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DYNAMIC PARAMETERS ESTIMATION OF DUST EMISSIONS OF HEAT-AND-POWER OBJECTS OF COAL MINES

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ОЦІНКА ДИНАМІЧНИХ ПОКАЗНИКІВ ПИЛОВИХ ВИКИДІВ ТЕПЛОЕНЕРГЕТИЧНИХ ОБ'ЄКТІВ ВУГІЛЬНИХ ШАХТ

Purpose. The development of estimation and prediction methods of dynamic parameters of dust emissions for coal-fired heat-and-power objects.

Methodology. The methods are based on the fact that the productivity of a heat-and-power objects is of stochastic nature. To determine the dynamic parameters of dust emissions from a flue of mine boiler facility the solutions of mathematic problem of random process emission in a definite level were used. The concentration of dust particles in the emissions of a heat-and-power object is determined as based on the selective realization of the random process of capacity in one-month period. To determine the peculiarities of maximum surface concentrations distribution and graph dust dispersion with respect to productivity of heat-and-power objects we used the UPRZA "EKOtsentr" software implementing the main principles of OND-86 methods.

Findings. The estimation of dynamics of productivity and dust emissions was carried out, which can be used for the monitoring of the degree of ecological danger of the emissions of heat-and-power objects of coal mining enterprises. The estimations of dust emission dynamics of heat-and-power objects allow improvement of prediction reliability for atmospheric air pollution in coal mining regions, as well as its danger level, in comparison with the estimation based on the average annual emission volumes.

Originality. The estimation and prediction methods of dynamic indicators of particulate matter (dust) emissions by heat-and-power objects of mines with respect to the volume of their solid fuel consumption were developed.

Practical value. The obtained regularity of pollutant ventilation, emitted by heat-and-power objects of mines, enables prediction of the levels of pollution for environmental objects of the adjacent territories, as well as taking timely air protection measures.

Keywords: *heat-and-power object, dust emission, ecological danger, dispersion*

The problem substantiation. The major influence of heat-and-power objects on the environment implies pollutant emissions and noise. The availability of high sources of heated emissions, i.e. flues, which discharge smoke fumes of generating units, is the peculiarity of heat-and-power objects of coal mines.

A coal-fired mine boiler facility is a potential source of permanent inflow of big quantity of disperse particulate matter and sulphur oxides into the atmospheric air. The fact is substantiated by the usage of offgrade coal of poor quality with more than 23 % ash value by boiler facilities of operating mines.

Dust emissions are caused by both fuel incomplete combustion and incombustible mineral constituents of coal. The percentage of the components is considerably high for black coal, which has high ash value. The particles of ashes and soot, emitted by heat-and-power objects, are dispersed in the surface air, and can spread to large territories polluting the air, soil and water bodies and worsening the living conditions for people in coal mining regions [1].

Particulate matter, emitted by heat-and-power objects, consists of mixture of soot (unburned coal particles), smoke (gas-particle systems, which consist of the particles of between 0.1 and 10 micrometer size) and dust (particles of coal, ash or rock).

The nature of coal and impossibility of its complete combustion determine the inevitability of dust emissions and substantiate the need in equipment for particulate matter collecting. The dust-collecting equipment, which is used by heat-and-power objects, enables reduction of particulate matter content in the emissions. The high ash value of solid fuel causes the significant deterioration of equipment and decreases the efficiency of flue ash collection for effluent combustion gas [2]. At the same time, the designed purification efficiency for the cyclones used is 80–90 %, but during the boiler facility operation it is decreased to 70–75 % [3]. The low efficiency of dust collecting equipment, which is used by heat-and-power objects, causes increase of negative effect of coal mining enterprises on the ecological state of the adjacent territories [4].

Most of heat-and-power objects of coal mines function all the year round, so they are permanent air pollutants. That is the reason for the need in permanent monitoring of the levels of environment pollution in the areas of heat-and-power objects location, which affect the adjacent residential areas directly [5]. Timely development and implementation of complex of nature conservation measures by coal mining enterprises will substantiate the sustainable functioning of coal mining regions in Ukraine, as well as provide ecologically safe living conditions of the population [6].

Review of the related researches. Gross dust emission by heat-and-power objects of coal mine should be estimated in tons per year according to the proper branch methods, which are based on the use of statistical data. The process is characterized by some contradictions concerning the choice of indicators of ecological safety. Thus, the use of parameters of gross emissions for harmful substances *Mi* (tons per year or gram per second) is reasonable for regional and especially for global ecological safety analysis. But the criterion is useless for the comparison of local emitters of different strength.

In order to determine the dynamic parameters of emissions of technological objects of coal mine overrunning the rated (permissible) value, it is recommended to use the methods [7]. The way enables the determination of atmospheric air pollution level for the mine adjacent territory and implementation of timely nature conservation measures.

The estimation of volume of emissions from flue of mine boiler facility is carried out either according to the valid guidelines [8] or simplified methods given in [9]. The obtained value is used for the further estimation of the level and degree of danger of atmosphere pollution by dust. At the same time, the actual average daily concentrations of solid particles, emitted from flue of boiler facility, are changed on a daily basis and differ from the average values, which are determined using gross emission. The degree of air pollution danger will be changed correspondingly, as it is estimated as based on the degree of pollution indices (PI) excess compared to their standard values (SV) in accordance with the paragraph 8.16 of the regulations [10]. In addition, the determination of the parameter, which regulates the percentage of cases of SV exceed, is stipulated. The parameter can not be assessed without the data of actual daily dynamics of dust emissions.

The allocation of unsolved issues. The problem of ensuring of energy efficiency and environmental safety of power objects is multipurpose (designing, maintenance, examination, auditing, prognostication, monitoring etc.) and complex one. This is conditional on the need in determination of the level of use of fuel and energy resources, technical state of equipment of power objects, implementation of nature conservation measures and so on. The difficulty of the problem solving is caused by a wide range of key parameters, factors and indices of environmental danger.

It is obvious that the regular data collection requires establishing standing observational stations for emissions monitoring from heat-and-power objects, which is not economically sound. That is the reason that the authors define the goal to determine the dynamic parameters of emission from coal-fired heat-and-power object on the base of permanently changed volume of coal consumption by heat-and-power objects, as used for the further estimation of parameters of the dynamics of dust emissions into the atmosphere.

The purpose formulation. The development of estimation and prediction methods of dynamic parameters of dust emissions for heat-and-power objects of coal mines.

The main part. In order to provide solution of the problem, let us analyze the main factors, which affect the dynamics of dust emission of coal-fired heat-and-power objects.

Let us turn to the methods [8], under which the gross emission of *j*-pollutant E_j occurring in the atmosphere from smoke fumes of boiler facility during T period of time is determined as the sum of gross emissions of every pollutant under the conditions of burning different fuels, as well as in case of their simultaneous combined burning

$$E_j = \sum_i E_{ji} = 10^{-6} \sum_i k_{ji} B_i \left(Q_i^r\right)_i, \qquad (1)$$

where k_{ji} is the parameter of emission of *j*-pollutant for *i*-fuel, g/GJ; B_i is the consumption of *i*-fuel in the T period of time, tons; $\left(Q_i^r\right)_i$ is the inferior operating combustion value of *i*-fuel, MJ/kg.

It is obvious that if $i = 1$, i.e. in case of burning of one type of fuel, particularly coal, the $\sum_i$ sign is omitted, and the form will become simplified.

The parameter of particulate matter (dust) emission in case of coal burning as *i*-fuel [9], is calculated using the formula

$$k_{ji} = k_t = \frac{10^6}{Q_i^r} a_{un} \frac{A^r}{100 - G_{un}} (1 - \eta) + k_{tS}, \qquad (2)$$

where k_t is the parameter of particulate matter emission, g/GJ; A^r is mass content of ash in the burnt coal per its working mass, % (depends on the type of power-generating coal); a_{un} is ashes percentage, which is emitted into the atmosphere from the boiler (ashes-loss); G_{un} is mass content of combustion agents in the particulate matter emissions, %; η is the efficiency of smoke fumes purification from particulate matter; k_{tS} is the parameter of emission of solid reaction products for interaction of sorbent agent and sulphur oxides and solid particles of sorbent agent, g/GJ.

Let us analyze the relevance and changeability of the parameters determining the mentioned calculation dependences (1, 2).

According to (1), gross emission of particulate matter in case of solid fuel burning, particularly coal, is mainly determined by its consumption B_i in a definite period of time, which is changed on a daily basis and often differ significantly from the average values, and substantiate the changeability of particles emission (dust) into the atmosphere.

The inferior operating combustion value of fuel Q_i^r is the value, which is constant for the particular rank of coal, MJ/kg. Thus, for burning of anthracite of ASSh rank it is 20.792 MJ/kg.

The A^r parameter in the formula (2) is determined by the ash value of the burning coal. Though, the parameter $a_{un}/(100 - G_{un})$ is determined by the furnace type and the type of burning solid fuel, it can very in the range of 0.0019 and 0.011, particularly for the furnace of forward stroke chain grate for ASSh anthracite burning the parameter is 0.0088.

The efficiency of smoke fumes purification from solid particles η is determined by the type of dust collection means, which are used. In case of cyclones, η is usually 0.8–0.9, and it is 0.95–0.98 for bag collectors.

The k_{tS} parameter is determined by the use of sorbent agent for sulphur oxides binding. It is usually used in case of fuel burning in fluid-bed. A sorbent agent is not used for low capacity boilers, so $k_{tS} = 0$.

The analysis carried out shows that gross emission of *j*-pollutant E_j, particularly dust from smoke fumes, is clearly defined by the volume of *i*-fuel B_i, i. e. coal. As the values of the other parameters remain almost unchanged, the dynamics of coal consumption is in proportion to the dynamics of dust emission from flue.

So, analyzing the coal consumption dynamics by boiler facility, it is possible to obtain the parameters of dust emission dynamics without measuring its current values.

To demonstrate the point let us consider the approximate calculations of gross emission of particulate matter for a type mine boiler facility, which produces heat energy. In case of continuous mode of boiler facility it is important to know the 24-hour coal consumption value. Its dynamics w for December 2014 is shown at the Fig. 1. The 24-hour coal consumption of boiler facility was 3021.26 ± 32.62 tons, and 93659 tons per month.

According to (2), the parameter of particulate matter emission (dust), particularly for anthracite burning in case of using cyclone for smoke fumes purifying without any sorbent agent, is determined using the formula, g/GJ

$$k_{ji} = k_t = \frac{10^6}{Q_i^r} a_{un} \frac{A^r}{100 - G_{un}} (1 - \eta) + k_{tS} =$$

$$= \frac{10^6}{20.792} 0.0088 \cdot 10 (1 - 0.85) = 634.86.$$

In this case, according to (1), we shall obtain the gross emission from the flue, tons per month

$$E_j = \sum_i 10^{-6} \sum_i k_{ji} B_i \left(Q_i^r\right)_i =$$

$$= 10^{-6} \cdot k_t \cdot B_i \cdot Q_i^r = 10^{-6} \cdot 634.86 \cdot 93659 = 59.46.$$

Thus, the gross dust emission of 59.46 tons per month or 1.92 tons per day corresponds to approximately 3021 tons per day of average coal consumption by boiler facility. It is obvious that increase or decrease of coal consumption will lead to the increase or decrease of dust emission in proportion. Only the parameters of coal consumption by the boiler facility and, thus, the corresponding parameters of emission dynamics should be determined.

The time series from the Fig. 1 demonstrates the fact that the coal consumption of the boiler facility is dependent on random factors, i. e. it is stochastic. And the cases of excess of average values of coal consumption up to 2.5 % are observed, which means the same

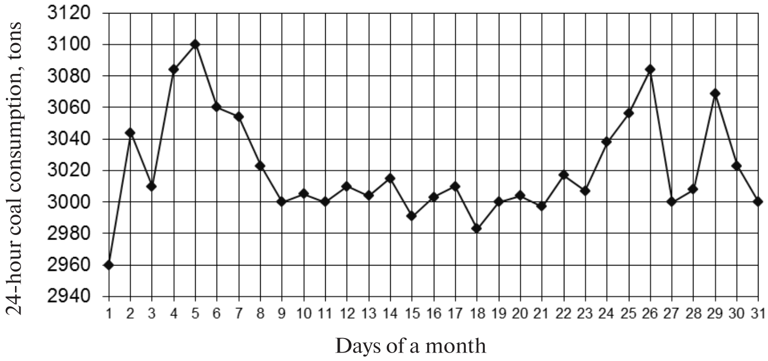

Fig. 1. Time series for coal consumption by heat-and-power object of coal mine

excess of dust emissions from the boiler facility flue in comparison to the rated average value (1.92 tons per day or 59.46 tons per month).

Thus, the 24-hour dust volume of 1.92 tons per day corresponds to the average dust emission rate of 22 g per second, and maximum one of approximately 23 g per second in case of 2.5 % exceed of the average values of coal consumption.

The series mentioned can be considered as the realization of the random process of coal consumption in one-month period. The availability of such a realization enables determining of missing dynamic parameters of dust emission from a flue of a boiler facility using known solution of mathematical problem of random process emission in a definite level by A. A. Sveshnikov (first solved by Reis in 1944–1945), which was used in the methods [7]. The approach is productive for the estimation of ecological danger of pollutants emission into the atmosphere in case of exceed of the rated values.

While solving the problem, we are to consider that the random function of change process of coal consumption by boiler facility in time and thus of dust emission, are the stationary with density of distribution, which is close to the normal law. It is quite permissible as the coal consumption is varied in random manner (vacillated) in the range, reasoned by the plan for boiler facility and air temperature, under the condition that there no explicit factors, particularly breakdowns and downtimes, which can lead to significant deviation from normal process of coal consumption and, thus, dust emissions.

Let us consider the sequence of integration for the stationary random process with normal A. A. Sveshnikov distributional law. Thus, the mean value cases of stationary random function stay above the definite level a at a time unit is

$$\bar{\upsilon}_a = \frac{\sigma_\upsilon}{2\pi\sigma_x} e^{-\frac{(a-\bar{x})^2}{2\sigma_x^2}}, \qquad (3)$$

where $\bar{x}$ is a mean value of random function x at the chosen interval; σ_x is quadratic mean of random function calculated with respect to the proper dispersion, which is equal in number to the value of autocorrelation function of random process in the (0) point, i.e. $\sigma_x^2 = K_x(0)$, and σ_υ is quadratic mean of the speed of random function change; it is determined by the speed dispersion of value change of its ordinate, which is equal

$$\sigma_\upsilon^2 = K_\upsilon(0) = -\frac{d^2}{d\tau^2} K_x(\tau)\Big|_{\tau=0}. \qquad (4)$$

Considering (3), the number of cases the random process exceeds the a level during T days is determined as

$$\bar{n}_a = T\bar{\nu}_a. \qquad (5)$$

And the average time of the process being above the a level is calculated using the expression

$$\bar{\tau} = \pi\frac{\sigma_x}{\sigma_\upsilon} e^{\frac{(a-\bar{x})^2}{2\sigma_x^2}} \left[1 - \Phi\left(\frac{a-\bar{x}}{\sigma_x}\right)\right], \qquad (6)$$

where $\Phi(x)$ is integral Laplace function.

Finally, the integral for determination of mean time of the stationary random function being above the definite level a in T time period is as follows

$$\bar{t}_a = T\frac{1}{2}\left[1 - \Phi\left(\frac{a-\bar{x}}{\sigma_x}\right)\right]. \qquad (7)$$

The value also can be determines as

$$\bar{t}_a = \bar{n}_a\bar{\nu}_a.$$

In a special case, when $a = \bar{x}$, i.e. the mean duration of mean value excess for the random function is determined (in our case, the average value of coal consumption or average rated value of dust emission by heat-and-power objects), the formulas mentioned are simplified:

Let us turn to the practical application of the formulas. We shall obtain the statistical values, describing the dynamics of exceed of coal consumption by heat-and-power objects of the definite level and, which is numerically equal to its average value, i.e. $a = \bar{x}$.

Let us find the preliminary autocorrelation function of the process using the data from graph from Fig. 1 and the assessment formula

$$K_x(\tau) = \frac{1}{n-\tau}\sum_{i=1}^{n-\tau}(x_i - \bar{x})(x_{i-\tau} - \bar{x}),$$

where τ is time shift, equals to 1, 2, 3, ...; x_i is daily coal consumption by a boiler facility, tons per day.

The initial fragment of calculated normalized autocorrelation function of the process is shown at Fig. 2.

To continue the calculations it is important to have the most exact analytical expression of autocorrelation function of the process at its initial interval. The requirement is reasoned by the need for determination of disperse of speed change rate for a random function using the second derivative of $K_x(\tau)$ in the zero point. So, considering the type of normalized graph of autocorrelation function, let us approximate the initial sec-

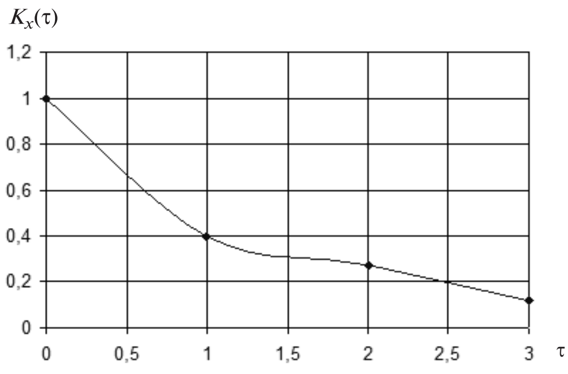

Fig. 2. Normalized autocorrelation function of random process of coal consumption by heat-and-power objects of a coal mine

tion of autocorrelation function for its values in $\tau = 0$; 1 and 2 points; we shall use the equation general exponent. As a result we obtain the following expression of autocorrelation function of random process of coal consumption as follows

$$K_x(\tau) = \sigma_x^2 (b_0 + b_1 e^{b_2 \tau}), \quad (8)$$

and its second derivative as

$$\ddot{K}_x(\tau) = K_\upsilon(\tau) = -\sigma_x^2 b_1 (b_2)^2 e^{b_2 \tau}, \quad (9)$$

where $\sigma_x^2 = 1048.632$ is dispersion of random process of coal consumption, t^2/day^2; $b_0 = 0.2398$; $b_1 = 0.7602$; $b_2 = -1.5585$ are exponent index values, obtained by least-squares method with b_2 index selection for approximation errors minimization.

Now let us define the dynamic parameters of exceed of coal consumption by the boiler facility of $a = \bar{x} = 3021.9$ tons per day level for the period of $T =$ = 30 days, i.e. the level of average coal consumption with the dispersion $\sigma_x^2 = 1048.6$ ($\sigma_x = 32.38$ tons per day). It will be recalled that the volume of $\bar{x} = 3021.9$ tons per day corresponds to the gross dust emission of 54.46 tons per month or 1.815 tons per day.

Let us calculate the dispersion of speed rate for a random function of coal consumption, considering (4, 9). We obtain

$$\sigma_\upsilon^2 = K_\upsilon(0) = -\frac{d^2}{d\tau^2} K_x(\tau)\big|_{\tau=0} = \sigma_x^2 (b_1 b_2^2) =$$
$$= 0.9(0.7602(-1.5585)^2) = 5579.8 (\sigma_\upsilon = 74.69).$$

Let us calculate the average value of exceeds of average coal consumption level per month for this source data, day^{-1}

$$\bar{\upsilon}_a = \frac{\sigma_\upsilon}{2\pi\sigma_x} = \frac{74.69}{2 \cdot 3.14 \cdot 32.38} = 0.3673.$$

The average number of exceeds of average coal consumption level per month, times

$$\bar{n}_a = T\bar{\nu}_a = 30 \times 0.3673 = 11.019.$$

Average duration of each exceed of average level, day^{-1}

$$\bar{\tau} = \pi \frac{\sigma_x}{\sigma_\upsilon} = 3.14 \frac{32.38}{74.69} = 1.3613,$$

and average time of $a = \bar{x}$ level exceed per month is, day

$$\bar{t}_a = \bar{n}_a \bar{\nu}_a = 11.019 \cdot 1.3613 \approx 14.99,$$

i.e. half of a month or 50 % of boiler facility working time, as expected in case of $a = \bar{x}$.

Then the levels of atmospheric air pollution were calculated for the maximum emission intensity. The calculations were carried out as based on the use of UPRZA software, which applies the main principles of OND-86 (All-Union normative document – 86) The Methods of Calculations for the Concentration of Harmful Substances in the Atmospheric Air from Enterprises Wastes.

The source data for the calculations are as follows: source height 30 m, source mouth diameter 1 m, speed of air-gas mixture withdrawal 2 mps, emission temperature 56 °C. As based on the volume of annual dust emission (suspended matter) and its danger class (IV), it was determined that the boiler facility of the mine belongs to the III danger class with the rated sanitary protective zone of 300 m.

The results of the calculations, as represented in the form of map for surface dust concentration, are shown at the Figs. 3, 4.

As we can see, in case of maximum emission intensity of the boiler facility the values of surface dust concentrations can reach 5.7 of MPC in the sanitary protective zone and 3 of MPC out of it under the adverse

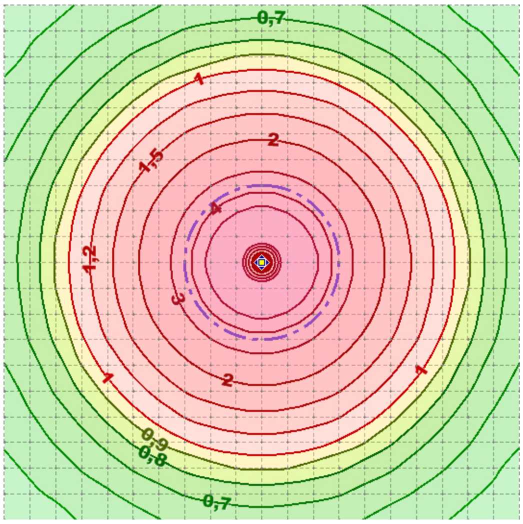

Fig. 3. The distribution of maximum surface dust concentrations (MPC quotas) for the emission intensity of 23 g per second (calculation cell size is 100× 100 m)

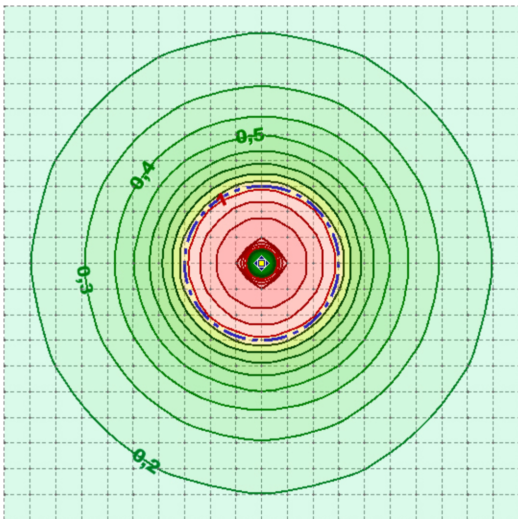

Fig. 4. The distribution of maximum surface dust concentrations (MPC quotas) for the emission intensity of 6 g per second (calculation cell size is 100× 100 m)

meteorological conditions. The zone of influence of a boiler facility is about 900 m for this intensity.

It is also determined that the permissible intensity of dust emissions for the given conditions is 6 g per second.

The emission intensity level can be reached without the decrease of boiler facility productivity in case of installation of gas-cleaning equipment with dust purifying efficiency of not less than 90–95 %.

It should be noted that the detection and estimation of dynamic parameters of processes with such relatively low deviations are reasonable for the emissions, which cause the air dust concentrations of the values close to MPC or other threshold levels of ecological danger of atmospheric air pollution, stated by [10].

Thus, the main parameters of coal consumption dynamics were determined. They show the adequate dynamics of dust emission from a boiler facility flue. So, it can be stated that the rated value of dust emissions of 54.46 tons per month (22.2 g per second) is to be exceeded almost 11 times per month, the duration of exceed is to be 4.047 days, i.e. about 16.8 % of the boiler facility working time. In the terms of environmental safety this means the 11 times per month exceeded safe concentration of dust or about 16.8 % of the boiler facility working time in the territory of boiler facility location with dust content of 1 MPC.

Finally, we should state that it is possible to carry out the calculations for the other rated level a, in this case the obtained probabilistic characteristic can be used for the prognosis of ecological danger of not only dynamic dust emission, but also other air pollutants.

The conclusions and further development prospectives. In addition to standard estimation of gross emission of particulate matter from a boiler facility flue, which is the base for the estimation of the level of atmospheric air pollution and its danger level for the environment, the other dynamic parameters of dust emission should be determined. This requires the additional 24-hour information about its changeability.

As for the definite coal-fired boiler facility, the only major dynamically changed parameter of coal consumption per 24 hours is definitely proportional to the dust emission from the boiler facility flue, and it is recorded daily, which is of great importance. So, the monthly consumption changeability enables estimation of changeability of dust emission from the boiler facility flue.

The availability of monthly coal consumption dynamics enables determining of missing dynamic parameters of dust emission from a flue of a boiler facility using known solutions of mathematical problem of random process emission in a definite level. It can be supposed that the random function of change process of coal consumption in time and thus of dust emission, are the stationary with density of distribution, which is close to the normal law under the condition that there no accidental factors of explicit nature, particularly breakdowns and downtimes.

The known integrations from the abovementioned problem enables the estimation of different parameters of dust emission dynamics exceed of the stated levels, which can be used for the prediction of the degree of ecological danger of the dynamic dust emission of a coal-fired heat-and-power object.

The application of the methodology enables reliable assessment of the pollution levels of the territories adjacent to a heat-and-power object and timely development and implementation of efficient measures for the decrease of the negative influence of coal mines on the environment.

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Государственные санитарные правила охраны атмосферного воздуха населенных мест (от загрязнения химическими и биологическими веществами). Введены МОЗ Украины 09.07.97. Приказ № 201.

Мета. Розробка методики оцінки та прогнозування динамічних показників пилових викидів теплоенергетичних об'єктів, що працюють на вугіллі.

Методика. Методика базується на тому, що продуктивність теплоенергетичних об'єктів вугільних підприємств має стохастичний характер. Для оцінки динамічних показників пилового викиду шахтної котельні використані рішення математичної „задачі про викиди випадкового процесу за встановлений рівень“. Концентрація частинок пилу у викидах теплоенергетичного об'єкта визначена за вибірковою реалізацією випадкового процесу його продуктивності на місячному інтервалі. Для визначення характеру розподілу максимальних приземних концентрацій і побудови карт розсіювання пилу в залежності від продуктивності теплоенергетичних об'єктів використовували програму УПРЗА „ЕКОцентр“.

Результати. Проведена оцінка динаміки продуктивності та пилових викидів, що можуть бути використані для контролю екологічної небезпеки викидів теплоенергетичних об'єктів вугледобувних підприємств. Прогнозні оцінки динаміки пилового викиду теплоенергетичних об'єктів дозволяють підвищити достовірність прогнозу рівня забруднення атмосферного повітря й ступеня його небезпеки у вугледобувних регіонах, у порівнянні з оцінкою за середньорічними обсягами викидів.

Наукова новизна. Розроблена методика оцінки динамічних показників викиду твердих частинок (пилу) теплоенергетичними об'єктами вугільних шахт у залежності від обсягів споживаного твердого палива.

Практична значимість. Отримані закономірності розсіювання забруднюючих речовин, що викидаються теплоенергетичними об'єктами шахт, дозволяють прогнозувати рівні забруднення об'єктів навколишнього середовища на прилеглих територіях і своєчасно впроваджувати повітряохоронні заходи.

Ключові слова: *теплоенергетичний об'єкт, екологічна небезпека, пиловий викид, розсіювання*

Цель. Разработка методики оценки и прогнозирования динамических показателей пылевых выбросов теплоэнергетических объектов, работающих на угле.

Методика. Методика базируется на том, что производительность теплоэнергетических объектов угольных предприятий имеет стохастический характер. Для оценки динамических показателей пылевого выброса шахтной котельной использованы решения математической „задачи о выбросах случайного процесса за установленный уровень“. Концентрация пылевых частиц в выбросах теплоэнергетического объекта определена по выборочной реализации случайного процесса его производительности на месячном интервале. Для определения характера распределения максимальных приземных концентраций и построения карт рассеивания пыли в зависимости от производительности теплоэнергетических объектов использовали программу УПРЗА „ЭКОцентр“.

Результаты. Проведена оценка динамики производительности и пылевых выбросов, которые могут быть использованы для контроля экологической опасности выбросов теплоэнергетических объектов угледобывающих предприятий. Прогнозные оценки динамики пылевого выброса теплоэнергетических объектов позволяют повысить достоверность прогноза уровня загрязнения атмосферного воздуха и степени его опасности в угледобывающих регионах, по сравнению с оценкой по среднегодовым объемам выбросов.

Научная новизна. Разработана методика оценки динамических показателей выброса твердых частиц (пыли) теплоэнергетическими объектами угольных шахт в зависимости от объемов потребляемого твердого топлива.

Практическая значимость. Полученные закономерности рассеивания загрязняющих веществ, выбрасываемых теплоэнергетическими объектами шахт, позволяют прогнозировать уровни загрязнения объектов окружающей среды на прилегающих территориях и своевременно внедрять воздухоохранные мероприятия.

Ключевые слова: *теплоэнергетический объект, экологическая опасность, пылевой выброс, рассеивание*

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