Part 6

# ADVANCED TECHNOLOGIES AND POWER INSTALLATIONS FOR THERMAL AND ELECTRIC ENERGY GENERATION

## 6.1. Improvement of the thermal cycle of traditional combined-cycle TPPs

### 6.1.3. Effect of regenerative heating of condensate and feed water on thermal economy of the plant

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For straight-condensing power plants, application of regeneration leads to an increase in thermal economy, since by that heat losses in the cool source – a condenser of the turbine plant are reduced. Relation of the inner absolute plant efficiency with the regenerative heating $\eta_{ir}$ and without it $\eta_{ic}$ (at all other conditions being equal) is the following:

$$\eta_{ip} = \eta_{ik} \frac{1 + A_p}{1 + A_p \eta_{ik}}, \qquad (6.7)$$

where $A_p$ is an energy regeneration factor - a ratio of the total work, obtained from the steam flows, entering the regenerative bleedings off, to the work, generated in the turbine by the condensing flow. For installation without the intermediate superheating of steam $A_p$ is as follows:

$$A_p = \frac{\sum_{1}^{z} \alpha_j (h_0 - h_j)}{\alpha_к (h_0 - h_к)}, \qquad (6.8)$$

here $j$ is a number of regenerative bleedings off in a range of 1 to z; z is an amount of regenerative bleedings off; $\alpha_j$ are arts of steam bleedings off for regeneration; $\alpha_c$ is a part of steam flow, entering the turbine condenser.

For combined heat power plants correlation between $\eta_{ip}$ and $\eta_{ic}$ is described by dependence:

$$\eta_{ip} = \eta_{ik} \frac{1 + A_p + A_{rb}}{1 + \eta_{ik}(A_p + A_{rb})}, \qquad (6.9)$$

where $A_{rb}$ - energy coefficient for steam flows of regenerative bleedings off determined by the following formula:

$$A_{rb} = \frac{\sum_{1}^{m} \alpha_{rb\,j} (h_0 - h_{rb\,j})}{\alpha_k (h_0 - h_k)} \qquad (6.10)$$

here $m$ is an amount of steam bleedings off from the turbine to the heat consumers; $j$ – a number of steam bleedings off to the heat consumers; $h_{rb\,j}$ - enthalpy of steam in the bleeding off.

From the comparison of (6.8) and (6.9) follows, that at all other conditions being equal, the effect of regeneration application at CHPPs is always lower than at the condensing installation.

It should be noted that at increase in a number of stages of regenerative heating each successive stage gives a smaller, compared to the preceding, increment of the performance index. For this reason, a number of regenerative bleedings off, even at condensing installations, does not exceed 8...9.