

ADVANCED TECHNOLOGIES AND POWER INSTALLATIONS FOR THERMAL AND ELECTRIC ENERGY GENERATION

6.3. Heat and power supply units of low capacity

6.3.8. Ecological efficiency as a result of replacement of heating boiler-houses with small CHPPs

Ilyin E.T. CJSC "Complex energy systems"

The main ecological effect of replacement of heating boiler-houses with low-capacity combined heat and power plants (CHPPs) is reached due to reduction of fuel consumption, connected with increase in thermal and electric energy generation, based on cogeneration cycle, and also due to reduction of energy losses in power networks as well as additional reduction of fuel expenses.

Estimation results of fuel consumption reduction on each component are presented in Tabs. 6.25 and 6.26. Reduction of harmful emissions can be estimated on the bases of harmful emission standards. In case of gas combustion, NO_x emissions are less.

For all boiler units, put into operation after 1992, the standard GOST 26943—86, irrespective of their productivity, establishes the NO_x emission standard of 125 mg/m³ at gas combustion and 185 mg/m³ at oil combustion. Results of calculations show that at combustion of 1 kg of reference fuel, about 10,5 m³ of flue gases are formed on the average. Thus, having estimated fuel saving, it is very easy to define reduction of harmful emissions using the following expression:

$$M_{\text{NO}_x} = m_{\text{NO}_x} s_{\text{fg}} B_s \cdot 10^{-6}, \quad (6.23)$$

where M_{NO_x} — reduction of mass emissions of nitrogen oxides, t/year; m_{NO_x} — specific content of nitrogen oxides in flue gases, mg/m³; s_{fg} — average unit flow rate of flue gases, formed at combustion of 1 kg of reference fuel, m³/kg; B_s — total annual saving of reference fuel in case of replacement of heating boiler-houses with low-capacity CHPPs, t/g.

Results of calculations are presented in Tab. 6.27.

The presented results of calculations show that replacement of heating boiler-houses with small CHPPs results in

considerable fuel saving, improvement of reliability of thermal and electrical power supply due to increase in a number of independent power sources and reduction of harmful emissions, discharged into the atmosphere, without additional expenses for creation and installation of treatment facilities.

Table 6.27. Estimation of mass emissions of nitrogen oxides in case of replacement of heating boilers with small CHPPs

Power unit	Annual total saving of reference fuel, mln t/year	NO _x emission reduction, t/year
Steam turbines ($N_{\text{est}} = 14,26$ thous. MW)	24,585	32267,813
GT ($N_{\text{est}} = 24,7$ thous. MW)	43,926	57652,875
GT and steam turbines ($N_{\text{est}}^{\text{total}} = 28,6$ thous. MW)	47,1435	61875, 844

Besides, it is necessary to take into account considerable reduction of greenhouse gas emissions, in particular, CO₂. If to assume that all natural gas consists of pure methane, then at fuel burning it is possible to reduce emissions of CO₂ by 50,706, 90,598 and 97,232 million t/year, accordingly, depending on type of thermal power plants and their combination.

Thus, replacement of heating boiler-houses with low-capacity CHPPs allows to improve environmental characteristics of thermal and electric power generation, as well as essentially increase fuel saving.