Coreless Fluxing Benefits for Ferrous Foundries

David Williams, Rod Naro, ASI International

There has always been a negative stigma against using fluxes during the melting of irons in induction foundries. The refractories used in induction furnaces, such as silica-based linings, were less tolerant to chemical attack from fluxes. In many ferrous melt shops, Lime/Fluorspar (CaF_2) additions are commonly used whether for desulphurization, phosphorus reduction, deoxidation, coke cleansing or improving metal cleanliness. Recent changes in flux formulations (the reduction or elimination of chlorides and fluorides in fluxes), have achieved positive successes in induction melting and pouring operations. In the past, these furnaces were typically removed from service prematurely because of the inability to effectively and safely remove stubborn slag and insoluble build-up.

During the last 50 years, the melting of various ferrous alloys in coreless induction furnaces has changed significantly. During the same period, while ductile iron production and hybrid steels have experienced continued growth, the quality of metallic charge such as “pig iron”, carbon steel and other iron-units has steadily deteriorated. The result: slag related melting problems have become widespread in recent years, lending to slower melting rates and less efficient use of the coreless furnace. Whether it is a medium frequency or main frequency furnace, there has been an increase in insoluble build-up formation.

A small iron foundry that had success utilizing flux additions in a 500 pound medium frequency coreless induction furnace to combat slag build-up is shown in the accompanying example below.

This family-owned foundry had noticed unexpected “lining growth” in the 500 lb coreless induction furnace, at the rate of 25 mm (1- inch) per day. As shown above, a 2-inch thick layer of build-up occurred in 2 days of operation. There were attempts made to mechanically remove the build-up with a chipping hammer but the concern of damaging the lining prevented this to be a viable option. This became an emergency situation due to the rapid reduction of the furnace capacity and resulting loss of production.

A piece of the build-up was analyzed and found to be a combination $2MnO \cdot SiO_2$, tephroite, and $2FeO \cdot SiO_2$, fayalite. Actual build-up chemistry was found to be: 69.4% SiO_2, 11.2% FeO, 6.7% MnO, 6.6% Al_2O_3, 2.7% CaO, and 1.7% MgO. It should be noted that the FeO and MnO levels were higher than normal.

Superheating the molten metal bath at the end of the heat was attempted to remove the build-up but did not work. However, success was achieved when continuous Redux EF40**(Patent 7,618,473B1)**, fluoride-free flux additions to the charge (1 pound flux per ton of metal) were done. The foundry was able to reestablish the furnace capacity without any damage/wear to the domestic silica working lining.

It was later found that a recent change to a different “pig iron” coincided with the change in the sponge-like foamy black slag within the furnace. The slag change was attributed to the amount of FeO in the charge, i.e. from the condition of the pig iron. The foundry continued to use the pig iron but did modify the charge to keep the build-up manageable. This included the continuous use of flux.

Initially, the foundry could barely continue to melt through 3 days of operation. Afterwards, they returned to their normal two week production cycle. There was no longer any doubt about the effectiveness of the flux and any potential damage to the working lining.

Currently, mild fluxes like Redux EF40 can enhance lining life in ferrous induction applications while preventing insoluble build-up deposition. Many case histories in coreless induction furnaces, channel induction furnaces, press pouring furnaces and ladles applications, have proven to be successful. Now ferrous foundries do **not need to fear FLUXES**, just use them properly, as prescribed by the manufacturer.

Dcw 01-2016