KILNS AND FURNACES USED IN CERAMIC AND REFRACTORY INDUSTRIES

A General Description And Comparison

Fig - Tunnel Kiln Car loaded with Wares (Refractory Bricks) coming out of the Kiln after Firing.

Kiln technology is quite ancient. The development of the kiln from a simple earthen trench filled with pots and fuel i.e. pit firing, to modern methods happened in stages. With the advent of the industrial age , kilns and furnaces were designed to utilize electric power and more refined fuels, including natural gas and propane instead of just wood or coal etc. The majority of large, industrial pottery kilns now use natural gas, as it is generally clean, efficient and easy to control. Modern kilns can be fitted with computerized controls, allowing fine adjustments during the firing cycle. A user may choose to control the rate of temperature increase or *ramp*, *hold* or *soak* the temperature at any given point, or control the rate of cooling as per the requirement. Both electric and gas kilns are common for smaller scale production in industry.

Fuel Fired Furnaces or Combustion Type of Furnaces are used to a greater extent in industry than the electric types because of high cost of electricity, but however the latter is preferred because it offers various advantages which may sometimes counter balance the cost factors for example,

(1) Cleanliness of operation.

(2) Quicker response in attaining the desired temperature.

(3) Better control of furnace atmosphere and temperature.

(4) Better cost and fuel efficiency.

Firing in Electric Furnaces is done by either of the following two methods –

(a) Induction Type: With primary or induced current flowing through resistors or by currents induced in the charge itself.

(b) Resistor Type: With the current applied to an external resistor, from which the heat is transmitted to the charge (stock material) either by conduction through a liquid or by radiation and conduction through a gaseous medium.

In Batch Type Kilns and Furnaces the temperature is practically kept constant throughout the interior. The wares or refractory bricks or any other item to be heated is laid in a certain position and remain there until the firing is completed. It is then generally removed by the same door by which it entered.

In Continuous Type Kilns and Furnaces has pre-heating and after-cooling zones, and the charged materials i.e. wares, bricks, etc. moves while it is being heated and the temperature varies from zone to zone remaining steady at the particular zone. In some cases the charge or stock material passes from over a stationary hearth, or else the hearth itself moves. The stock material passes over skids or rolls, being carried away in an incline by the force of gravity, or it is pushed through the furnace by mechanical means.

For many purposes the Rotating Hearth or Rotating Table Furnaces are very useful. The material may also be fed through the furnace by screw action in which system the whole furnace is a revolving tube with internal screw thread.

The Car-type or Periodic Furnace has a movable hearth which, however, remains stationary during the cooling period. The car is moved to a position outside the furnace for loading and unloading. This type of

furnace is generally used for firing heavy or bulky shaped bricks. A similar principle is applied in the so-called Elevator Furnaces.

The Reverberatory type Coal Fired Grate Furnaces have bridge wall over which the flame sweeps into the furnace hearth.

If the flames are developed inside the heating chamber proper, and they come in direct contact with the stock material, the furnace is said to be Direct Fired type Furnace. If the flame is produced under the hearth and then sweeps up into the heating chamber then the furnace is to be Under Fired. According to the nature of the flow pattern the furnace may also be called Side Fired orOver Fired. For certain processes contact with the flue gas may be injurious to the materials being heated, in such cases the charge is sometimes, closed in a Muffle (Muffle Furnace) which are generally heated either by flue gas or by electric power.

In Batch Type Fuel Fired furnaces the products of combustion leave at a high temperature and carry with them a large amount of heat which can not be utilized directly in the furnaces. Part of this heat is utilized by Regenerators or Recuperators in pre-heating the cold stock (charge at ambient temperature) or the combustion air. Both principles are used in Tunnel Kiln in which pre-heating and cooling zones are provided along with the burning zone or firing zone as integral parts of the kiln itself. As the name suggests Tunnel kiln is a long structure in which the wares or materials which are to be fired are pushed from out-side loaded on Tunnel Kiln cars and are transported through the kiln while the temperature is increased steadily first, by the products of combustion (flue gas, hot air) until entering the firing zone of the kiln where it is fired directly or indirectly either by fuel or by electric power. So, after due pre-heating these cars carrying stocks (wares / charges) enter the combustion zone / firing zone / soaking zone / burning zone where it gets properly fired and the hot fired materials (stocks) leaving the firing zone, gives up its heat to the cooling air and thereby gets cooled gradually in the after-cooling zone before leaving the Tunnel Kiln. The following table distinguishes some aspects between the batch-type and continuous-type furnaces. In the forthcoming articles we will discuss more on some of these and other furnaces individually which are used exclusively in large to medium scale metallurgical and non-metallurgical industries.

Comparison between Batch Type and Continuous Type Furnaces

	Batch Type Furnaces	Continuous Type Furnaces

Capital Investment	Less	More
Flexibility of Operation	More	Less
Fuel Efficiency	Less	More
Production	Firing quality inferior in bulk production	Firing quality better in bulk production
Operating Cost	Less	More

Source : http://viewforyou.blogspot.in/2009/07/kilns-and-furnaces-used-in-ceramic-and.html