



Cupola Furnace: Working Principle, Construction, Applications (With PDF)

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As the name suggests “**Furnace**” probably you guess a little bit. When we need to heat any substance we use a furnace.

Cupola furnace is one of the furnace where we melt different types of metal some are cast iron, some are maybe bronze.

So today we discuss the **working principle of Cupola Furnace** as well as see the **construction, advantages, disadvantages, and applications of Cupola Furnace**.

And a piece of good news at the end of the article we have two surprises, one is **I give you the PDF of this article** and the second is a **Quiz on Cupola Furnace for practice**.

Let’s start with the **definition of Cupola Furnace**.

What is the Cupola Furnace?

Cupola furnace is a melting device. We used this device in the forging operation where Cast Iron, Bronze, and other alloying elements are melted.

This is a very old device we used in manufacturing for melting because this system produces good cast iron from Pig Iron. The shape of this device is cylindrical but others size is also available.

While choosing a **cupola furnace** we keep some valid factors that are **Melting Point Temperature**, Shapes and many more.



Source: By Ab5602 (talk) – Own work,)

Construction of Cupola Furnace:

The **Cupola Furnace** is consists of:

- Legs
- Slag Hole
- Sand Bed
- tuyers
- Preheating Zone
- Melting Zone
- Charging Door
- Brick lining



- Spark Arrester

Let me describe these parts of cupola furnace in details:

Legs:

Legs are provided for supporting purposes.

Slag Hole or Slag spout:

The slag hole is used for removing or extracting the slag from the melting iron.

Sand Bed:

This is in taper form and from this, the melted iron comes out easily.

Tuyeres:

By tuyeres, we enter the gas to the proper burn of fuel.

Preheating Zone:

In the Preheating zone, the heating process started and heats the metal charge about 1090 degrees Celsius.

Melting Zone:

In the melting zone, we do not provide much heat to melt the metal charge because it's already melted in the preheating zone with a temperature of about 1090 degrees Celsius.

Charging door:

From here we supply the charge to the furnace. The various charges for the cupola furnace are Pig Iron, Coke and limestone.

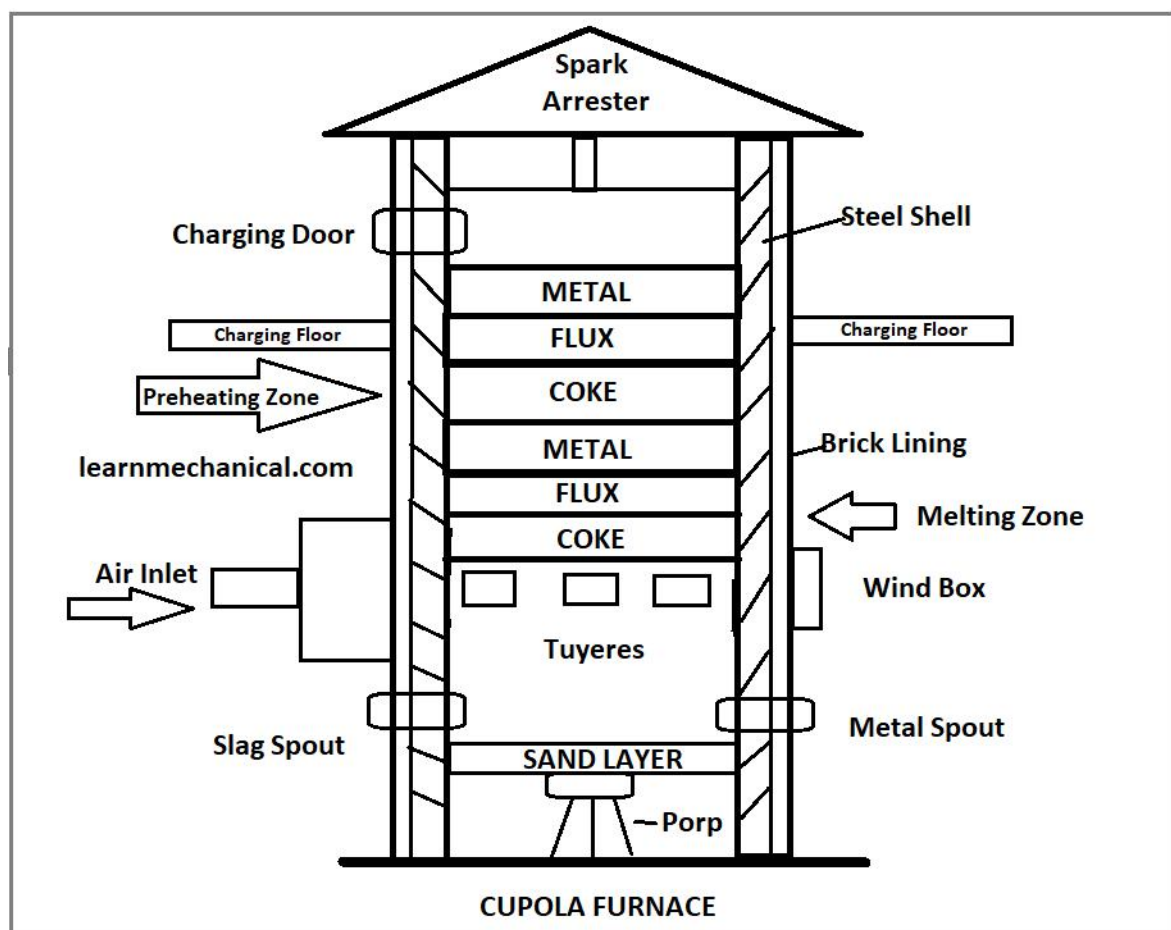
Brick lining and Steel shell:

The shell of the cupola furnace is being usually made of steel and it's called a steel shell.

Spark Arrester:

This device used in the system for preventing the emission from the fireplace.

Here is the Schematic Diagram of Cupola Furnace:



Schematic Diagram of Cupola Furnace



Working Principle of Cupola Furnace:

The **Cupola furnace works on the principle where we generate heat from burning coke and when the temperature of the furnace is above the melting point of the metal then the metal is melt.**

The charge introduced in the cupola consists of **pig iron, scrap, casting rejection, coke, and flux. Coke is the fuel and limestone are added as a flux to remove undesirable materials like ash and dirt.** The scrap consists of Steel and cast iron rejections.

The **working of Cupola furnace is**, Over the sand Bottom, Coke in charged extending up to a predetermined height. This serves as the coke bed within which the combustion takes place.

Cupola operation is started by igniting the coke bed at its bottom. After the Coke bed is properly Ignited, alternate charges of limestone, pig iron, and coke are charged until the level of the charging Door.

Then the air blast is turned on and combustion occurs rapidly within the coke bed. Within 5 to 10 minutes after the blast is turned on the first molten cast iron appears at the tap hole.

Usually, the first iron which comes out will be too cold to pour into sand molds. During the cupola operation, molten metal may be tracked every 10 minutes depending on the melting rate and the capacity.

All the oxygen in the air blast is consumed by the combustion, Within the combustion zone.

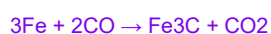
The chemical reaction takes place which is,



This is an **exothermic reaction**. The temperature in this zone varies from **1550 to 1850 degree Celsius**.

Then hot gases consisting principally of Nitrogen and carbon dioxide moved upward from the combustion zone, where the temperature is 1650 degree Celsius.

The portion of the coke bed if the combustion zone is reducing zone. It is a protective zone to prevent the oxidation of the metal charge above and while dropping through it. As the hot carbon dioxide gas moves upward through the hot coke, some of it is reduced by the following reaction.



This is an **endothermic reaction.**

The first layer of iron above the reducing zone is the melting zone where the solid iron is converted into the molten state. A significant portion of the carbon is picked up by the metal also takes place in this zone.



The hot gas is passed upward from the reducing and melting zones into the preheating zone which includes all layers of charge above the melting zone up to the charging Door.

Since the layer of the charge is preheated by the outgoing gases which exist at the top of the cylindrical shell. this temperature in this zone is around 1090 degrees Celsius.

Advantages of Cupola Furnace:

These are the following advantages of Cupola Furnace:

- For operation purposes, this is a simple and economical device.
- A wide range of materials can be melt.
- This device used for removing the slag present in the Iron.
- Comparison of electric furnace This is very less harmful.
- This is having high melting heat I.e 100 tones/hr.
- The floor space required is less and to perform the operation skilled operator not required.

Disadvantages of Cupola Furnace:

There are some disadvantages of Cupola Furnace and here is that:

- In cupola furnace, The main disadvantage is that sometimes unable to maintain the close temperature.

Applications of Cupola Furnace:

The **main application of Cupola Furnace** is different types of cast iron is produced from this device like Malleable, Grey cast iron, and the copper base alloy is also manufactured by this device.



Conclusion:

So today we have learned about the **Working Principle, Construction, Diagram, Advantages, Disadvantages, and Applications of Cupola Furnace**. If you like this article, don't forget to share it on social networks.

If you have any queries or doubts about the Cupola Furnace, you can ask me in the comment section or we have a dedicated discussion board for you where you directly post your question: [Click here to post your question](#), and also you can [join our facebook group](#). I will love to hear from you and glad to help you. Till then enjoy rest your day. Cheers

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