

Blast furnace

[Science](#), [Chemistry](#)



Blast furnace is a continuous unit of shaft-type. The charging of burden is conducted from above, through the typical charging unit, which is the gas damper of the blast furnace. It is reduced rich iron ore (at present time resources of rich iron ore are preserved only in Australia and Brazil), sinter or pellets in the blast furnace. Sometimes granular pellets are used instead of crude ore.

Blast furnace consists of five constructive elements: top cylindrical part is top throat, that is necessary for the charging and distribution of burden in furnace; the highest splayed conic part is shaft, where the heating process of materials and the reducing of iron from oxides pass; the widest cylindrical part is belly, in which the process of softening and melting of the reduced iron passes; tapering conic part is bosh, where a reducing gas – carbon monoxide is generated, the cylindrical part is hearth, that is used to accumulate liquid products of blast furnace method – cast iron and slag.

And the top element is tuyere zone, where is the injection of combined blast into the furnace, and the lower element is blast-furnace bottom. There are tuyeres on the top of hearth – holes for supplying of heated to high temperature blast. Blast is compressed air, enriched with oxygen and hydrocarbon fuel. At the level of the tuyeres temperature rises to about 2000 ° C. As the distance upward the temperature drops, and it reaches 270 ° C in the top throat. Thus, different temperatures are set at different heights in the furnace, because of that different chemical processes of transition of ore into metal proceed. [pic] Blast furnace in Sestao, Spain. Coke burns off and generates carbon dioxide and large amount of heat at the top part of hearth, where oxygen supply is big enough. [pic][pic][pic][pic][pic] Carbon dioxide,

leaving enriched oxygen zone, reacts with the coke and generates carbon monoxide is the main blast furnace method reducing agent. [pic][pic][pic]

Rising upward, carbon monoxide reacts with iron oxides, taking oxygen and reducing to less oxidized oxide: [pic][pic][pic][pic][pic][pic]

Resulting from the reaction, the molten metal drips the hot coal down, becoming saturated with carbon, and results in alloy, that contains 2.14 - 6.67% of carbon. This alloy is called cast iron. Except carbon, it includes a small part of silicon and manganese. In the number of deciles of a percent sulfur and phosphorus, detrimental impurities, are included in the cast iron composition. Except cast iron, in the hearth slag is generated and accumulated, in which all detrimental impurities gather. Earlier slag was tapped through a slag notch.

Now both iron and slag are tapped through the iron notch at the same time, so the contact of cast iron and slag increases while mixing and the part of sulfur cast iron transits in slag. Separation of cast iron and slag passes already beyond the blast furnace - in a runner, with the help of the plate gate of skimmer arrangement because of different melting liquid densities. Separated from the slag, cast iron proceeds into hot metal ladles, or into mixer ladles. Slag is poured into slag pots through slag runners. Blast-furnace foundation

Modern furnace together with all constructions and metal structures, lining (brickwork) and burden stock and melting products can have a mass of more than 30 thousand tons. This mass should be evenly transferred to the ground. The lower part of the foundation (sole) is made in the form of a massive concrete slab with thickness of 4 m. Columns lean on the sole, <https://assignbuster.com/blast-furnace/>

furnace metal structures (shell). The upper part of the foundation (pie) is a monolithic cylinder of refractory compression, on which is the furnace hearth. Blast-furnace hearth

Blast-furnace hearth is the lower part of blast furnace, it is cylindrical inside and conic (sometimes cylindrical) due to the outer form. Hearth has cast iron and slag outlet assemblies (iron and slag notches) and assemblies (tuyeres) for blowing warmed up (at cowper stove) to 1100-1400 ° C, oxygen enriched to 23-25?? % air. Hearth blast furnace is the most main part of its construction. It collects up to 1, 000 tons and more molten smelting products – cast iron and slag. The burden column, with the mass of 9-12 tons, presses the bottom of the furnace.

The pressure of hearth gases is 0. 4-0. 5 MPa, and their temperature reaches 1700-2100 ° C in the coke combustion sources. Coke, liquid cast iron and slag hearth gases move and are restored continuously within the hearth. In fact it is a powerful, continuously moving reactor. In this regard, strict requirements for strength, tightness and fire resistance are demanded to these constructions. The main constructional elements of the hearth are shell, coolers, iron and slag notch, tuyere assemblies. Iron notch Iron notch is a rectangular channel, 250-300 mm broad and 450-500 mm tall.

The channel is made in hearth brickwork at the height of 600-1700 mm from the surface of the blast-furnace bottom. Slag notch channels are made at the height of 2000-3600 mm. The iron notch is closed by refractory mixture. The iron notch is opened via drilling out the hole of 50-60 mm diameter with drilling machine. After tapping of cast iron and slag (the tapping of cast iron

and slag is carried out through iron notches on large modern blast furnaces), holes are blocked with the help of an electron-beam gun.

The electro-beam gun tip gets in and refractory mixture of the notch is supplied under pressure. The blast furnace snag notch is protected by water-cooled elements, which are called slag stopper and compressed-air operated lever-type construction, controlled distantly. Large volume blast furnaces (3200-5500 m³) are equipped with four iron notches, working by terms, and one slag notch. The tapping of cast iron and slag from the blast furnace includes the following: 1. opening of the iron notch (if necessary in the slag notch); 2. aintenance, directly connected with leakage of cast iron and slag; 3. closing of the iron notch (if slag was tapped through the slag notch, then closing of slag too); 4. notches and runners repair. [pic] 1. Hot blast 2. Melting zone (bosh and hearth) 3. Reduction zone of ferrous oxide (belly) 4. Reduction zone of ferric oxide (shaft) 5. Pre-heating zone (top throat) 6. Feed of ore, limestone and coke 7. Exhaust gases 8. Column of ore, coke and limestone 9. Removal of slag 10. Tapping of molten pig iron 11. Collection of waste gases