INVESTIGATION OF THE PIT ATMOSPHERE BY LASER SOUNDING

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ABSTRACT

An operative control for purity of air basin of open-pit minings (pits) is of practical interest in the aspect of well-timed warning of services concerned about the presence of a threatening situation.

The peculiarity of the pit relief offers the premises for accumulation of deleterious impurities. The meteorological situations when calm is followed by temperature inversion in the atmosphere are especially dangerous in this respect.

The main components of the atmospheric contamination in the pit are exhaust gases of internal combustion engines. The dust, being produced while boring and excavating the rock, is less essential. The atmospheric pollution by dust and products of explosives combustion during explosive work is strong but occasional.

At present there are no any methods that enable the situation to be quickly estimated over entire pit space. A lidar offers good possibilities to solve this problem.

The possibility of detecting aerosol pollutions using single-frequency sounding is undoubted. In the case of pit spaces a possibility arises of the estimate of atmospheric contamination by harmful gases using aerosol scattering. This becomes possible because of good correlation between gas and

aerosol components of engine exhaust.

A ruby lidar has been installed on one of the pit slopes to estimate the possibilities of laser sounding of pit space. The possibility of mounting of calibrated targets in different regions is important in methodical respect that allows to obtain the optical thickness of all the path and its separate parts, and, besides, to calculate the values of the backscattering coefficient avoiding the absolute lidar calibration. The sounding was made both along the reference paths and over the entire pit space that made it possible to separate out the contours of regions with the increased impurity concentration. Taking sufficiently small path regions by means of the screens set at both ends of the region one could obtain both general value of the optical thickness up to the isolated region and the differential value of the attenuation factor . This enabled the ratio $b = \frac{\beta_\pi}{\alpha}$ necessary for the lidar equation solution to be obtained. Considering the aerosol fine dispersion β_π could be expected to be close to a Rayleigh one. However, β_π was obtained much smaller that is accounted for the absorption contribution in the total attenuation factor. Taking into account the experimental results a theoretical model of the aerosol optical properties is suggested. Parallel measurements of concentrations and microphysical parameters by sampling allow good correlation between the results of sounding and contamination parameters to be found. The experimental results are compared with the calculated ones.

The possibility of using the lidar to predict the situations with increased contamination level is discussed. It is stipulated by the fact that temperature inversions are revealed in the aerosol scattering signal. In its turn the situations with a high contamination level are connected usually with similar inversions.