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我们将始终坚持一贯的质量第一原则，通过与最终用户和过滤设备厂家的紧密技术合作、良好的服务创造共赢效果，为中国过滤事业踏实的做出自己的贡献！

Iron & Steel Manufacturing Process

IRON & STEEL MANUFACTURING PROCESS

Process Summary:

The production of iron and steel is a complex operation, which is traditionally carried out in an integrated process. There are a number of interrelated stages in this process, the main ingredients for which are iron ore fines, coal and limestone. The first stage is ‘coke making’ in which the coal is carbonised into higher carbon content coke by baking it in a high temperature, low oxygen content oven. In a separate stage, the iron ore fines, together with limestone and coke are fed to a ‘travelling grate’ sintering furnace where the coke is ignited and fuses the iron ore into sinter, essentially for ease of handling. (Alternatively, the iron ore can be converted into pellets – see separate flow-chart). The sinter is then crushed and graded following, which it is fed into a blast furnace - together with some coke and limestone flux. A blast of oxygen is then injected into the base of this furnace by means of a hot air lance and this combusts with the coke to raise the temperature to ca 1500$_o$C and form carbon monoxide gas. This strips the oxygen from the incoming (Fe_2O_3) ore, the heat causes the reduced iron to melt and the ‘hot metal’ as it is known is tapped at regular intervals through a vent in the furnace. Meanwhile, the molten limestone flux combines with impurities such as coke ash and this also is periodically tapped off as a molten slag. The ‘hot metal’ is either fed in molten form to the next stage or solidified into ‘pig iron’.

In an alternative operation, the direct reduction process, iron ore is reduced by means of coal (not coke) and/or natural gases. This is typically carried out in a rotary kiln and produces what is termed sponge iron. The process obviates the need for coke ovens, sintering and blast furnace facilities and creates a product that may be considered a substitute for steel scrap, which is normally the principal raw material in electric arc furnaces.

In a third operation - the smelting reduction method - the ‘hot metal’ is made in two stages, first by partial reduction of the ore in a rotary kiln, again using coal (for both heat and gas), followed by final reduction and melting in a furnace. Once again, the technique obviates the need for coke ovens and sintering plant.

The second part of the manufacturing process is the conversion of iron into liquid steel. One of two quite different furnaces is used for this purpose, these being referred to as the basic oxygen furnace and the

electric arc furnace.

In the first mentioned, the ‘hot metal’ from the blast furnace is carried in ladles to the basic oxygen furnace, usually being pre-treated en-route with quicklime to remove undesired elements such as sulphur. When the furnace is charged with the hot metal (possibly together with some scrap steel), a water-cooled lance is lowered into it through which high purity oxygen is blown at extremely high velocity, thus initiating a powerful exothermic reaction. As a result, no external heat source is needed. Any carbon, which is present in the hot metal, is oxidised to carbon monoxide gas, which after cleaning is used as fuel. Other elements in the metal are also oxidised and floated off as slag - primarily through the addition of fluxes such as quicklime with which they combine. When the steel has been sufficiently refined, the furnace tilts to pour the molten metal into a pre-heated ladle in the form of ‘crude steel’. This process is particularly suited to the production of large volumes of steels of similar quality.

By comparison, in the electric arc furnace process the basic raw material is primarily steel scrap, although for chemical balance purposes, direct reduced iron, sponge and pig iron may also be added. In fact, in some cases electric arc furnaces operate with 100% direct reduced iron. With this technology, the raw material is melted using heat generated by an electric arc produced by graphite electrodes, the molten metal which ensues, as before being poured into a ladle. Electric arc furnaces frequently operate in what are termed ‘minimills’. Due to their relatively small scale, lower capital cost and lower energy costs; electric arc furnaces are more flexible and ideally suited to specialty steels.

The steel made from either of these processes may then be subjected to a further process described as secondary steelmaking or ladle refining, in which the steel is ‘fine-tuned’ e.g. subjected to ‘argon-oxygen decarburization’, degassing and/or the addition of special additives for ultimate use. The molten steel will then be fed to a continuous casting process where ‘slabs’ and ‘blooms’ or ‘billets’ are formed. After ‘scarfing’ to remove surface defects, the castings are hot rolled into the required product i.e. bars, rods or steel sheets. The layer of oxide, which forms on the surface, is subsequently removed in an acid pickling stage following which the sheets will be cold rolled and surface treatments such as galvanising or tinning applied as required.

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