Green Steel Production through Waste Utilisation

By Tata Steel | Category: Implemented Innovations

Slag produced in steel making is a 'waste'. At LD1 Silicon & Manganese is mainly used as a deoxidiser and slag, thus produced becomes solid, creating fumes, sound and dust pollution. Several trials have been conducted with different materials since 2000 to solve this problem. The steel slag consists of valuables like Al_2O_3 and CaO. Addition of this slag in Si-killed steel making, produces liquid slag which is conducive for cleaner steel. The innovation demonstrates utilisation of waste slag. This slag contains 50% CaO, and hence is suitable to replace lime. This has the potential of saving Rs. 30 crores per annum in addition to reduction of >20KT CO_2 emission.

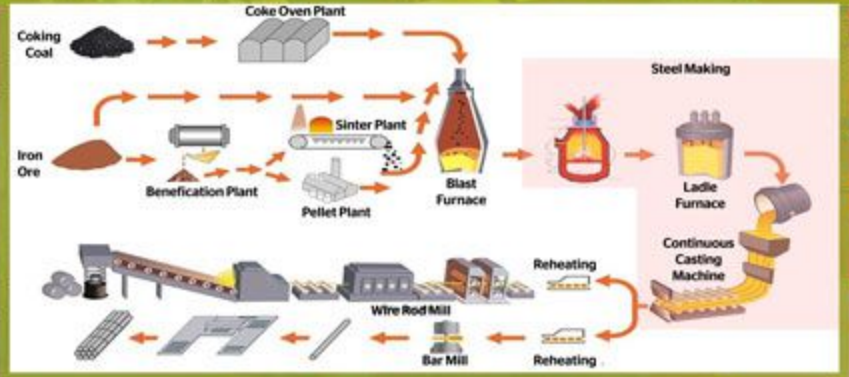
The Context

- Slag crusting causes abnormal sound and dust during arcing
- Harmful fluorspar gets added to the fluidise slag
- Delayed recovery of Fe Alloys added at LF
- Slag not conducive for absorption of inclusion in steel
- Slag crumbling on cooling and dusty environment
- Constraint of space for dumping
- Disposal of dusty slag

The Innovation

Enriching Si-Mn slags with Alumina lowers its melting point below steel-making temperatures. There is a restriction of Al content in steel in the open casting process for castability issues due to which the Al addition is not advisable in Tata Steel's process. Use of synthetic slag to make the slag liquid is available in the market, but at a huge cost. Since 2000, several trials have been conducted with different materials like colemanite, borax, Silica etc. Some success was achieved, but there was a negative impact on the process and product. The boron bearing material created cracks in the products. Silica was adversely impacting ladle refractory and synthetic slag was adding to the cost.

After LF slag from other steel melting shops at TSL was analysed. it was found that the waste contained valuables like Al_2O_3 and CaO which has the potential to modify the slag.



This waste slag was used as a trial to condition their silicate slag. The first trial was conducted in 2016. Trials were conducted at different addition locations in steel making. These trials did not give a positive result due to the poor mixing with already-crusted slag. In the second attempt, the furnace refractory got affected in a major way. In the absence of slag splashing, maintenance time increased which reduced productivity. The idea was dropped. The last trial was done in ladle during tapping, wherein the mixing was excellent. Several trials were then conducted to determine the adequate quantity and optimum size. Having a viable solution to support slag addition for 3.3 MT of steel posed the next challenge. LD#1's growth from 1MT to 3.3MT in the last 35 years in the same geographical area left the team with no additional space for putting up a new facility. High-rise bins designed to dispense inside BOF were modified and redesigned with >50M of piping to convey this slag into steel ladle. A Vibro Feeder was installed to feed the desired quantity in 3 minutes. In addition to monetary benefits, there is a yearly reduction of >20KT CO_2 emission and work area enhancement by reducing arcing noise (96dB to 70dB) and dust (3.7 to 1.3 mg/NM3).

Overcoming Challenges

Challenge #1

Selection of slag conditioner: Continuous trials with the in-house BF slag, purchased synthetic slag, addition of silica and boron based material, colemanite, Al_2O_3 enriched slag were conducted.

Challenge #2

Selection of steel making stage for addition: Several trials were conducted at each stage of steel making.

Impact of the Innovation

revenue impact

₹300 mn