Investigation of Tuyere Nose Failures in a Blast Furnace

THE PROBLEM

IH7 blast furnace uses copper, water-cooled nozzles (tuyeres) as the injection point for high velocity, pre-heated air mixture to the blast furnace for iron oxide reduction. These tuyeres periodically fail and each failure a significant loss to the company. IH7 has had an unacceptably high rate of tuyeres failures at the furnace. Currently, the exact mechanism of the failures is unknown so IH7 would like to model the tuyeres design as a possible failure mode.

THE PROJECT

Determine:

- Areas of poor heat transfer/high heat load of current tuyere design based on varying hot face temperatures and water flow conditions
- Benefits/drawbacks of “hard surfacing” on tuyeres
- Suggest possible design changes to current tuyeres design to improve tuyere performance. IH7 to set constraints in these cases.

THE OUTCOME

- Hot spot is caused by uneven copper thickness at tuyere tip. Reduction of the thickness of the copper at tuyere tip reduces both hard facing temperature and copper temperature.
- Shutting down operation increase the tuyere temperature by about 900 °F. Emergency water operation increase the tuyere temperature by about 150 °F.
- As the thickness of the hard facing increases, the temperature of the hard facing increase. But the copper temperature will maintain as a constant. Lowering the hard facing absorptivity reduces both hard facing temperature and copper temperature.

Sponsor: Arcelor Mittal
Students: Xingjian Chen, Yan Chen