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STEAM BOILERS, POWER FUEL, BURNER FACILITIES, AND AUXILIARY EQUIPMENT OF BOILERS

The Method Used for Justification of Engineering Solutions for Multistage Plate-Type Mufflers Attached to Gas-Air Ducts of Thermal Power Plants

V. B. Tupov

National Research University Moscow Power Engineering Institute, ul. Krasnokazarmennaya 14, Moscow, 111250 Russia

Abstract—This paper describes technical and economic problems associated with the selection of designs of mufflers attached to gas-air ducts of thermal power plants. A method is suggested that makes it possible to determine the dimensions of each stage of plate-type mufflers on the basis of achieving the lowest total discounted costs in order to provide the required acoustical performance at a permissible aerodynamic resistance of a muffler. The condition of the lowest total discounted costs for a multistage muffler, which is valid for different types of mufflers, has been obtained.

Keywords: noise attenuation, power-generation equipment, noise attenuators

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Most of the expenses for noise attenuation at thermal power plants are due to gas-air ducts; to attenuate noise produced by the latter, plate-type mufflers have come to widespread use all over the world [1]. Figure 1 shows plate-type mufflers of different types. The sources of noise can be gas turbines, blower fans, smoke exhausters, and fans used for local ventilation [2]. In this case the plates of a muffler may constitute parts of both a dissipative and a reactive (nondissipative) muffler.

A dissipative plate-type muffler (see Fig. 1a) is an array of hollow parallel baffle plates filled with sound-absorptive material, and these baffle plates split one channel into several parallel channels. The sound-absorptive material is protected from being blown out by means of the perforated sound-transmitting shield. A distance between the extreme plates and the housing of the muffler is one half of the distance between the plates that are equidistant. The required thickness of the plates is determined from the peak in the noise spectrum: the lower the frequency of sound being attenuated, the thicker the plates of the muffler should be. If the frequency response of noise abatement differs from the frequency response of the muffler, then a muffler consisting of two or three stages is used, with each of these stages providing noise attenuation in its range. Plates 100, 200, and 400 mm thick are most commonly used. Besides, the plate-type mufflers consist of several stages with due regard for the fact that the specific acoustic efficiency decreases along the length of the muffler.

In order to attenuate noise produced by smoke exhausters, reactive mufflers of the "one quarter wavelength of sound" are used. Reactive mufflers, for example, of the "Helmholtz" type (Fig. 1b) allow one to reduce the noise pollution level on low frequencies. When a sound wave reaches a certain volume, an opposite-phase wave is generated, the amplitudes of which, when superimposed on a principal sound wave, become equal to zero. Baffle *8* created volumes of the chambers, which vary in lengthwise direction, and this makes it possible to abate noise in the broad range of frequencies.

Resonant-type mufflers of the one-quarter wavelength type (Figs. 1c, 1d) are most widely used. In this case one side of the tilted baffle plate in the muffler may be lined by sound-absorptive material. The plates shown in Fig. 1c are used when they are arranged horizontally, while those shown in Fig. 1d, vertically. In the latter case the design of the muffler prevents dust from being accumulated between the plates.

Until the present time the selection of multistage plate-type mufflers has been based on providing required operational parameters—the acoustic performance and the permissible aerodynamic resistance, and it has been made by exhaustion of various versions, without regard for the costs of mufflers. The implementation of such an approach may result in large additional capital and operating costs. To compare the version of mufflers, which have different acoustical performance and service life, it is a good practice to implement the method of discounted costs [3]: the dimensions of each stage of the plate-type mufflers are determined on the basis of providing the lowest total discounted costs (DC), in Russian rubles, with achieving the required acoustical performance and the permissible aerodynamic resistance of a muf-