Algorithm Research Exposure Dust Emissions Enterprises Of Building Production On The Environment

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Abstract: This paper describes the algorithm research level of exposure to dust emissions, the organization and layout of the sanitary protection zone of the enterprise of building production on the basis of statistical data on emissions share in Russia in the Rostov region, the issues of the impact of harmful substances on the human body and developed measures to reduce air emissions.

Introduction
All the Rostov region, is subject to strong air pollution. Adversely impact on human health and its performance determines the need for additional measures for air protection, taking into account the specific characteristics of enterprises in the region. For the testing methods used in the algorithm research level of exposure to dust emissions of enterprises of building production as objects of study chosen by the company - "Sebryakovcement", "Kavkazcement" holding "Eurocement Group", "Chiriyurt cement factory" - representatives of the basic cement of the construction industry.

While in Russia is currently operating 49 (working - 45), with a total annual capacity of enterprises – 73.7 million tons of cement - the degree of capacity utilization - only 50%. The largest share in total Russian production occupy Northwest, Central Black Earth, Volga, North Caucasus, Urals, which produce cement, not only for their own needs, but also deliver it to the neighboring regions. Southern Federal District of Russia most of all full of cement plants.

The main environmental problems of all plants cement production are emissions of solids (dust). The main sources of emissions: the explosions in the quarry with extraction of raw materials, crushers and hammer mills, wet/dry grinding mills, clinker kiln, trucks for transportation of raw materials and finished products.

Technique
To identify the level of exposure to cement construction dust, we used the results of certification of workplaces on working conditions and instrumental measurements made during production monitoring. In 2015, the laboratory ambient air studies in the Rostov region grew by 13.8%. The proportion of samples exceeding 5 LAC (Limit Admissible Concentration) increased and amounted to 0.029%. In 2015, the analysis of air quality of the city revealed with atmospheric pollution levels above LAC (ranked 5 places): Rostov-on-Don, Azov, Shakhty, Bataysk, Taganrog. [1-10].

With limited funding organizations there is a need to develop cost-effective spending.
We propose an algorithm to study the level of exposure to dust emissions of enterprises of building production on the environment, providing specific characteristics of enterprises and developing a system to prevent dust production areas, comprising the steps of:

1. Analysis of the climate, the local geographic and meteorological features of the location of enterprises of the construction industry: the use of schematic maps of the city and its surroundings with landmarks; applying to the industrial site map diagram with the main emission sources, sanitary protection zone (SPZ), territory, weather stations, points of observation for atmospheric pollution; definition of the diurnal variation of the intensity and frequency of surface and elevated temperature inversions, different speeds and wind directions, calm, rain, fog; consideration of local topographic features at atmosphere pollution calculation and setting LAE (Limit Admissible Emission);

2. Assessment of environmental hazard building enterprise (EHE): using dimensionless ratio \( K_{EHE} \) determined by the ratio of the parameter \( P \) to the consumption of contaminated gases \( G_g \), m\(^3\)/s [1, 2]:

\[
K_{EHE} = \frac{P_v}{10^3 G_g}.
\]  

The variable parameter \( P_v \) for each pollutant is calculated by a known formula, with the origin taken to cut the source of pollution

\[
P_v = \sum T \cdot P \cdot B_{ji} \cdot R_{ji} \tag{2}
\]

where required for the dilution air \( T \cdot P \cdot B_{ji} \), m\(^3\), determined according to the formula:

\[
T \cdot P \cdot B_{ji} = 10^3 \frac{M_{ji}}{C_{LACi}} \tag{3}
\]

parameter \( R_{ji} \) is defined by the formula:

\[
R_{ji} = \frac{m_{ji}}{(H_j + D_j) \cdot C_{MAXi}} / C_{LACi}. \tag{4}
\]

\( m_{ji} \) - the number of sources in the company, the same type of emitting pollutants, pcs.; \( C_{MAXi} \) - the maximum concentration of the pollutant in the mouth of the source mg / m\(^3\); \( C_{LACi} \) - limit admissible concentration in mg / m\(^3\); \( D_j \) - the diameter of the mouth of the source of m; \( H_j \) - height \( j \)-th source, m.

The essence of the introduction of an algorithm for determining \( K_{EHE} \) reduced to the calculation of the dimensionless \( C_i \) concentrations of pollutants at the exit of the chimney and change of dimensionless coordinates \( \eta, \xi, H \) (respectively, the dimensionless transverse to the longitudinal and vertical coordinates) assigned to the characteristic linear dimension of the sanitary protection zone \( L_{SPZ} \).

In accordance with the algorithm determined risk category 4 company depending on the known criteria \( P_v \) (formula (2)):

\[
\begin{align*}
P_v & \geq 10^8 - 1 \text{st category}, \\
10^6 & > R \geq 10^6 - 2 \text{nd category}, \\
10^6 & > P \geq 5 \cdot 10^6 - 3 \text{rd category}; \\
P & < 5 \cdot 10^4 - 4 \text{th category}.
\end{align*}
\]

The boundaries of the sanitary protection zone can also be determined by a change in the dimensionless ratio of conditions \( K_{EHE} \leq 2 \).

Studies on the average performance of the plants showed that when the amount of SPZ: \( L_{SPZ} < 25 \text{m} \) area for production of building materials dates back to the 2nd category of environmental risk, at 25 \(<L_{SPZ} < 50 \text{m} \) - to the 3rd category of danger, 50 \(<L_{SPZ} < 75 \text{m} \) - to 4 th hazard category. In the calculations of the mass emissions approximated ingredients and is related to the total time of the plants for the season. You can select SPZ equal \( L_{SPZ} = 75 \text{m} \), for which pollution below the LAC. From experiments it follows that condition \( K_{EHE} \leq 2 \) is fulfilled when the amount of sanitary protection zone \( L_{SPZ} > 75 \text{m} \).

3. Conduct hazard identification in the workplace: an analysis of dust emitted substances and their combinations with the sums the harmful effect, their quantitative characteristics, the identification of the actual value; characteristic of applied technologies, pollution control equipment installed chimneys, the quantitative characteristics of emissions from the rationale for the measurement data and balance sheets, the type of pollution control equipment, the composition of raw materials, fuel, a survey of similar productions, literature data; stationary characteristics, route and supervision under a torch for air pollution, current scientific and technical forecast of its change, the rate of excess MPC and hazard classes of substances [12-14].
4. Evaluation of the hygienic conditions of the population living in the sanitary protection zones and areas to be included in the sanitary protection zones; analysis of data on the impact of pollution of the atmosphere with dust on human health and the environment: forests, parks, wildlife, historical and cultural monuments, buildings, power lines, metal products (corrosion); analysis of actual field comparison of the results of maximum one-time concentrations of substances in the atmosphere and design of the field according to the actual release of the parameters (on individual substances); inventory assessment of concentrations of emission sources parameters and observation substances in the atmosphere using accepted when calculating the values of the background concentrations; development of card schemes to the calculation results of air pollution at the adverse weather conditions and the release of all the substances and combinations of substances; development of measures to reduce emissions, up to partial or total stop of the enterprise under adverse weather conditions in short periods of air pollution.

5. Assessment of the impact of levels of dust emissions building production plants, animals and humans: observation of the change in the chemical composition of plants and snow cover; changes in plant species composition, anthropogenic transformation of plant communities along the factor of contamination: as a result found that the cement dust from the animal causes damage to the skin integument, the development of inflammation of the mucous membranes, affects the respiratory tract, settling in the bronchi and lungs, and in humans cement dust causes a number of serious diseases of the respiratory system - pneumoconiosis caused by fibrogenic mineral dust (silicosis, anthracosilicosis, asbestosis) and silicotuberculosis, provided that silicosis is a determining cause disability or death; alkaline cement base and a high allergenicity chromate lead to serious diseases of the skin, respiratory tract and mucous membranes of the oral cavity and the nasopharynx.

6. Development of greening project (dendrology project and estimates for the implementation of the works) for the enterprises of the construction industry in view of the formation of schemes and shelterbelts location, alleys, taking into account the differentiated range selection for each zone area (depending on the gas concentration) on species of plants, shrubs and trees in the buffer zone, as they are an effective way to protect residential areas from the harmful effects of industrial emissions enterprises, the value of which is determined by the current legislation in accordance with the hazard class enterprise [15].

The main focus for the construction industry enterprises is to choose rocks when landscaping with high dust binding properties. When you create a project of landscaping the sanitary protection zone and carrying out landscaping work, all healthy and valuable in - sanitary hygienically existing plantations must be saved.

In this case at least 50% of the total number of trees planted should occupy the main tree species, which has the highest sanitary efficiency, viability in these soil and climatic conditions, and gas resistance in relation to the emissions of the industrial enterprises [7].

All kinds of industrial plants on its territory must have plantations, passing the strip around the perimeter for decorating unsightly industrial buildings, commercial and warehouse premises and territories occupied by containers, parts, products finished goods, raw materials and other materials, for example, from trees with high crown in two or three with a number chess planting. The second part of the plantations are obscuring hiking path runs from shop to shop, to the warehouse of finished products, to the entrance and the dining room. For such landings are recommended plants with dense canopy of high altitude, high-growth, providing maximum microclimate effect, in the shortest possible time and with the cost of care minimum: Ash green, Ailanthus altissima, Elm plumose branch y etc. Third part of the plantations are forming recreation areas workers at lunchtime. They are created when large enterprises next to each shop or department for a small part of the territory of the whole work. These areas need to be addressed as a quiet rest areas shaded resting places, with watering sites, vertical gardening and ornamental plantings pleasing the eye (colors, beautiful flowering shrubs, lawns). The fourth part of the plantations are to ensure that in the conditions of the Rostov area shading buildings and plants from excessive solar radiation. Moreover, depending on the nature of the production process of features solve the problem of intensity and density of planting along the fronts so as to not degrade the shading operating conditions. For landings along the shops on the narrow strip
of land is better suited to other pyramidal and Turkestan poplar and vines (grapes and wild fiveleaves its shape). The green dress industrial site always reflects the peculiarities of production. If a chemical or metallurgical enterprise, it is very sharply limited range of species, due to high demands on the gas resistance. If this enterprise construction industry (ferroconcrete plants, cement plants), combined heat and power plants or fertilizer companies, the focus is on the choice of landscaping rocks at high dust binding properties.

If necessary, absorb and dissipate odors industrial complexes, selected plants, the most efficient in gas exchange, such as the Canadian poplar, ash, maple [8-12].

For the preparation of the project of landscaping the territory sanitary protection zone needs the following material:
- Long-term plan of building area of sanitary protection zone, tallies with the general plan of the city or industrial area;
- The scheme of transport and pedestrian roads, as well as the scheme of underground utilities;
- Vertical planning of territory and cartogram excavation;
- Micro and macro-climatic characteristics of the area;
- Quantitative and qualitative data of air pollution and the radius of the spread of harmful emissions;
- Layout and inventory data on existing green spaces sanitary protection zone;
- Design assignment.

The project landscaping sanitary protection zone are: dendrology project, explanatory note and the estimates for the production of greening works. Dendrology project consists of a scheme of placing of green spaces of different types, scale 1:1000; dendrology plan a scale of 1:500 with an indication of the structure, size, array (profiles and details in scale 1:200 or 1:100), the range of plants for landscaping sanitary protection zone; alignment of the drawing at a scale of 1:500.

Explanatory note to the landscaping project of sanitary protection zone proves:
- Selection of plants layout of various types in the direction of the smoke dependence with existing objects and sites, released during the demolition and withdrawal from the area of residential development;
- Structure of individual protection zones, arrays, arrays of optimal size, the extent of landscaping;
- Select the range of trees, shrubs, flower lawn, plants for landscaping sanitary protection zone, depending on the climatic region, the nature of industrial production, the effectiveness of this breed in clean air, its gas resistance;
- Agro-technical recommendations for the creation and maintenance of green spaces in the area and measures to improve the gas resistance of plants;
- A feasibility study of this option.

Result

Thus, the algorithm research level of exposure to dust emissions of enterprises of building production reveals the basic problem of the construction industry - the imperfection of the process, since the Russian cement is produced by high-cost, outdated technologies; most atmospheric particles held in the air for a long time, do not precipitate at the ejection locations and dry atmosphere flows fall into regional and global contaminants.

Conclusions

The received algorithm allows to identify ecologically fragile enterprise and to actively influence the parameters of the processes for the stabilization of the ecological situation at the plant and within residential areas. In addition, taking into account the analytical relationships obtained during mathematical simulation model is formed by environmental hazard assessment based on the famous KEH criterion [1]. It allows you to predict air pollution as a function of meteorological parameters of anthropogenic dispersal migration of dust aerosols and develop an automated complex of measures on greening of industrial areas.
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