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Influence of Climatic Factors and the Ground Surface on the Required Noise Abatement from Power Equipment

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Abstract—The influence of climatic factors and the ground surface on the required noise abatement from the power equipment is analyzed. It is shown that annual oscillations of temperature and humidity lead to substantial variations in the levels of the sound and the sound pressure from the same source in the design point, while the ground effect surface can in some cases cause an increase in the sound pressure levels in the design point, and in other cases—their decrease. When developing the measures on sound suppression of the power equipment, it is recommended to take into account the influence of climatic factors depending on annual variations in temperature and humidity for this terrain as well as on the category of the ground surface.

Keywords: noise abatement of the thermal power station, sound attenuator, climatic factors, ground effect
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Questions of noise abatement of power equipment using attenuators, the selection and expenses for the fabrication of which depend on the required noise abatement, are topical [1]. In regulation documents *SNiP* (Sanitary Norms and Rules)-*II-12-77* [2] and *SNiP 23-03-2003* [3], the influence of climatic factors and the ground surface on the determination of the required noise abatement is not taken into account at all. Accepted *GOST* (State Standard) *31295.I-2005* and *GOST 31295.2-2005* [4, 5] make it possible to take into account the influence of the temperature, the humidity, and the state of the surface on the noise propagation from the source. Further, the influence of these climatic factors and the ground surface on the required noise abatement as applied to the steam escape upon the actuation of the main steam valve of the boiler of the thermal power station is considered below. In this case, the variation of the levels of the sound and the sound pressure in the same point from the same source is followed annually during oscillations of the air temperature and humidity.

The range of varying the noise levels because of climatic factors increases as the distance from the noise source increases. Thermal power stations with electric power of 600 MW and larger, which use coal and fuel, should have a sanitary protection zone (SPZ) no smaller than 1000 m, and those operating with the gas and gas–mazut fuel—no smaller than 500 m. Thermal power plants (TPP) and district boiler houses with thermal power of 232 MW (200 Gkal/h) and above should have an SPZ no less than 500 m with the operation using the coal and mazut fuel, and no less than 300 m when using the gas and mazut fuel (the latter as the reserve) [6]. Therefore, the influence of climatic factors is considered at a distance from 300 to 1000 m.

The influence of climatic factors can be evaluated using the following expression [5]:

$$\Delta L_{fT}(DW) = A_{\mathrm{atm}2} - A_{\mathrm{atm}1},$$

where $\Delta L_{fT}(DW)$ is the variation of the levels of the sound pressure, dB, at various states of the atmosphere; and $A_{\mathrm{atm}1}$, $A_{\mathrm{atm}2}$ is noise damping because of sound absorption by the atmosphere at various values of the temperature and humidity, dB.

Oscillation of the barometric pressure in limits of 931–1064 kPa (700–800 mmHg) causes the variation in the sound level (SL) by approximately 0.1 dBA; therefore, we can neglect this factor.

Figure 1 shows the variation in SL ΔL_p depending on temperature t_{a} and humidity φ is the calculated point at a distance of 500 m from the steam emission. The plot is constructed based on data [4]. It is seen that the maximal variation in the SL in the design point reaches 9.8 dBA upon lowering the air temperature from –4.1 to –25°C with humidity of 30%.

Figure 2 shows the annual variation in SLs for various distances from the calculated point to the noise source (steam emission) by the example of five cities arranged in various geographical areas. The data on the annual variation of climatic conditions for these cities are taken from [7, 8]. It is seen in Fig. 2 that the maximal values of the SL are in April–October, while minimal ones are in November–March.

Table 1 represents the results of calculations for various cities depending on the distance from the noise source to the design point. The maximal variation in