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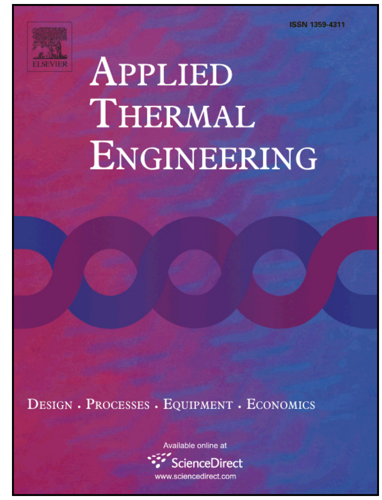


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# Heat transfer and discrete phase modelling of coal combustion in a pusher type reheating furnace

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ABSTRACT

Mathematical as well as numerical modelling of a reheating furnace is a difficult task because of the complexity in geometry as well as the involved heat transfer and combustion phenomena. The complexity is further aggravated by the presence of discrete coal particle combustion and the periodic transient movement of the steel billets. The aim of this work is to perform a three-dimensional simulation for a pusher type reheating furnace of steel billets with coal burners. The reacting fluid flow and heat transfer inside the furnace is simulated using a commercial software ANSYS Fluent 15.0 and an in-house 3-D transient code is developed to simulate the thermal diffusion in the periodically moving billets. The actual process is then modelled by coupled simulations of the furnace and the billets with an iterative approach. This kind of coupling greatly reduces the computational effort without much affecting the accuracy. On comparison of the results with the data obtained from a real facility, a good agreement is found leading to the conclusion that the proposed methodology is adequate for simulating the system.

**Keywords**: Pusher type reheating furnace, Coal combustion, Discrete phase model (DPM), Billet heating characteristic

**Nomenclature**

| | | | |
|---|---|---|---|
| $C$ | specific heat (J/kg.K) | | *Greek symbols* |
| $h$ | convective heat transfer coefficient (W/m$^2$.K) | $\varepsilon$ | emissivity |
| $k$ | thermal conductivity (W/m.K) | $\theta$ | azimuthal angle |
| $Q_{cf}$ | convective flux (W/m$^2$) | $\rho$ | density (kg/m$^3$) |
| $Q_{ir}$ | incident radiation flux (W/m$^2$) | $\sigma$ | Stefan-Boltzmann Constant ($5.67\times10^{-8}$ W/m$^2$K$^4$) |
| $T$ | temperature (K) | | |
| $t$ | time (s) | $\varphi$ | zenith angle |

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