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A blast furnace tapping simulator to better understand dead man flotation scenarios

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In the present study we implemented a simplified but fast simulation tool to keep track of the liquid fill levels of pig iron and slag inside a blast furnace (BF). It is able to calculate the estimated tapping rates based on only a few mandatory input parameters like the production rate obtained from the currently active charging recipe and the tuyere and topgas pressure levels. The calculation method is based on two main models: (i) in the hearth of the BF we only account for the vertical force balance of burden load, gas pressure and buoyancy of the dead man. From this force balance we can estimate the flotation behavior of the dead man and the hydrostatic pressure at the entrance of the taphole. This pressure level is used to solve (ii) the momentum balance for iron and slag inside the taphole to calculate the tapping flow rate for both phases. The taphole model is currently based on a stratified fluid assumption and also accounts for taphole erosion during the tapping process. The BF hearth is discretized in radial and angular coordinates. Hence, it is possible to account for heterogeneous porosity of the dead man and investigate various flotation scenarios. The simulation tool is therefore an efficient way to study and better understand BF tapping behavior in comparison with other available data like temperature measurements of the hearth. Further enhancements of the tool will include a more detailed taphole model that will account for conditions where the stratified fluid assumption might not be correct.

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