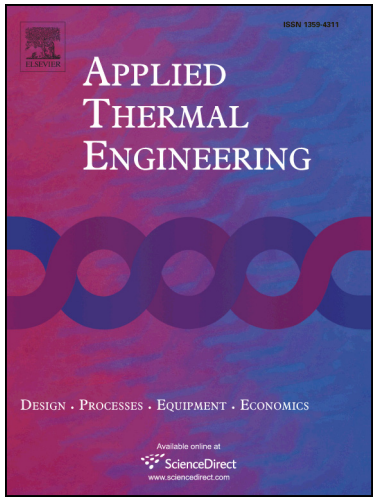

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Optimal allocation of surplus gas and suitable capacity for buffer users in steel plant

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Abstract: Byproduct gases are an important secondary energy source in the iron and steel industry. A novel mathematical programming model was established in this paper to study the optimal allocation of surplus gas in buffer users in the byproduct gas system, on the basis of which a new method for calculating the suitable capacities of gasholders and boilers was also proposed. The validity and practicability of the model and the design method were tested in an iron and steel enterprise. The results show that gas emissions were controlled, boiler efficiency was improved, and surplus gas-related power generation was increased by approximately 5×10^4 kWh in each hour compared with the actual data from the iron and steel enterprise. Finally, fitting curves of the relationship between the designed fuel load of the boiler and the capacity of the gasholder were obtained. Scientific guidance is thus provided for the improvement of buffer users in steel plants in the future.

Key words: iron and steel industry; byproduct gas distribution; boiler; gasholder; energy saving; optimization

Nomenclature

Sets

B set of boilers

K set of gasholders

G set of byproduct gases (BFG, COG, LDG)

b number of boiler (b=1, 2, …, B)

h number of G gasholder (h=1, 2, …, K)

t time period (t=1, 2, …, T)

Parameters

HV^G heating value of byproduct gas G, kJ/Nm^3;

HV_b^{min} minimum heating value demanded in boiler b, kJ/Nm^3;

HV_b^{max} maximum heating value demanded in boiler b, kJ/Nm^3;

HE_b^{min} minimum heat demanded in boiler b, kJ;

HE_b^{max} maximum heat demanded in boiler b, kJ;

P means the intersection point of the fitting curves;

R_{MAX} maximum amount of surplus gas, Nm^3/h;

R_{MIN} minimum amount of surplus gas, Nm^3/h;

R_{AVE} average amount of surplus gas, Nm^3/h;

R_{SMA} the mean value of R_{MIN} and R_{AVE}, Nm^3/h;

R_{LAR} the mean value of R_{MAX} and R_{AVE}, Nm^3/h;

V_H^G upper bound of G gasholder, Nm^3;

V_L^G lower bound of G gasholder, Nm^3;

V_{LL}^G minimum capacity of G gasholder, Nm^3;

V_{HH}^G maximum capacity of G gasholder, Nm^3;

$V_b^{G,e}$ amount of gas G needed in boiler b at its rated state, Nm^3;

$V_{f,t}^G$ amount of surplus gas at time t, Nm^3/h;