Materials required for alkaline oxygen furnace steelmaking

In the basic oxygen furnace (BOF) steelmaking process， the following types of materials are required to produce liquid steel (Figure 1)

Basic raw materials， such as hot metal， steel scrap and lime

Secondary raw materials， such as deoxidizer and carburizing agent.

Utility gases， such as oxygen， nitrogen and argon

Refractory materials and refractory materials， such as lining materials， gunning materials and repair materials

Consumable probes， such as temperature probes and sampling probes

Cooling water for cooling oxygen blowing guns and exhaust gases.

Basic raw materials

The basic raw materials required to make steel in the converter include (i) hot metal from the blast furnace， (ii) scrap and/or any other metallic iron source， (iii) iron ore， and (iv) melt. The scrap from the scrap box is the first material to be loaded into the converter. The hot metal is then poured into the converter from the hot metal charging ladle， after which the oxygen blowing begins. Flux， usually in block form， is injected into the converter via a bin system after the start of the oxygen blowing. Flux can also be injected as a powder into the furnace through the bottom spout. The composition and quantity of the basic raw materials used in the converter of a steel mill vary from mill to mill， depending on their availability and the economics of the process.

Hot metal or liquid iron is the main source of iron units and energy. Hot metal is received from the blast furnace in the form of open ladles or torpedo cars. In the case of open ladles， the hot metal is poured into a hot metal mixer to maintain its temperature and then used in the converter. The chemical composition of the hot metal can vary widely， but typically contains about 3.8% to 4.5% carbon， 0.5% to 1.5% silicon， 0.25% to 1.5% manganese， 0.05% to 0.15% phosphorus， and 0.03% to 0.08% sulfur.

In hot metal desulfurization plants， the sulfur content of the hot metal can be reduced to 0.001%. The composition of the hot metal depends on the practice and charge in the blast furnace. In general， when the blast furnace is operated in a cold state， the silicon content of the hot metal decreases and the sulfur content increases. If the phosphorus content in the blast furnace charge is high， the phosphorus content of the hot metal increases.

Carbon and silicon are the main contributors to the energy. The hot metal silicon affects the amount of scrap that can be loaded in the converter heat. For example， if the hot metal silicon is high， more heat will be generated due to its oxidation and therefore more scrap can be added to the heat. Hot metal silica also affects the amount of slag and thus the consumption of lime and the production of iron.

Hot metal is usually saturated with carbon and its carbon concentration depends on the temperature and the concentration of other solute elements (e.g. silicon and manganese). The carbon content of hot metal increases with increasing temperature and manganese content and decreases with increasing silicon content.

Knowing the temperature and carbon content of the hot metal as it is poured into the converter is important for process control of the converter. The temperature of the hot metal is usually measured in the ladle before the hot metal is loaded into the converter. Typically，the temperature of the hot metal is between 1300 degrees C and 1350 degrees C.

The high temperature and low oxygen potential favor desulfurization. In addition， the presence of other solute elements in the hot metal， such as carbon and silicon， increases the sulfur activity， which in turn enhances the desulfurization. Thus， in BOF converters，the low oxygen potential and high carbon and silicon content make the conditions more favorable for desulfurization from the hot metal rather than from the steel. Not all hot metals can be desulfurized. Hot metal used to make steel grades with stringent sulfur content is desulfurized in hot metal desulfurization plants， where desulfurization reagents can reduce sulfur in hot metal to 0.001%， but more often between 0.004 % and 0.005%. It is important that the slag produced after hot metal desulfurization is effectively removed by skimming. This slag contains a large amount of sulfur and any slag brought into the BOF will result in an increase of the sulfur content in the steel because the conditions in the BOF are not conducive to desulfurization.

Before pouring the hot metal into the BOF converter， it is weighed with a scale. It is very important to know exactly the weight of the hot metal because any error can cause problems with the chemistry， temperature and heat magnitude in the converter. This weight is also an important input to the electrostatic charge model.

Scrap is the second largest source of iron units in a coke oven converter after hot metal. Scrap is essentially recycled iron or steel， either generated within the steel plant (e.g.，