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THE THEORETICAL BASIS OF THE PROCESS OF TRANSPORT OF CONTAMINANTS IN THE PRIDEAUX-ROZNYCH LANDSCAPES IN THE PRESENCE OF THE DUST BELTS

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Purpose. This paper examines the impact of transport-road complex on the environment, as od-tion of the most powerful sources of pollution. Analysed the risk of gas emissions that are released BHA due to combustion of fuel in internal combustion engines, which contain a number of harmful substances that zubrod-evaluate roadside landscapes. ***Metodology.*** Inserted a number of conditions, depends on their content in the roadside, including on the level of organization of the artificial protection of the landscape, namely the dust belts that take almost the rule, a decisive role in the processes of transport and deposition of pollutants. ***Originality.*** So, the main factors that affect to the processes of diffusion and distribution of pollutants in roadside landscape are: transfer the impurity by the wind flow; turbulent diffusion of impurities in the horizontal and vertical planes; physical-chemical processes of transformation the impurities (gravitational deposition, chemical conversion, precipitation leaching); the presence of dustproof forest barriers. ***Practical value.*** To research the character of the processes of gravitational settling pollutants, it is recommended to use models of rheological Maxwell’s and Voigt’s bodies. *References 3, no tables, figures 4.*

Keywords: combustion products, migration and deposition of pollutants, geochemical barrier.

ТЕОРЕТИЧНЕ ОБҐРУНТУВАННЯ ПРОЦЕСУ ПЕРЕНОСУ ЗАБРУДНЮЮЧИХ РЕЧОВИН У ПРИДОРОЖНИХ ЛАНДШАФТАХ ЗА НАЯВНОСТІ ПИЛОЗАХИСНИХ ЛІСОСМУГ

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В роботі розглянуто питання впливу транспортно-дорожнього комплексу на навколишнє середовище, як одного із найпотужніших джерел забруднення. Проаналізовано небезпеку газових викидів, які викидаються внаслідок спалювання палива у двигунах внутрішнього згоряння, які містять ряд шкідливих речовин, що забруднюють придорожні ландшафти. Вставлено залежність вмісту забруднюючих речовин у придорожній смузі в залежності від рівня організації штучного захисту ландшафту, а саме пилозахисних лісосмуг, які приймають, практично, вирішальну роль у процесах переносу та депонування полютантів. На основі досліджень встановлено ряд факторів, які необхідно враховувати при вивченні питання розповсюдження та перерозподілу забруднюючої домішки в придорожньому ландшафті: особливості перенесення домішки вітровим потоком; турбулентна дифузія домішки в горизонтальній та вертикальній площинах; фізико-хімічні процеси трансформації домішки (гравітаційне осадження, хімічне перетворення, вимивання опадами). Для дослідження характеру процесів гравітаційного осідання забруднюючих домішок рекомендовано використовувати моделі реологічних тіл Максвела та Фойгта.

Ключові слова: продукти згоряння, міграція та депонування забруднювачів, геохімічний бар’єр.

PROBLEM STATEMENT. Any anthropogenic (man-caused) activity leads to the violation of certain ranges variation of the material, energetic and informational system’s properties, reduces its stability and, in general, can be considered as an external “contaminant” relatively to any natural-territorial complex (NTC).

Since the source of intense contamination NTC is directly road and transport streams, "pollution" is manifested in all forms: chemical, physical (energetic or parametric), biological, landscape-destructive (stational-destructin).

Total pollution the objects of environment has different effects, and therefore unidirectional method of their "neutralization" and counteraction not to be. So it is necessary to determine not only the specific "pollutant", which leads to a specific issue, and systematic approach to study the question of appropriate strategies and control means, to apply measures on preventing the spreading of contamination and to develop the environmentally optimal design of NTGES.

EXPERIMENTAL PART AND RESULTS OBTAINED. For modeling the dynamics of change in real structures NTC under anthropogenic impact must be considered simultaneously external influence on their composition. Supposing that it is necessary to study the process F(t) adjustment of the composition structure NTC from the moment when it suddenly applied some external influence is subordinated to a specific pattern. Provided the fact of attachment to the structure the certain external influence (the construction of a road and its further functioning), which was absent to a certain point in time then the countdown begins from the moment of application the impact. For this we use a single function (Heaviside's function) H(t) or e(t) fig.1, the value of which is:

$$H(t) = \begin{Bmatrix} 0, & t < 0 \\ 1, & t \geq 0 \end{Bmatrix} \quad (1)$$

The ordinate F(t) when t<0, will be absent when to multiply the function F(t) external influences on H(t) and for t>0 the ordinate of the function F(t), multiplied by the unit will retain its original meaning.

In the environment with the exhaust gases of motor transport gets more than 200 of pollutants that degrade not only the quality of its facilities, but also threaten human health. Its main features are characteristic geochemical flux of dispersion, dynamic and excess concentrations of pollutants in the action area.

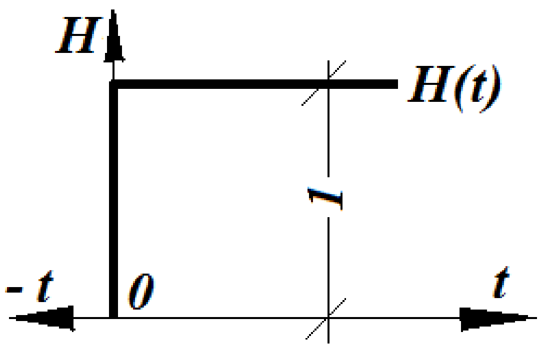


Figure1 – The graph of a single function (Heaviside's function)

For determining the migration of contaminants that get into the air from activities of vehicles, make use the theory of transport and dispersion pollutants in the surface layer of the atmosphere [3]. Theoretical research shows that the boundary layer of the atmosphere is characterized by a quite complex internal structure and is manifested in the formation of two sub layers: the ground layer of the atmosphere (located above an underlying surface) with a constant wind direction and persistence of turbulent flows in height; a free boundary layer (above the ground layer of the atmosphere). The underlying surface has a significant influence on the dynamics of air movements and is appears mainly turbulent character. Change with the height of vector's speed of movement can be represented in the form of a hodograph of the velocity (Fig. 2).

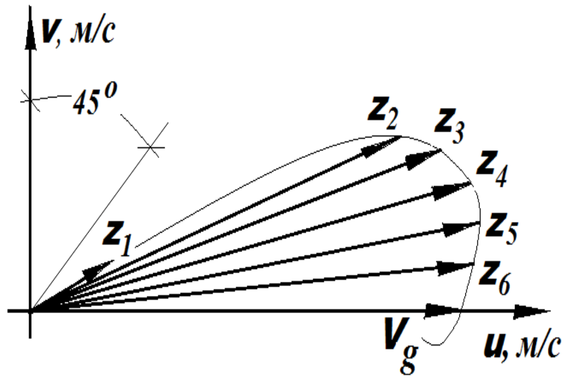


Figure 2 – The locus of the speed an air flow, where: V, m/s - wind speed; Vg - the value of speed geostrophic wind at the upper limit of the boundary layer; α=45°- the angle of a full rotation of the wind in the boundary layer; Zj - change of wind speed with height

Consequently, impurity, once in a turbulent environment, under the action of velocity pulsations in the air flow begins to spread in it, forming taxonometric a source of pollution. While large-scale air currents carry the amounts of impurities as a whole, and small turbulent pulsations that move chaotically in the air flow, dissipate impurities by mixing. The description of this process depends from the feature inflow of impurities in NTGES and from the final result to be obtained [1]. In our case, the turbulent diffusion of impurities must be considered relative to an infinitesimal source, moving with a certain speed for a long time (long-acting).

In general, the concentration q of the aerosol substance that is in an elementary volume of air and migrates together with the air flow in the atmosphere is a function of the spatial coordinates and time:

$$q = q(x, y, z, t). \quad (2)$$

Then, if $p(\vec{X}, t,\ \vec{X}', t_0)$ is the probability of displacement elementary volume which contains the impurity with concentration $q(\vec{X}', t_0)$, from a point with spatial coordinates $\vec{X}'$ at time t_0 to a point with spatial coordinates $\vec{X}$ at time t then the average value of the impurity concentration in the spatial point $\vec{X}$ at time t will be:

$$q(\vec{X}, t) < \int p(\vec{X}, t, \vec{X}', t_0) \cdot q(\vec{X}', t_0) \cdot d\vec{X}'. \quad (3)$$

When we know the initial distribution $q(\vec{X}', t_0)$ and the probability of all movements the elementary volumes in this space $p(\vec{X}, t,\ \vec{X}', t_0)$, then by integrating the right side (2) at all points of space will give a distribution of impurity concentration on three-dimensional space at time t.

$$\int p(\vec{X},t,\vec{X}',t_0)\cdot d\vec{X}'=1. \quad (4)$$

However, when winds are weak, polluting substances, which fall in the atmospheric air with the exhaust gases of motor transport, in the presence of dense geochemical barriers, including forest and the gas-dust-proofing strips are placed directly in the area of the roadway, forming an "air stagnation". This situation creates the greatest danger level at which the observed increase in the concentration of impurities in the surface layer, through their "soaring". Thus the speed of staying the suspended solids depends from the steady-state velocity of a falling particle in still air and the action of the forces gravity and air resistance (R):

$$R=kv_s^2 \quad (5)$$

where, k - the coefficient of proportionality;
v_s^2- the speed of the upward movement of air.
When falling impurity reaches a constant speed, then the force of gravity will be equal to the force of air resistance $P=R$:

$$mg=kv_s^2 \quad (6)$$

Then:

$$v_\tau=\sqrt{\frac{mg}{k}} \quad (7)$$

The formula for the resistance of environment will be of the form:

$$R=cF\rho\frac{v_s^2}{2} \quad (8)$$

where, c - the coefficient of proportionality;

$$c=f(Re)$$

F - the projected area of particles on a plane perpendicular to the velocity vector, m^2;
ρ - the density of the air.
From formulas 6 and 8, it follows that the coefficient of proportionality can be written as:

$$k=cF\frac{\rho_\text{п}}{2} \quad (9)$$

The speed of fall impurities in the air according to the formula 7 is:

$$v_\tau=\sqrt{\frac{2mg}{cF\rho}} \quad (10)$$

The coefficient of proportionality in the expression 10 can be represented by the Klyachko's formula:

$$c\approx\frac{24}{Re} \quad (11)$$

Re – the Reynold's number.
Then the formula 11 will look as:

$$Re=\frac{v_s}{v}d \quad (12)$$

v – the kinematic viscosity of air, m^2/s.
The numerical value of the speed can determine:

$$v_s=\sqrt{\frac{2mgv_sd}{24v_sF\rho}} \quad (13)$$

Then, by transformations we get:

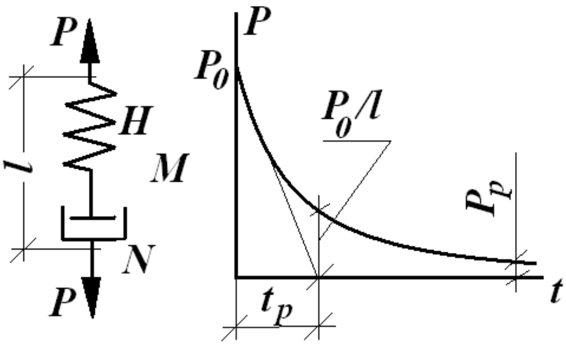
$$v_s=\frac{mgd}{12v_sF\rho} \quad (14)$$

Thus, further movement of the impurities in the vertical direction in the presence of a geochemical barrier is possible when the air velocity exceeds the maximum velocity of "soaring" impurities.

The research of migration processes and the deposition of pollutants in roadside landscapes in the presence of the dust-proofing strips are compounded by the impossibility of real experimental reproduce the problem.

Therefore there is a need to use models-analogues that are not physically identified with simulated system, and determine the similarity of the properties inherent in the original and the model using "rheological bodies" challenging environment, which is polluting aerosol. Such models are the elastic and viscous rheological Maxwell's body (Figure 3-a) or visco-elastic rheological Voigt's body (Figure 4-a).

The character of sedimentation the aerosol particles for these rheological bodies shown in Figure 3-b and 4-b.



a b
Figure 3 – Rheological Maxwell's body:
a – the model-simulator visco-elastic body;
b – character of process the sedimentation particles

CONCLUSIONS. So, the main factors that affect to the processes of diffusion and distribution of pollutants in roadside landscape are: transfer the impurity by the wind flow; turbulent diffusion of impurities in the horizontal and vertical planes; physical-chemical processes of transformation the impurities (gravitational deposition, chemical conversion, precipitation leaching); the presence of dustproof forest barriers.

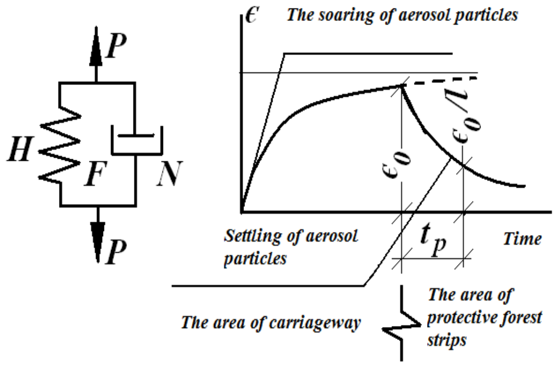


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Figure 4 – Rheological Voight body:

a – model-simulator visco-elastic body;

b – character of process the sedimentation particles

To research the character of the processes of gravitational settling pollutants, it is recommended to use models of rheological Maxwell's and Voigt's bodies.

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ТЕОРЕТИЧЕСКОЕ ОБОСНОВАНИЕ ПРОЦЕСОВ ПЕРЕНОСА ЗАГРЯЗНЯЮЩИХ ВЕЩЕСТВ В ПРИДОРОЖНЫХ ЛАНДШАФТАХ ПРИ НАЛИЧИИ ПЫЛЕЗАЩИТНЫХ ЛЕСОПОЛОС

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В работе рассматривается проблема влияния транспортно-дорожного комплекса на окружающую среду, как одного из мощных источников загрязнения. А также проведен анализ опасности выхлопных газов автотранспорта, состоящих из ряда опасных веществ, которые загрязняют придорожные ландшафты. Установлена зависимость содержание в придорожной полосе от уровня организации искусственной защиты ландшафта, а именно пылезащитных лесополос, от которых зависит практически решающая роль в процессе переноса и депонирования загрязнителей. На основании исследований установлено ряд факторов, которые необходимо учитывать при изучении вопроса распространения и депонирования загрязняющих веществ возле дороги: направление ветра, турбулентная диффузия примеси в пространстве, физико-химические процессы. Для исследования предложено использовать модели реологических тел Максвела и Фойгта.

Ключевые слова: продукты сгорания, миграция и депонирование веществ, геохимический барьер.