Effect of a ceramic insert with swirler on gas dynamics and heat exchange in a blast furnace tuyere

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Abstract

The use of natural gas can reduce the amount of coke needed to produce cast iron. In a common tuyere natural gas is pressed against the surface of the air passage by a stream of hot blow and mixes poorly with it. It leads to incomplete burning of natural gas and its pyrolysis. One way to improve the mixing of natural gas and hot blow is to install the swirler in the air passage. In these case, however, the intensification of the natural gas burning inside the tuyere can lead to a burnout of the inner cylinder.

In **Ansys Fluent 18.2**, using insulation insert with a swirler made in the form of a collar step at different places along the length of the insert, simulation of gas dynamics and its thermal state is carried out to solve the problem of mixing natural gas and hot blow in the air passage of tuyere.

Simpler assumptions were adopted. Among which the simulation area included not only the fluid medium inside the air passage, but also the insulation insert, i.e. solved the associated problem of heat exchange, and the processes of transfer of heat to the water of the cooling system are taken into account in extended boundary conditions.

The simplified calculation area scheme was created in the **DesignModeler** application, and the calculated grid was created in the **AnsysMeshing** application.

The boundary conditions were set for blow, natural gas, as well as for the border of the insert with an air gap separating it from the internal cylinder and the fluid with the tuyere nose.

Taking into account the symmetry of the computation region, the calculations were made for the half of tuyere.

It has been found that the mixing of natural gas and hot blow improves as the swirler moves along the length of the insert to the exit from the air passage. At the same time, heat duty of the insert decreases, thereby increasing the resource of its operation. At the same time, in the place of the swirler the diameter of the air passage is not less than downstream of the tuyere. The swirler`s shift toward the exit from air passage reduces the thermal load on the insert, thereby [increasing its service life](http://context.reverso.net/%D0%BF%D0%B5%D1%80%D0%B5%D0%B2%D0%BE%D0%B4/%D0%B0%D0%BD%D0%B3%D0%BB%D0%B8%D0%B9%D1%81%D0%BA%D0%B8%D0%B9-%D1%80%D1%83%D1%81%D1%81%D0%BA%D0%B8%D0%B9/in%2Bincreasing%2Bthe%2Bservice%2Blife)*.*

Key words: blast furnace, tuyere, simulation in Ansys Fluent environment, gas dynamics, heat exchange, natural gas burning, swirler, heat losses