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PRINCIPLES OF NORMALIZATION OF VENTILATION OF MINES USING DIESEL MACHINES

S.A.Kaliev
Institute of Mining, Almaty, Republic of Kazakhstan

ABSTRACT: To the problem of normalization of ventilation of mines, where self-propelled machines with diesel motors are used, it is necessary to approach from a position of system analysis of harmful factors of technological processes and it is necessary to estimate complex influence of these factors on the condition of mine atmosphere. That is why we worked out the method of calculation of required air amount by taking to account the whole complex of technological, technical and geometrical factors Besides the new method we worked out the arrangement for purification of mine air from exhaust gas and the process of ventilation for mines where self-propelled machines with diesel motors are used, and also the arrangement for independent contain of exhaust gas. The arragements and the process are used in practice

Increase of extraction of useful minerals and mine safety are the high-priority tasks for mining industry of Republic of Kazakhstan today Chief direction of underground mining's technical improvement is an expansion of volume of self-propelled diesel machines mining. Self-propelled diesel machines are used both İn the actual mining and the first mining at more than 20 mining enterprises, the coefficient of using in time of aforenamed machines reaches 0 73 at some mines (Lomaco, 1986)

Today this technology accounts for 50% of total underground output It received a large development effort in lead-zinc, copper, iron and gold industries It is known that equipment with diesel motors use at different deposits with different mining system using The chief using systems are panel and chamber-and-pillar method, level-chamber method, horizontal slicing method with filling, cross-cut end ore caving method (Table I)

The problem of normalization of ventilation of mines when diesel machines working is not amply investigated from positions of aerogasdynamics with taking into account of technological parameters. Up to now criterion of integrated estimation of harm (CIEH) is not defined, that is to say there is no criterion of estimation of level of harmful effect of exhaust gases from diesel machines used in any working (chamber, block, part of deposit) to mine atmosphere In this conditions chief criterion of mine atmosphere condition is correspondence between gas situation and aerogasdynamical parameters at alt working zones and standing codes and requirements. However organizing and control of ventilation must be earned out on the basis of calculation of aıı-exchange in aerodynamical ly connected workings when taking into account complex factors of condition forming An absence of aforenamed criterion for estimation of real danger of harmful exhaust gases from diesel machines at mines is a factor which discourages modern technologies using. Besides all earned to completion scientific works which were made for calculations of mine ventilation by factor "harmful exhaust gases from diesel machines", in our opinion, are unsystematic. They don't take into account all variety of factors in system man-machinery (diesel machines for ore mining and transport)-atmosphere of condition at mine The author proved that aforenamed objectively effects on a process of mine ventilation as a whole (Kaliev, 1989) It was also proved that the criterion of integrated estimation of harm and principle parameters of sources of gas emission (diesel machines) have a quantitative and qualitative effect on schedule of machine movement with taking into account its technological process and also system parameters Hence, when air quality for ventilation determining it is not taken into account complex of variety of connection of factors and parameters of system, that is why there are many mistakes in these calculations, which cause the unfounded ^nd unjustified results In this connection we substantiate aforenamed criterion the essence of which is in estimation of averaged probability of exception (adaptı veness) of harmful effect (Rogov, 1973) So, in big range of conditions hanrful effect level to mine atmosphere will be different and results of its influence may not be synonymous

So, if we adopt that when "N" ciossed parameters of connections of gas-source (machine) with

Table 1 Principles indicators of self-propelled machines with diesel motors using at mines of Republic of Kazakhstan

	Mining system {mining enterprises)	Mining and geological conditions		Machines mark, diesel capacity (horsepower)	Quantity of exhaust gas, m-Vs	Country, company
		Deposit bedding, thickness and hardness ofrocks	'.Mining parameters (HxBxL), m			
1	Panel and chamber-and-pillar system (Zhezkazgantsvetmet)	Flat deposit 3-25 6-18	12xl50x x400	MoAZ 190 Toro-40D 450 Toro-501DL 326	0 25 044 0 37	USSR Tamrock Tamrock
2	Sublevel-chamber system and slicing ore extraction with filling (Tekely lead-and-zinc combine)	Steep deposit 25-30	25x42x30	Toro-200D S6	0 10	Finland
		6-16	3 5x4x40	ST-5A 160	021	GFR
3	Level-chamber system and slicing ore extraction with filling (Leninogorsk complex ore combine)	Steep deposit 30-35	60x10x60	LK-1 115	0 16	Poland
		4-14	3 5x4x40	ST-5A 160	021	GFR
4	Slicing ore extraction with filling (Zhezkentsky mining-and-metallurgical combine)	Steep deposit 35-40	3x4x40	Toro~200D 86 Kawasaki 116	0 10 0 15	Finland Japan
		1-14				
5	Sublevel caving with buttock ore di awing (Shrflkiinsky nunc)	Steep deposit S-20	10x10x20	1oro-350D \m	0 23	Finland
		16-20				

atmosphere of condition (mine) existing there are some regulated conditions of maximum allowable concentration of harmful impurities in air for ventilation, then for every R,, j=1, ,N, parameters it is possible to calculate quantity of special criterion of harm level as

$$J_j = \int_{R_j^x}^{+\infty} \varphi (R_j) dR_j \qquad (1)$$

where j - number of variations of qualitative characteristics of system, R_j^x - maximum allowable concentration of harmful impurities or standardized quantity for parameter of connections R, , $R_j^{\wedge}$ and Rj_v - top and bottom quantities of gas-source harm Äs a rule by integral function tp(R,) in some time interval /0,T/ $Rj^{\wedge}$ and R_v are taken by the way of statistical data process on a length of time /0,T7 It is clear, if $R_j^x \geq R_j^{\wedge}$, that $J_j = 0$, if $R_j^x \leq R_{jV} < R_j^{\wedge}$, $J_j = 1$ In other cases

$$0 < J_j < 1 \qquad (2)$$

Hence, a quantity for criterion of integrated estimation of harm determination it may be written in common form as

$$J_{CIEH} = [\, 1/\sqrt{N} (\sqrt{\textstyle\sum_{j=1}^{N} J_j^2})] , \qquad 0)$$

Thus physical essence of 0) criterion is in estimation of gas-source {machine, equipment) harmful effect on atmosphere of condition (mine) by average norm of vector in measured space when $(0 \leq J \leq 1)$ This criterion JftHI allows to normalize a level of harm, to do an estimation of harmful effect of machines with diesel motors using al mine workings, on mine atmosphere and also lo solve wide range oi problems on die way of control of ventilation

Side by side with this it is impossible lo by-pass d methodical aspect of this problem I he lau ıs thai methods used now for calculation of air quantity and instructions for diesel machines using al mine workings became obsolescent I hey don't present reality of aerogasdynamic processes whit h aie al mine with taking into account special conditions of mining systems It is necessary to noli: ihdl m conditions »I complex oie mines method ol statistical dilution of gases using for calculation of mine working ventilation causes to substantial increase of operation expenses for ventilation That is why at the Institute of Mining (Republic of Kazakhstan, Almaty) new method of calculations of system of mine workings ventilation was worked out with taking into account exhaust gases of diesel machines factor It was tested at mines of the Republic where diesel machines are used (Kahev, 1993)

So, for calculation of seventy of ingress of harmful gases into mine workings it is necessary to know a time of technological process (T_c) of machine with diesel motor work which we may calculate by the following expression

$$T_c = 20 + L_{tr}/0\ 31 \text{ ,s} \qquad (4)$$

under the following conditions speed of movement of diesel machines must be not less than $V_e < 5\ 5$ m/s for empty machines and $V_l < 2\ 7$ m/s for loaded machines, a distance of ore transportation from face lo ore chute (L_{tr}) for drift workings $0 < L_{tr} < 500$ m, for chamber workings $0 < L_{tr} < 1000$ m

Now we may calculate a quantity of any harmful (toxic) component

$$q^e{}_{w\,i} \leq q^l{}_{w\,i} = \frac{C_{av\,i}\ V_w}{100\,(C_{MAC}\ T_c)} \text{, m/s} \qquad (5)$$

or in common

$$\sum_{i=1}^{n} q_{w\,i} \quad q^e{}_{w\,i} + q^l{}_{w\,i} \text{ m}^3\text{/s} \qquad (6)$$

Necessary quantity of air for mine workings ventilation (Q_a) by components of exhaust gases from diesel machines it may be calculated bv the following form

$$Q_a \quad \sum^{n} q_{w} K_d K_s \text{ m}^3\text{/s} \qquad (')$$

or foi mine in common

$$Q_m \quad 1/K_L \sum_{i=1}^{m} Q_a \text{ m}^3\text{/s} \qquad (8)$$

whut ((I\ i a vu age conti ni Ml ion ı • as iiicdsuiul in workings alinospliuc wlitn (lust I machine working, % per volume; V_w -volume of working where diesel machine works, m-*, CMAC " maximum allowable concentration of toxic gases, % per volume, Kj - coefficient of dilution ratio; K_s - coefficient of simultaneously of machines work m working (it is tiken as 1 0, 0 9, 0.85 when one, two, three or more machines working), K_e - coefficient of ventilation effectiveness, m - number of workings at a part or mine in a whole

CONCLUSIONS

Analysis of investigations, which were done by author at different mines of Kazakhstan, showed that harmful effect of gas emission from diesel machines on mine atmosphere may be decreased by the way of methodical, organizing and technical measures So, on the basis of aforenamed factors we worked out a classification of methods for calculation of air quantity and methods for flight against harmful gases from diesel machines at mines

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