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The Estimation of Height of the Mouth of the River of Sources and Influence of Building of Industrial Facilities at the Modelling of Pollution of the Atmosphere by the Emissions

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Abstract: In this study was developed mathematical models o f air pollution emissions, taking into account the height of the mouth of the sources and impact of construction of industrial facilities. The degree of outdoor air pollution is defined by calculation, corresponding to the actual state of the air as used in the calculation of reliable data, taking into equation describing the full range of concurrent sources of emission of harmful substances as well as existing background pollution.

Key words: Modeling, pollution, air emissions, height mouth, sources of harmful substances, influence of buildings, industrial facilities

INTRODUCTION

Among problems of environmental protection the researches, it is great importance have the appraisal of influence of the polluting harmful substances on an ecological situation of environments, considering adverse weather conditions and district orography (topography, city structures) at a variable profile of speed, transfer and diffusion of impurity taking into account classification of atmospheric stability and features of their existential distribution (Aydosov *et al*., 2005). They are a basis for an objective assessment of a state and a tendency of changes of pollution of the air basin and also development of possible actions for ensuring purity of air. Now for the description of processes of transfer and diffusion of impurity, it is used a number of the mathematical models based on the solution of the equation of turbulent diffusion. At the modeling processes of distribution of impurity an important role is played by a choice of the numerical algorithms having properties of conservatism and monotony. Such properties will be possessed the numerical algorithms offered by us.

On the basis of the carried out researches on the assessment of extent of impact on environment it will be carried out the complex of actions for protection of the air atmosphere, it will be developed the nature protection actions and approaches to ensuring of ecological safet a complex of actions for reduction of emissions in the atmosphere, during of actions for protection of waters and a soil cover is revealed the economic efficiency from introduction of nature protection actions, it was done the analysis of actions for decrease in emissions of harmful substances (Bakirbayev, 2001; Perminov, 2003).

MATERIALS AND METHODS

It was used the methods of mathematical modeling a hydra-thermo-dynamics and calculus mathematics, applied programming, numerical experiments on the computer and comparison of results to data of supervision, the methods of planning of experiment and system and analytical approach including methods of theories of systems of model of calculation of dispersion of the polluting substances in the atmosphere (Banin, 1979).

Main part: Let's enter the designations, used at the creation of mathematical model C, C_x, C_y, the concentration of harmful substances in external air,

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mg/m^3; M amount of the harmful substances released by a source into the atmosphere, mg/sec; k the dimensionless coefficient, considering influence of the eminence of the mouth of a source on pollution level; v the rated speed of a wind, accepted according to the recommendation of the Head Sanitary and Epidemiologic Department = 1 m sec^{-1}; $H_{bilding}$ building height from an earth surface to its roof at a flat roof to a roof ridge at a span roof to lamp top cornice at the longitudinal lamps, located closer 3 m from a windward wall of the building, m; l building length (size, perpendicular to the direction of a wind), m; b building width (the size along the direction of a wind), m; x distance from a leeward of wall of the building to a point in which concentration is defined, m; S, S_1, S_2, S_3, S_4, the auxiliary dimensionless quantity, allowing to define the concentrations of harmful substances at distance of y, m on a perpendicular from an axis of torch from the pointed sources; b_1 distance within a roof of the wide building from its windward side to a point in which concentration is defined, m; b_2 distance within a roof of the wide building from a source to a point in which concentration is defined, m; L amount of the air-gas mix which is thrown out from a source of m/sec^3; m the dimensionless coefficient, showing what amount of the impurity emitted by a source are participated in pollution of circulating zones; b_3 distance within a roof of the wide building from a source to a leeward wall of the building, m; H the relative height of the building equal (H-1, 8 $H_{bilding}$)/($H_{boundary}$-1, 8 $H_{bilding}$) at the location of the mouth of a source out of a uniform or between corpuses zone of the narrow building and over a windward zone of the wide building and equaled (H-$H_{bilding}$)/($H_{boundary}$-$H_{bilding}$) at the location of the mouth of a source out of windward, over leeward or over between corpuses zone of the wide building; $H_{boundary}$ the limit height of low sources, m; x_1 the distance between buildings.

RESULTS AND DISCUSSION

The sources of harmful substances, polluting circulating zones of buildings should be carried to the low (Miyakoda and Rosati, 1977).

Boundary position of the mouth of the source to which it is worked as low, it is find on formulas for the narrow separate located building:

$$H_{boundary} = 0.36\, b_3 + 2.5\, H_{bilding} \quad (1)$$

for the wide separate located building:

$$H_{boundary} = 0.36\, b_3 + 1.7\, H_{bilding} \quad (2)$$

For group of buildings:

$$H_{boundary} = 0.36\, (b_3 + x_1) + H_{bilding} \quad (3)$$

where, b_3 is a distance from the source, located within a roof to the leeward wall of the building. The sources which are throwing out harmful substances at height, exceeding $H_{boundary}$ and not polluting circulating zones over and behind the building should be carried to the high.

Formulas for calculation of concentration of harmful substances in external air at pollution by its emissions choose from low sources depending on the building type, the type of the source, the location of the mouth of a source and the place of detection of concentration.

Narrow separate locating: In the integrated circulating zone or over it. In the integrated circulating zone at $0 \le x \le 6$ $H_{bilding}$:

$$C_x = \frac{1.3Mk}{v}\left[\frac{0.6}{H_{bilding}l} + \frac{42}{(1.4l+b+x)^2}\right],\ C_y = \frac{1.3Mk}{v}\left[\frac{0.6}{H_{bilding}l} + \frac{42}{(1.4l+b+x)^2}S_1\right],\ C = \frac{2Mk}{vlH_{bilding}}, \quad (4)$$

Out of the circulating zone behind the building at x>6 $H_{bilding}$:

$$C_x = \frac{55Mk}{v\,(1.4l+b+x)^2};\ C_y = C_xS_1;\ C = \frac{7.2Mk}{vl\,(b+x)} \quad (5)$$

Wide separate locating: In the windward circulating zone. On the roof in the windward circulating zone at $b_1 \le 2.5$ $H_{bilding}$ (Grishin, 1992):

$$C_x = \frac{1.3Mk}{v}\left[\frac{1}{H_{bilding}l} + \frac{42}{(1.4l+b_1)^2}\right];$$
$$C_y = \frac{1.3Mk}{v}\left[\frac{1}{H_{bilding}l} + \frac{42}{(1.4l+b_1)^2}S\right];C = \frac{3.9Mk}{vlH_{bilding}} \quad (6)$$

On a roof out of the windward circulating zone at $b_1 \le 2.5$ $H_{bilding}$:

$$C_x = \frac{55Mk}{v(1.4l+b_1)^2};\ C_y = C_xS;\ C = \frac{6.2Mk}{vlb_1} \quad (7)$$

In the windward circulating zone at $0 < x \le 4$ $H_{bilding}$:

$$C_x = \frac{5.6Mmk}{vlH_{bilding}};\ C_y = C_xS_1;\ C = \frac{2.8Mmk}{vlH_{bilding}} \quad (8)$$

Out of the windward circulating zone behind the building at x>4 $H_{bilding}$:

$$C_x = \frac{15Mk}{vl(b+x)}; C_y = C_x S_1; C = \frac{7.2Mk}{vl(b+x)} \quad (9)$$

Out of the windward circulating zone over the roof at $H^{\sim}$<0.3. On the roof out of the windward circulating zone at $b_1 \geq 2.5$ $H_{bilding}$:

$$C_x = \frac{55Mk}{vb_2^2 + 55L};\ C_y = C_x S_2;\ C = \frac{7.2Mk}{vlb_2 + 7.2L} \quad (10)$$

In the leeward circulating zone at $0<x\leq 4$ $H_{bilding}$:

$$C_x = \frac{1.3Mmk}{v}\left[\frac{0.8}{H_{bilding}l} + \frac{42}{(1.4l+x)^2}\right];\ C_y = \frac{1.3Mmk}{v}\left[\frac{0.8}{H_{bilding}l} + \frac{42}{(1.4l+x)^2}S_3\right]; C = \frac{2.8Mmk}{vlH_{bilding}} \quad (11)$$

Out of the leeward circulating zone behind the building at x>4 $H_{bilding}$:

$$C_x = \frac{55Mmk}{v(1.4l+x)^2 + 55L}; C_y = C_x S_3; C = \frac{7.2Mmk}{vl(b_3+x) + 7.2L} \quad (12)$$

Out the windward circulating zone over the roof at H>0.3. On the roof out of the windward circulating zone at $b_1 \geq 2.8$ ($H-H_{bilding}$) and y<($H-H_{bilding}$):

$$C_{x,y} = \frac{26Mk}{vb_2^2 + 26L}S_4;\ C = \frac{3.6Mk}{vlb_2 + 3.6L} \quad (13)$$

In the leeward circulating zone at $0<x\leq 4$ $H_{bilding}$:

$$C_x = \frac{1.3Mmk}{v}\left[\frac{0.8}{H_{bilding}l} + \frac{20}{(1.4l+x)^2}\right]; C_y = C_x S_3;\ C = \frac{1.4Mmk}{vlH_{bilding}} \quad (14)$$

Out of the leeward circulating zone behind the building at x>4 $H_{bilding}$:

$$C_x = \frac{26Mmk}{v(1.4l+x)^2 + 26L};\ C_y = C_x S_3; C = \frac{3.6Mmk}{vl(b_3+x) + 3.6L} \quad (15)$$

In the leeward circulating zone or over it. In the leeward circulating zone at $0<x\leq 4$ $H_{bilding}$:

$$C_x = \frac{1.3Mk}{v}\left[\frac{0.8}{H_{bilding}l} + \frac{42}{(1.4l+x)^2}\right]; C_y = \frac{1.3Mk}{v}\left[\frac{0.8}{H_{bilding}l} + \frac{42}{(1.4l+x)^2}S_3\right]; C = \frac{2.8Mk}{vlH_{bilding}} \quad (16)$$

Out of the leeward circulating zone behind the building at x>4 $H_{bilding}$:

$$C_x = \frac{55Mk}{v(1.4l+x)^2};\ C_y = C_x S_3;\ C = \frac{7.2Mk}{vlx} \quad (17)$$

Group of the buildings: In the windward circulating zone of the wide of the first on the stream building. In an between-case circulating zone at $H_{bilding}<x_1\leq 4$ $H_{bilding}$:

$$C_x = \frac{14.4Mmk}{vlx_1};\ C_y = C_x S_1;\ C = \frac{7.2Mmk}{vlx_1} \quad (18)$$

In the between-case circulating zone at 44 $H_{bilding}$< $x_1 \leq 84$ $H_{bilding}$:

$$C_x = \frac{3.6Mmk}{vlH_{\Sigma\Delta}};\ \ C_y = C_x S_1;\ C = \frac{1.8Mmk}{vlH_{\Sigma\Delta}} \quad (19)$$

Out of the windward circulating zone of the first on the stream building of the wide building on the roof at $H^{\sim}$<0.3. In the between-case circulating zone at $H_{bilding}<x_1\leq 4$ $H_{bilding}$:

$$C_x = \frac{1.3Mmk}{v}\left[\frac{2}{lx_1} + \frac{42}{(1.4l+x)^2}\right]; C_y = \frac{1.3Mmk}{v}\left[\frac{2}{lx_1} + \frac{42}{(1.4l+x)^2}S_3\right]; C = \frac{7.2Mmk}{vlx_1} \quad (20)$$

In the between-case circulating zone at 4 $H_{bilding}<x_1\leq 8$ $H_{bilding}$:

$$C_x = \frac{1.3Mmk}{v}\left[\frac{0.5}{H_{KJb}l} + \frac{42}{(1.4l+x)^2}\right]; C_y = \frac{1.3Mmk}{v}\left[\frac{0.5}{H_{bilding}l} + \frac{42}{(1.4l+x)^2}S_3\right]; C = \frac{1.8Mmk}{vlH_{bilding}} \quad (21)$$

Out of the windward circulating zone of the first on the stream of the wide building on the roof at $H^{\sim}$>0.3. In the between-case circulating zone at $H_{bilding}<x_1\leq 4$ $H_{bilding}$:

$$C_{x,y} = \frac{1.3Mmk}{v}\left[\frac{2}{lx_1} + \frac{20}{(1.4l+x)^2}S_3\right];\ C = \frac{3.6Mmk}{vlx_1} \quad (22)$$

In the between-case circulating zone at 4 $H_{bilding} < x_1 \leq 8\ H_{bilding}$:

$$C_{x,y} = \frac{1.3Mmk}{v}\left[\frac{0.5}{H_{bilding}l} + \frac{20}{(1.4l+x)^2}S_3\right]; C = \frac{Mmk}{vlH_{bilding}} \quad (23)$$

In the between-case circulating zone the first on the stream at the wide building and $H^{-}<0.3$. In the between-case circulating zone at $H_{bilding} < x_1 \leq 4\ H_{bilding}$:

$$C_x = \frac{1.3Mk}{v}\left[\frac{2}{x_1 l} + \frac{42}{(1.4l+x)^2}\right];\ C_y = \frac{1.3Mk}{v}\left[\frac{2}{x_1 l} + \frac{42}{(1.4l+x)^2}S_3\right];\ C = \frac{7.2Mk}{vlx_1} \quad (24)$$

In the between-case circulating zone at 4 $H_{bilding} < x_1 \leq 8\ H_{bilding}$:

$$C_x = \frac{1.3Mk}{v}\left[\frac{0.5}{H_{bilding}l} + \frac{42}{(1.4l+x)^2}\right];\ C_y = \frac{1.3Mk}{v}\left[\frac{0.5}{H_{bilding}l} + \frac{42}{(1.4l+x)^2}S_3\right];\ C = \frac{1.8Mk}{vlH_{bilding}} \quad (25)$$

Over the between-case circulating zone the first on the stream at the wide building and $H^{-}>0.3$ In the between-case circulating zone at $H_{bilding} < x_1 \leq 4\ H_{bilding}$:

$$C_{x,y} = \frac{1.3Mk}{v}\left[\frac{2}{x_1 l} + \frac{20}{(1.4l+x)^2}S_3\right];\ C = \frac{3.6Mk}{vlx_1} \quad (26)$$

In the between-case circulating zone at 4 $H_{bilding} < x_1 \leq 8\ H_{bilding}$:

$$C_{x,y} = \frac{1.3Mk}{v}\left[\frac{0.5}{H_{bilding}l} + \frac{20}{(1.4l+x)^2}S_3\right]; C = \frac{Mk}{vlH_{bilding}} \quad (27)$$

In the between-case circulating zone or over it at the first on the stream of the narrow building. In the between-case circulating zone at $H_{bilding} < x_1 \leq 6\ H_{bilding}$:

$$C_x = \frac{1.3Mk}{v}\left[\frac{1.5}{x_1 l} + \frac{42}{(1.4l+b+x)^2}\right];\ C_y = \frac{1.3Mk}{v}\left[\frac{1.5}{x_1 l} + \frac{42}{(1.4l+b+x)^2}S_1\right];C = \frac{7.2Mk}{vl(x_1+b)} \quad (28)$$

In the between-case circulating zone at 6 $H_{bilding} < x_1 \leq 10\ H_{bilding}$:

$$C_x = \frac{1.3Mk}{v}\left[\frac{0.25}{H_{bilding}l} + \frac{42}{(1.4l+b+x)^2}\right];\ C_y = \frac{1.3Mk}{v}\left[\frac{0.25}{H_{bilding}l} + \frac{42}{(1.4l+b+x)^2}S_1\right];\ C = \frac{1.3Mk}{vlH_{bilding}} \quad (29)$$

For the calculated value is taken the wind direction, perpendicular of the axial side of the building. At the axial direction of the wind of the concentration of harmful substances will be less.

The decreasing coefficients of S, S_1, S_2, S_3 and S_4, taken at the choice of places of air fence and the solution of other tasks, connected with determination of concentration, there, it is counted by the formulas and at the calculation of concentration of harmful substances for the second and the next buildings in the direction of a wind, the afflux of harmful substances is determined taking into account distance x by an axis of a torch and distance of y, perpendicular by torch axes:

$$S = e^{\left[-\frac{30y^2}{(1.4l+b_1)^2}\right]};\ S_1 = e^{\left[-\frac{30y^2}{(1.4l+b+x)^2}\right]};\ S_2 = e^{\left[-\frac{30y^2}{b_2^2}\right]};\ S_3 = e^{\left[\frac{-30y^2}{(1.4l+x)^2}\right]};\ S_4 = e^{\left\{-\frac{30\left[(H-H_{bilding})^2+y^2\right]}{b_2^2}\right\}} \quad (30)$$

Resumes: In research, it is received the models, considering heights of the mouth of sources and influence of building of industrial facilities, model of transfer and a dispersion of harmful substances in dependence of circulation of atmospheric air between buildings taking into account their difference of height and the direction of a wind and also the decreasing coefficients of S, S_1, S_2, S_3 and S_4, entered at a choice of places of air fences are received.

CONCLUSION

The following results are received:

- The calculated models, considering quantity and concentration of harmful substances and height, width the building and also distance between of the buildings

- Models of concentration of substances taking into account circulation of the atmosphere between buildings
- The models of decreasing coefficients of S, S_1, S_2, S_3 and S_4 entered at a choice of places of air fences

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