composition of dust
4) comparative analysis of the dispersed composition of dust particles collected from the leaves of apricot trees (Prúnus armeníaca) in the residential zone of the Sredneakhtubinsky district of the Volgograd region with the dispersed composition of dust particles in a conditionally clean zone (control)
5) conclusions and recommendations based on the research results.

Analysis of publications
Analysis of publications on the study of the dispersed composition of dust on plant leaves led to the conclusion that in Russia most of the works on this topic are devoted to the study of dust in the traditional way in an urban environment: sampling of atmospheric air in residential areas with subsequent analysis of dust particles. So, for example, Zaitseva N.V., May I.V., Maks A.A., Zagorodnov S.Yu. assessed the exposure of the population in the zones of influence of emissions from industrial stationary sources of enterprises of machine-building and metallurgical profiles in the study of the dispersed and component composition of the solid component of dust [11]. Golokhvast K.S. studied nano- and micro-sized particles of atmospheric suspensions and their ecological effect in the cities of the Far East [12]. Somewhat later, Golokhvast K.S., Revtskaya I.L. and others investigated the distribution of dust particles by seven classes in the snow of Birobidzhan and in the “Bastak” reserve zone. They showed that in the atmospheric suspensions of the city of Birobidzhan, in ecologically significant quantities (up to 72.4%), technogenic microparticles are contained. The authors noted that the city of Birobidzhan has a negative effect on the composition of atmospheric suspended matter in the Bastak reserve [13]. Prosviryakova I.A., Shevchuk L.M. presented the results of a hygienic assessment of the content of fine particulate matter in the ambient air in a residential area located in the zone of influence of vehicle emissions. The authors analyzed the fractional composition of solid particles, carried out a hygienic assessment of the degree of air pollution, and determined the levels of risk to public health caused by air pollution of residential areas with fine particles [14].

There are few results of analyzes of Russian researchers who studied dust on plant leaves, but without analyzing their fractional composition.

So, Chernysheenko O.V. studied the leaves of urban trees and shrubs (Populus balsamifera; Pópulus nigra; Symphoricarpos albus; Sambucus nigra) according to the intensity of dust accumulation on them, but the dispersion of dust was not considered by the author [15]. Ageeva E.A., Kazantseva M.N. assessed the dust-holding capacity of leaves of trees and shrubs (Sorbus sibirica, Cotoneaster malanocardu, etc.) in Tyumen. Analysis of the data obtained showed that the average amount of dust deposited by the leaves of urban plants is significantly higher than in the green zone of the city. The dispersion of dust was not considered by the authors [16]. L. I. Atkina, M. V. Ignatova studied the amount of dust trapped by leaves on trees of Malus baccata L., Sorbus aucuparia L., Acer negundo L., Crataegus sanguinea L. in urban plantings of Yekaterinburg, growing along the highway, nevertheless, they did not study the diameters of dust particles [17].

As for foreign scientists, in this direction there is a fairly large number of works devoted to the study of fine dust on plant leaves in an urban environment. Thus, A. Przybysz, A. Saebo, H. Hanslin [etc.] monitored the accumulation of solid particles and trace elements on the leaf blades of evergreen species (Taxus baccata L., Hedera helix L. and Pinus sylvestris L.) in urban and rural areas taking into account the amount of precipitation and time. The authors found the greatest accumulation of pollutants in the air in the foliage of plants protected from rain; in places prone to traffic pollution, and the least dust accumulation was found in the leaves of rural plants. Among the analyzed species, P. sylvestris had the greatest amount of precipitated fine particles and microelements. These results showed that when assessing the overall effect of vegetation on pollutant recovery, it is necessary to take into account both the dynamics of deposition and leaching of leaves by rains during the season [18]. Later, R. Popek, A. Lukowski, C. Bates [etc.] carried out a series of studies in five Polish cities to study the fractions of fine dust, heavy metals and PAHs on plant leaves (Tilia cordata Mill). The authors found that strong winds reduced the amount of fine dust on the leaves, especially the finest fractions, but they did not find any connection with precipitation [19]. G. Sgrigna, A. Saebo, S. Gawronska [etc.] studied fine dust of different fractions: from 0.2 to 2.5 microns and from 2.5 to 10 microns on the leaves of a plant - Quercus ilex, incl. and deposition of PM 2.5; PM 10 in four districts of Terni (Italy). In this work, changes were found in the deposition of fine dust, which correlated, according to the authors, “with the distance to the main roads and the position downwind relative to the industrial zone” [20]. Y. Song, B. Maher, F. Li [etc.] carried out studies of fine dust on the leaves of trees of five evergreen plants in Beijing (China), studying their morphology, size, elemental composition, incl. their mass concentration [21]. J. Shi, G. Zhang, H. An [etc.] studied the elemental composition, density and size fractions of fine particles on the
leaf surfaces of 14 urban green plants (Salix matsudana, Euonymus japonicus, Magnolia denudate, Sophora japonica, etc.) from the overpass Xizhimen and to the Olympic Forest Park in Beijing (China) [22].

L. Mo, Z. Ma, Y. Xu [etc.] evaluated dust deposition on leaves and wax layer of 35 species (11 shrubs, 24 trees) in Beijing, China. Differences in the accumulation of fine dust between the species were found. Thus, Cephalotaxus sinensis, Euonymus japonicus, Broussonetia papyrifera, Koelreuteria paniculata, and Quercus variabilis were effective in capturing small particles. The results of this study can help to select species for urban green spaces, the purpose of which is to capture air pollutants and mitigate the adverse health effects of air pollution [23]. L. Lin, J. Yan, K. Ma [etc.] presented a new approach to the quantitative characterization of particulate matter deposited on the leaves of urban trees (Salix matsudana, Ailanthus altissima, Fraxinus chinensis), which consists in the accurate determination of the amount, size, shape and the spatial distribution of particles with different diameters on the leaves [24]. S. Janhall conducted an analytical review of studies devoted to the deposition rate of fine dust on the leaves of urban plants, the study of the density of PM2.5 and PM10, PM> 10 on the leaves; the relationship between aerodynamic drag and dispersion of dust particles, etc. and came to an interesting conclusion that the deposition of large particles on plant leaves is more effective at high wind speeds. In her opinion, urban vegetation affects air quality precisely through the effects of the deposition and dispersion of pollutants [25].

Y. Xu, W. Xu, L. Mo [etc.] studied the quantitative assessment of dust particles of three fractions: (0.2-2.5 microns), (2.5-10 microns), (> 10 microns), accumulated by 17 species of urban plants in Beijing (China). The authors concluded that the greatest accumulation of dust by weight on the leaves was accounted for by particles of the fraction: > 10 microns, while the accumulation of fractions: 0.2-2.5 microns and 2.5-10 microns was less [26]. U. Weerakkody, J. W. Dover, P. Mitchell [etc.] were also engaged in the quantitative assessment of dust particles on the leaves of plants of green walls in the city, where they found the largest number of particles of all sizes on the needles of Juniperus chinensis L. This study highlighted the importance of individual leaf size in capturing fine dust, regardless of their changing micromorphology [27]. S. Singh, P. Bhattacharya, N. Gupta studied the quantitative deposition of dust on the deciduous surface of urban trees: Thevetia peruviana, K. Schum in industrial, residential and other zones of Delhi (India). Their experiment gave a positive assessment to these plant species as tolerant bioindicators of atmospheric air pollution [28]. A. Przybysz, G. Nersisyan, S. Gawronksi revealed the ability of evergreen conifers (Taxus baccata L. and Pinus nigra Arn.), as well as deciduous plants (Carpinus betulus L.) to remove fine dust from the atmospheric air with urban greenery in winter [29]. X. Sun, H. Li, X. Guo [etc.] determined the diameter of dust particles and the area they occupied on plant leaves (Euonymus japonicus, Pyracantha fortuneana, Ligustrum vicaryi, Amygdalus trifol, Ligustrum sinense, etc.). According to the authors, the structure of the leaf surface significantly influenced the ability of plants to retain fine dust: plants with a thick waxy layer or large and dense stomata, for example (E. japonicus), adsorbed more fine dust. This study provides a scientific basis for the ability of landscape plants to retain particles of different diameters [30]. Meanwhile, some researchers on dust on the leaves of urban plants emphasized the fact that this type of monitoring can be used as an alternative to traditional monitoring of air pollution. Thus, M. Zampieri, J. Sarkis, Pestana, C. Rafael [etc.], after conducting a study of dust particles on plant leaves in an urban environment, they concluded that, for example, the T. granulosa can be used as a passive biomonitor and a valuable alternative to air pollution monitoring and spatio-temporal assessment of fine dust [31]. T. Zhang, Y. Bai, X. Hong [etc.] measured the amount of fine dust and heavy metals deposited on the leaves of the Euonymus japonicus plant in Beijing (China) during the East Asian monsoon, noting that plants can be effectively used as biomonitor of environmental pollution [32]. L. Lin, G. Chen, J. Yan [etc.] conducted a factor analysis of the landscape metrics of dust particles deposited on leaf surfaces (Ailanthus, Ash, and Willow). As a result of the conducted research L. Lin, G. Chen, J. Yan [etc.] believe that it is possible to provide a high spatial monitoring of dust in the urban environment using indicators such as dust particles on the leaves of urban plants [33].
This work is aimed at studying the dispersion composition of dust particles on plant leaves (using the example of apricot trees (Prúnus armeníaca)) as passive biomonitors of atmospheric air quality and identifying areas of environmental risk in the residential zone of the Sredneakhtubinsky district of the Volgograd region.

**Research materials and methods**

In this case, the research material was the leaves of apricot trees (Prúnus armeníaca), which grow on this territory of the residential zone. This is a massive species found in the city of Volgograd and the Volgograd region with high frequency. The collection of material for the study was carried out at the end of June 2018 after the completion of intensive leaf growth. Leaf samples were taken at a height of 1.5–2 m of the crown (the height of the layer of atmospheric air inhaled by humans). The leaves were taken at 6 points at different distances from the industrial zone: from 150 m to 800 m, in different cardinal points, with different wind loads. When collecting leaves, attention was paid to the condition of the leaf blade: it should not be subject to changes, for example, traces of insect activity or the presence of bacterial necrosis or any other damage. 10 samples were made at each point. Each sample represents leaves from one species of apricot tree (Prúnus armeníaca). Leaf blades were selected in 10 replicates, using several apricot trees (Prúnus armeníaca) (up to 3 pcs.) At each point. At the same time, the leaves of an apricot tree (Prúnus armeníaca) were sampled in a conditionally clean zone (control) in the SNT "Oroshenets" on the bank of the Varvarovsky reservoir (Sovetsky district of Volgograd). All collected leaves for each sample were placed in paper bags. All packages were signed with the date and time of material collection, then they were delivered to the laboratory, avoiding shaking.

The dust from the leaves of one sample was washed into a beaker with distilled water. The resulting suspension was filtered through the middle of the AFA-VP filter and dried at a temperature of no more than 30–40 ° C (the natural temperature of atmospheric air in summer in Volgograd and the Volgograd region). The dried filtrate (dust from leaves) was placed evenly on a glass slide, which was mounted on an optical microscope. Each sample contained a wash of dust from 10-15 leaves of one plant species (Prúnus armeníaca). At each point in the study, at least 1000 dust particles were collected.

At the second stage, a study of the dispersion composition of dust collected on the leaves of apricot trees (Prúnus armeníaca) in the residential area of the Sredneakhtubinsky district of the Volgograd region and on the leaves of apricot trees (Prúnus armeníaca) in the conditionally clean zone (control) in the SNT "Oroshenets" on the bank of the Varvarovsky reservoir was carried out (Soviet district of Volgograd). Measurements of dust particles, dust processing, study of the dispersed composition of dust were carried out in accordance with clauses 11-13 of GOST R 56929-2016 [34] using the SPOTEXPLORER computer program, which allows digital processing of black and white images in Windows Bitmap format (*. bmp), by the volume of a dusty particle, its equivalent diameter was calculated, and the number of particles of various sizes was determined. After scanning the photograph, the dispersed composition of the general population of dust was determined. The measurement results were drawn up in the form of tables, on the basis of which the differential and integral curves of the distribution of the mass of particles by size were constructed, plotting the values (particle diameter) on the abscissa axis, and on the ordinate axis - the distribution density of particles of the corresponding size in percent. Thus, not only the dispersed composition of the general population of dust was determined, but also its finely dispersed component according to GOST R 56929-2016.

At the 3rd stage, a comparison and analysis of the dispersion compositions of dust obtained as a result of sampling dust particles from the leaves of apricot trees (Prúnus armeníaca) in the residential area of the Sredneakhtubinsky district of the Volgograd region, from the leaves of apricot trees (Prúnus armeníaca) in a conditionally clean zone (control) in SNT "Oroshenets" on the bank of the Varvarovsky reservoir (Sovetsky district of Volgograd).
Results and their analysis

The studies were carried out in a residential area near residential buildings (points: No. 4, No. 5, No. 6) and social facilities (hospital - point No. 1, kindergarten - point No. 3, boarding school - point No. 2) in the Sredneakhtubinsky district of the Volgograd region.

The material for the study was the leaves of apricot trees (Prúnus armeníaca), which grow on the territory of the residential area at points: №1,2,3,4,5,6. Leaf blades were collected in dry weather at the end of June 2018. A total of 600 pieces were collected at six points. Apricot tree leaves (Prúnus armeníaca), 100 pcs. leaf blades at each point.

Dust was found on the leaf blades of apricot trees (Prúnus armeníaca). Dust particles on the leaves of common apricot (Prúnus armeníaca) were studied using a Versa 3D scanning microscope and are shown in Figure 1.

Figure 1. Photo of dust particles with indicated dimensions on a leaf blade of an ordinary apricot (Prúnus armeníaca)

Initially, studies were carried out of the dispersed composition of dust particles on the leaves of apricot trees (Prúnus armeníaca) in the conditionally clean zone (control) in the SNT "Oroshenets" of the Soviet district of Volgograd, which were subsequently compared with data from the residential zone. The distribution of the number of particles on the leaves of apricot trees (Prúnus armeníaca) from the conditionally clean zone by equivalent diameters (N (dh),%) according to PM2.5 was no more than 12.16%, PM10 - 18.73%; distribution of mass of particles over equivalent diameters (D (dp),%) according to PM 2.5 - 16.17%, and according to PM10 - 21.16%.

The research was carried out in 6 points of the residential zone of the Sredneakhtubinsky district of the Volgograd region.

Point number 1 - this is the territory of the hospital on the Hospital st. (Sredneakhtubinsky district of the Volgograd region). This is the western point and it is located approximately 660 meters from the industrial zone. The research results for this area are shown in Fig. 2,3. As an illustration, Fig. 2 shows the distribution of dust particles in the form of 10 integral curves constructed in a probabilistic-logarithmic grid based on 10 samples of dust particles taken from leaf blades (100 pcs.) Of apricot trees (Prúnus armeníaca) at each point under study, which contained at least 1000 pieces. Dust particles studied with an optical microscope. The abscissa axis (x) plotted the particle diameter (dp, μm), and the ordinate (y) - the mass fraction of particles (D (dp),%).
Figure 2. Integral curves of particle mass distribution over equivalent diameters in the probabilistic-logarithmic grid for dust sampled in the residential area on the street. Hospital (Sredneakhtubinsky district, Volgograd region) - Point number 1

Figure 3 shows diagrams of mass distribution (D (dp),%) and amount (N (dp),%) of dust particles by equivalent diameters along the Hospital st.

Figure 3. Distribution of mass and number of particles by equivalent diameters,% for dust sampled in a residential area on the street. Hospital, (Sredneakhtubinsky district, Volgograd region), point number 1: a) Diagram of particle mass distribution by diameter (D (dp),%) b) Diagram of the distribution of the number of particles by diameter (N (dp),%)

Point number 2 - this is the area around the boarding school (Vorovskogo street, Sredneakhtubinsky district, Volgograd region) and it is located in the southeast. The distance to the industrial zone is approximately 630 m. The research results for this territory are shown in Figure 4,5.
Figure 4 Integral curves of particle mass distribution over equivalent diameters in the probabilistic-logarithmic grid for dust sampled in the residential area on the street. Vorovskogo (Sredneakhtubinsky district, Volgograd region), point number 2

Figure 5 shows diagrams of mass distribution (D (dp),%) and number (N (dp),%) of particles by equivalent diameters along the Vorovsky st.

![Diagram of particle mass distribution by diameter (D (dp),%)](image1)

![Diagram of the distribution of the number of particles by diameter (N (dp),%)](image2)

Figure 5. Distribution of mass and number of particles by equivalent diameters, % for dust sampled in a residential area on the street. Vorovskogo, (Sredneakhtubinsky district, Volgograd region), point number 2: a) Diagram of particle mass distribution by diameter (D (dp),%); b) Diagram of the distribution of the number of particles by diameter (N (dp),%)

Point number 3 - this is the territory of the kindergarten on the Kavkazskaya st. (1) in the Sredneakhtubinsky district of the Volgograd region. The research results for this area are shown in Fig. 6.

Figure 6 shows diagrams of particle mass distribution (D (dp)), number of particles by (N (dp), %) by equivalent diameters.
Figure 6. Distribution of mass and number of particles by equivalent diameters, % for dust sampled in a residential area on Kavkazskaya street (1), (Sredneakhtubinsky district, Volgograd region), point No. 3: a) Diagram of particle mass distribution by diameter (D (dp), %); b) Diagram of the distribution of the number of particles by diameter (N (dp), %)

Point number 4 - this is the territory of residential buildings, in the immediate vicinity of industrial enterprises, 300 meters from the main sources of emissions. The research results for this area are shown in Fig. 7.

Figure 7 shows the diagrams of the distribution of the mass of particles by diameter (D (dp), %) and the number of particles by diameter (N (dp), %).

Figure 7. Distribution of mass and number of particles by equivalent diameters, % for dust sampled in a residential area on Kavkazskaya street (2), (Sredneakhtubinsky district, Volgograd region), point No. 4: a) Diagram of particle mass distribution by diameter (D (dp), %); b) Diagram of the distribution of the number of particles by diameter (N (dp), %)

Point number 5 - this is the territory of low-rise residential buildings in the north-west of the study area on the Nechayeva st. in the Sredneakhtubinsky district of the Volgograd region at a distance of less than 200 meters from the industrial zone. The research results for this territory are shown in Figure 8, 9.
Figure 8. Integral curves of particle mass distribution over equivalent diameters in the probabilistic-logarithmic grid for dust sampled in a residential area on the Nechaev st. (Sredneakhtubinsky district, Volgograd region), point number 5

Figure 9 shows diagrams of particle mass distribution by equivalent diameters (D (dp),%) and the number of particles by diameter (N (dp),%).

Figure 9. Distribution of mass and number of particles by equivalent diameters, % for dust sampled in a residential area on Nechaev st., (Sredneakhtubinsky district, Volgograd region), point 5: a) Diagram of particle mass distribution by diameter (D (dp),%); b) Diagram of the distribution of the number of particles by diameter (N (dp),%)

Point number 6 - this is the territory of low-rise residential buildings in the northeastern part of the investigated residential area on the Omskaya st. in the Sredneakhtubinsky district of the Volgograd region, 150 m from the industrial zone. The research results for this area are shown in Fig. 10,11.
Figure 10. Integral curves of particle mass distribution over equivalent diameters in the probabilistic-logarithmic grid for dust sampled in a residential area on the Omskaya st. (Sredneakhtubinsky district, Volgograd region), point number 6

Figure 11 shows the diagrams of the distribution of the mass of particles (D (dp), %) and the number of particles (N (dp), %) by equivalent diameters.

Figure 11. Distribution of mass and number of particles by equivalent diameters, % for dust sampled in a residential area on the Omskaya st., (Sredneakhtubinsky district, Volgograd region): a) Diagram of particle mass distribution by diameter (D (dp), %); b) Diagram of the distribution of the number of particles by diameter (N (dp), %)

From the presented figures, it can be concluded that the safest territory in the residential area is point No. 2 (boarding school on Vorovskogo street, Sredneakhtubinsky district of the Volgograd region), heavier fractions were recorded on it, size: 10-20 microns and 20-40 μm, although the number of leaders is RM 10. This point is located at a distance of more than 600 m from the industrial zone.

Points No. 1,5,6 are located in the immediate vicinity of industrial enterprises, at a distance of about 200-250 m and represent zones of environmental risk for living, since the largest amount of fine dust (PM10) was recorded on the leaves of apricot trees, both in terms of quantity and weight. Dust particles of heavy fractions (20-40 microns) were found at point No. 6 in large quantities, but a fraction of 20-40 microns was not found at point No. 5. This indicates that the direction and speed of the wind have a great influence on the distribution of dust particles. It is also worth paying attention to point number 1,
since at this point there is a social object - a hospital complex, and at this point the most fine dust was found - PM 10, both in quantity and in mass.

**Points No. 3** also falls into the zone of environmental risk, although it is located at a distance of more than 800 m from the industrial zone, but PM 10 was found in it in large quantities, both in mass and in their number. A kindergarten is located at this point.

**Points No. 4** occupies a borderline security position. On the one hand, a high percentage of fine dust (PM 10) was recorded in it in terms of quantity, however, in terms of mass, dust particles divide the percentage between PM 10 and a fraction of 10-20 microns, they in the samples at this point turned out to be practically in equal proportions.

The distribution of dust particles in the analyzed points is due to the absence of precipitation from April to July 2018 in the study area, but depended on the speed and direction of the wind and the number of days of wind loads, which are shown in Figure 12.

**Figure 12.** Diagram of wind direction and its speed versus number of days (March-June 2018)

It can be seen from the diagrams in Figure 16 that the prevailing winds: west, east, southeast did not affect the spread of dust particles, since the enterprise is located in the study area in its northern part, and the study of the residential zone took place south of the industrial zone.

However, the north wind, which prevailed for 10 days at a speed of 4.3 m / s, could have a significant effect on the spread of fine dust from the industrial zone to point No. 3, which can be attributed to the zone of environmental risk, there is a kindergarten, it is got into the zone of influence of the north wind, despite the fact that the territory of the kindergarten is 800 m away from the industrial zone. Nevertheless, it is known that fine dust can hover in the air for a long time, for 3-14 days or more, and in the absence of influence from precipitation, winds can be carried over long distances. The north wind could have affected the territories of points 4 and 5, where the largest amount of PM10 was found, up to 90%, and heavy fractions, which> 10 µm, predominate in weight.

The northeast wind, which blew for 7 days at a speed of 6.5 m / s, influenced point No. 6.2. The northwest wind stayed only 10 days during 3 months, with an average speed of 5 m / s and could also have an effect on point No. 1.

**Summary**

As a result of the studies, the dispersed composition of dust on the leaves of apricot trees (Prunus armeniaca) in the residential area of the Sredneakhtubinsky district of the Volgograd region was revealed. Found fine particles: PM2.5, PM10, which in their values (N (dp),%), (D (dp),%) significantly exceed the data on fine dust in a conditionally clean zone (control) in SNT "Oroshenets" (Sovetsky district of Volgograd). This creates certain environmental risks for local residents. The excess of fine
dust in the study area can be due to various factors: both natural and technogenic pollution of the environment. Therefore, in the future, simultaneously with studies of the dispersed composition of dust, it will be chemically analyzed in order to quickly detect sources of pollution in residential areas in Volgograd and the Volgograd region and develop environmental measures.

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