Optimisation of Reverts Usage on Sintering Processes and Impact on the Sinter Quality

An experimental study into the mechanisms of sintering processes and production by utilising additives

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TATA STEEL

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An experimental study into the mechanisms of sintering processes and production by utilising additives

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Abstract

Utilisation of reverts in sinter production is nonetheless challenging considering physical and chemical characteristics: physical by means of presence of extreme amount of fine material (<1mm) and chemical in terms of heavy metals, alkalis and uneven distribution of materials. Poor granulation, affecting permeability and degrading of cold strength of produced sinter are negatively influencing sinter processes. On the other hand, reverts contain valuable materials as carbon- and iron-bearing materials, and can affect the sinter process positively. Steelmaking companies generate large quantities of reverts, however the impact of reverts on sinter processes and sinter quality is not fully investigated. With this in mind, this study investigates the impact of revert blends utilised in sinter blend on sinter processes and quality.

In this research the revert blend is composed of basic oxygen furnace sludge (BOF-sludge), low zinc blast furnace sludge (low zinc BF-sludge) and sinter plant dust collector. These reverts are combined in ratios of 0.7:0.25:0.05. To achieve research objectives, firstly a pre-process procedure is developed, to investigate the effect of reverts on granulation process. Pre-process procedures are selected by judging their sinter bed permeability with increasing moisture content in sinter blend.

To appraise the impact of reverts on sinter processes and quality, sinter blends “revert: ore” ratios are incrementally increased. This was executed in following ratio order (5:95 – 15:85 – 25:75). Increasing reverts ratio, affects not only the average granule particle diameter negatively (PSD RRd), but affects basicity and carbon in blend positively. Results depict that incrementally increasing reverts ratio in sinter blend, generate more return sinter fines, but increases productivity to a certain extend.

In addition, effect of olivine versus dolomite as fluxing agents was investigated in combination with revert: ore ratio of 15:85. Furthermore, from another site, reverts being BOF-sludge and BF-sludge are utilised in ratio 1:1, with same ore: revert ratio as before. In the last two experimental phases moisture content in sinter blend was decreased to 6.5 wt.%. PSD RRd for revert blends are smaller, but in this case also generate smaller sinter granules. Larger granules resulted in higher cold permeability values, but not in higher productivity. In addition, sinter fluxed with dolomite leads to lower sintering intensity, compared to that of fluxed with olivine.

Results depict that in almost all cases, utilisation of reverts in sinter blend has impact on flow through sinter bed positively or negatively. The flow through sinter bed was found to be greatly influenced by sinter granule sizes. Increasing carbon content with higher basicity resulted in stronger sinter for both reverts and non-revert blends. Nevertheless, revert blends performed weaker compared to non-revert blends. Regarding sintering intensity, revert blends have a lower sintering intensity compared to non-revert blends. X-ray fluorescence (XRF) and chemical analysis present that sinter from revert blends have in all cases lower FeO presence compared to non-revert blends with same carbon content. X-ray Diffraction (XRD) analysis presented that revert blends have higher hematite presence compared to their non-revert blends. This indicates the relatively lower FeO presence in sinter produced with revert blends. In addition, from XRD-analysis a positive correlation between SFCA and calcium ferrites minerals and cold strength is discovered.