

**Iron - Manufacturing process related to the specified manufacture(s)**

December 2013 update: addition of new processes description and some modifications

Related manufacture(s)	Description of manufacturing process
M-1: Iron Powders (Iron Powder made by sponge iron process, atomization processes (gas and water) and electrolysis)	<p>Iron powder via atomization process (gas and water) - A thin stream of molten metal is disintegrated by the impact of high-pressure jets of liquid water or gas (air, nitrogen, argon). Tiny droplets of iron are formed and rapidly solidify into small particles of iron metal. With high-pressure water jets, the shape of the iron particles is irregular. Iron granules are collected, dried and ground to the set size distribution. The iron powder is then reduced in a decarburizing furnace to achieve specific chemical composition and desired metallurgical properties. The powder is finally milled and homogenised. Additives are eventually added before the packaging and the shipping to the customers</p> <p>Sponge iron powder The Höganäs process is a direct reduction method for production of sponge iron powder using magnetite ore (Fe<sub>3</sub>O<sub>4</sub>) and carbon as raw materials. The reduction process takes place in a gas fired tunnel kiln at around 1200°C for 60 hours producing a sponge iron cake that is crushed, milled and magnetically separated from impurities. The final reduction is made in a continuous furnace under hydrogen atmosphere. Before the packaging, particles are screened to achieve the desired particle size</p> <p>Iron powder via electrolysis The manufacture of iron powder by electrolysis is a batch process. The anodes are usually made of iron or low carbon steel. The electrolyte of the cell consists of a sulphate solution (temperature 50°C). Pure iron is deposited as a brittle lightly adhering sheet on the cathodes. After washing, drying, and stripping, the deposited iron is ground. Further milling and annealing is carried out to meet requirements of specific applications.</p>
M-2: Carbonyl Iron Powders (Iron Powder uncoated, made by thermal decomposition of Iron pentacarbonyl)	<p>Carbonyl Iron Powder - Iron Powder uncoated, made by thermal decomposition of Iron pentacarbonyl Carbon monoxide reacts under pressure with iron powder to form iron pentacarbonyl, Fe(CO)<sub>5</sub>. Iron pentacarbonyl is purified by distillation (residual metals typically &lt; 10 ppm). Purified iron pentacarbonyl is vaporized by heating and decomposed to Carbonyl iron powder and CO.. During the decomposition process, iron particles grow on nuclei to form spherical iron particles. This process achieves properties (chemical composition, particle shape and distribution) unmatched by water-atomization or gas-atomization processes. The typical size range of Carbonyl Iron Powder is from &lt; 1 to 8 microns (primary particles) . Raw iron powder grades can be sent to finishing processes such as milling, classifying, mixing and coating according to further uses.</p>
M-3: Iron Furnace / Pig Iron	<p>Iron Furnace / Pig Iron - Iron, Furnace in the form of liquid iron [also known as hot metal], pig iron and in various other cold forms is produced in the blast furnace. Pig iron is also produced by smelting ilmenite ore in electric furnaces where the primary product is titanium dioxide slag.</p> <ul style="list-style-type: none"> <li>• Reduction of iron ore in a blast furnace</li> </ul> <p>The blast furnace is a counter-current gas/solids reactor in which the descending column of burden materials [coke, iron ore and fluxes/additives] reacts with the ascending hot gases. The process is continuous with raw materials being regularly charged to the top of the furnace and molten iron and slag being tapped from the bottom of the furnace at regular intervals.</p> <ul style="list-style-type: none"> <li>• In the upper part of the furnace, free moisture is driven off from the burden materials and hydrates and carbonates are disassociated.</li> <li>• In the lower part of the blast furnace shaft, indirect reduction of the iron</li> </ul>