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ENSURING OPTIMAL PUMP OPERATING MODE

When changing the pump feed mode with the network characteristics unchanged, the task is to ensure a shift in the pump characteristics by changing the rotation frequency to a point that ensures a minimum deviation of the efficiency from the optimal values, i.e., minimum power losses for moving the working medium.

When regulating by throttling (control valve), by changing the network characteristics, the hydraulic resistance of the network increases, while a decrease in flow relative to the nominal value is accompanied by a decrease in efficiency.

$$\eta_2 = \frac{N_n - \Delta N}{N_n} = 1 - \frac{\Delta N}{N_n} = 1 - \frac{\rho g \Delta Q \Delta N}{N_n}. \qquad (1)$$

Since, in the turbulent mode of movement of working media, which is typical for the main operating modes of thermal power plants, there is a quadratic dependence of pressure losses Δ*N* from consumption *Q*:

$$\Delta H = kQ^2, \qquad (2)$$

then the increase in pressure losses during throttling occurs more intensively than the decrease in flow, therefore the product $\Delta Q \Delta H$ increases:

$$\eta_2 < \eta_1.$$

Accordingly, the power costs for moving the medium:

$$N_{кор2} = \rho g Q_2 H_2, \qquad (3)$$

Thus, when throttling is used, hydraulic losses in the network and, accordingly, power costs increase.

When regulating by changing the rotation speed.

$$\frac{Q_3}{Q_1} = \frac{n_2}{n_1};\ \frac{H_2}{H_1} = \left(\frac{n_2}{n_1}\right)^2;\ \frac{N_3}{N_1} = \left(\frac{n_2}{n_1}\right)^3, \qquad (4)$$

At $Q_3 < Q_1, n_2 < n_1$ and $H_3 < H_1$, i.e., pressure losses, and, consequently, power costs for moving the medium, are reduced.

Accordingly, the efficiency value when regulating the rotation speed is higher than when regulating by throttling, i.e:

$$N_{п.п.} < N_{п.др.}$$

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