Metal melting and energy saving in different types of melting furnaces

In today's world, a large proportion of metal smelted from ore or secondary waste is made using **melting furnaces** that use electricity as a source of energy. Among them are **electric arc furnaces**, which allow to remelt various alloyed waste, as well as to carry out melting on a carbon charge, which requires complete oxidation of impurities. A **straight arc furnace** assumes that an electric current is converted into thermal energy due to a fire arc that occurs in the space between the electrodes and the metal to be melted. Nowadays, the **arc furnace** is a fully automated and highly mechanized system, in which preparation for the next melting requires a minimum of time.

Unlike the previous type of electric furnaces, one of the advantages of the **induction melting furnace** is the absence of an electric arc, due to which it is possible to produce alloys with a low proportion of carbon, gases and other impurities. The introduction of the latest technologies in such units helps to organize the **melting process** in compliance with a number of important conditions that are necessary to obtain a high quality alloy. The main factors that determine this process include high temperature, the ability to create in the melting space of **induction furnaces** acidic, neutral atmosphere or even smelting in an environment close to vacuum.

Where are electric **melting furnaces** usually used?

Equipment of this type is installed at foundries, precision casting sites and repair shops.

For the efficient operation of an arc or **induction melting furnace**, it is necessary to have three-phase electric current and special transformers that are able to convert alternating current into direct current and provide its appropriate frequency.

The **electric induction furnace** is designed for casting cast iron and steel alloys of the highest quality. It also melts non-ferrous metals and alloys such as copper, bronze, brass and aluminum. The high temperature level creates an opportunity for processing of refractory metals.

One option is to use solar lights as a source of energy for smelting metal. The use of solar ovens for industrial purposes can be effective even in outer space.

The principle of operation of electric arc furnaces

Electric arc furnaces operate on three-phase electric current. Metal smelting in an **arc furnace** occurs by forming an electric arc between the graphitized electrodes and the charge to be melted. Such equipment is called a **straight arc furnace**. There are also **electric arc furnaces** of indirect action, in which the arc is at some distance from the heated metal.

The main element of such **melting furnaces** is a metal casing, the inner walls of which are lined with refractory material. To load the charge into the **arc furnace**, a removable erection is used, which must be lifted and set aside. The housing also has a drain hole with a gutter through which the molten metal is discharged into the bucket. A special cradle with an electric or hydraulic drive is used to tilt the housing towards the working window or outlet.

Electricity is supplied from transformers to the **arc furnace** body via copper busbars. Carbon or graphite electrodes are used during operation. The length of the arc in the furnace is adjusted automatically. Spent electrodes are constantly replaced with new ones. The **melting process** takes

place in a limited space, the walls of which are lined. Increasingly common is a three-phase furnace, in which arcs occur between the three electrodes and the metal being processed.

As one of the alternative energy sources for gas **melting furnaces**, a new type of fuel can be used, which is obtained by underground gasification of coal. The production of this synthesis gas, the content of the combustible fraction in which is more than 90%, occurs by blowing an oxygen mixture into coal deposits that are not subject to development in the usual way.

Metal smelting in an arc furnace

When smelting a metal in **electric arc furnaces** should take into account both its physical and chemical properties. Each metal has its own transition temperature from solid to liquid, at which the **melting process** begins directly. In order to accelerate it in **electric melting furnaces**, different types of oxidants are used.

What is usually the main component of the charge during metal smelting in an **arc furnace**?

The basis of the charge is steel scrap, to which iron ore pellets are added.

Recycling of steel in **electric arc furnaces** requires appropriate material quality. Scrap laid in **melting furnaces** of this type must meet the following characteristics:

- Have a minimum of impurities of non-ferrous metals;
- Be not very oxidized, without rust;
- Contain no more than 0.05% phosphorus.

Nowadays, the share of use in **electric arc furnaces** of such primary products of iron ore processing as sponge iron and metallized pellets is growing.

Electric heating and heating stoves can also be used, which can be used to maintain a comfortable temperature in your own home. Systems that reproduce the appropriate humid atmosphere in the bath or sauna should work both as a **stove and air conditioner**.

Modern induction furnaces: design features

The design of the **electric induction furnace** provides for the presence of a melting and so-called induction **furnace units**. The inductor coil, through which the metal is smelted in **induction furnaces**, is made of copper. The inclination of the case is regulated by means of plungers which work on hydraulics.

The charge is heated in **induction furnaces** by creating an alternating magnetic flux in induction **furnace units**. In this case, eddy currents cause a constant movement of liquid metal inside the smelter, which contributes to a homogeneous mass. Crucibles of **induction furnaces** are made of acid or basic lining according to what metal is going to be smelted in it.

What is the main advantage of an **induction melting furnace**?

Due to the absence of an electric arc, it is possible to produce steel that will contain a minimum of carbon and gases.

Typically, a **working induction furnace** is used to make steel and alloys from alloyed waste. Another option involves the use of pure iron and ferroalloys. In addition, an **electric induction furnace** can be used to smelt non-ferrous metals such as copper and aluminum.

It can be quite hot in a room where **melting furnaces** are constantly operating. Therefore, for the safety and comfort of the personnel servicing the **working induction furnace**, an air cooler is a necessary element. At the same time the **furnace and the conditioner** should function at the same time.

Factors influencing the process of metal melting

Factors that affect the **melting process** of a metal include temperature, pressure, the presence of various impurities, slags and oxidants. **Induction melting furnace** is used for melting both ferrous (iron and its alloys) and non-ferrous (copper, brass, aluminum) metals. The ability to create a high temperature is favorable for the smelting of refractory metals. The main mass of steel is smelted in an **arc furnace**. The table makes it possible to compare the melting points of the most common metals at atmospheric pressure.

Metal	Temperature, °C
Aluminum	660,4
Iron	1539
Copper	1084,5
Tin	231,9
Cast iron	1100-1300
Steel	1300-1500

The use of vacuum in electric arc and **induction furnaces** allows the smelting of refractory metals and the production of special corrosion-resistant and heat-resistant alloys. Vacuum **arc furnace** assumes that the electric arc burns under reduced pressure, and the temperature is 3700 ° C. **Electric arc furnaces** of this type require a constant current, which ensures the stability of the burning of the electrodes. This is primarily a **straight arc furnace** in which the function of the cathode is performed by the electrode, and the charge to be melted is the anode.

Steel smelting in **electric arc furnaces** is one of two main methods:

1. The use of alloyed elements and fresh charge with their complete oxidation;
2. The **process of melting** doped fragments without oxidants or with the addition of gaseous oxygen.

When using the second method, short-term blowing of the oxygen mixture into the melting space of the furnace is assumed.

Advantages of using an induction melting furnace

Induction melting furnace makes it possible to produce high quality alloys. Among the advantages of units with induction **furnace units** include:

- Melting without an electric arc with minimal burning of metal;
- Electrodynamic circulation of liquid metal, which contributes to a homogeneous mass;
- The small size of **melting furnaces** of this type thanks to what it is possible to carry out melting in the closed chamber in the conditions of vacuum or with use of inert gas.

Induction furnace coils need cooling, so there is a need to use both the **furnace and the air conditioner**. Cold water is supplied via a flexible cable.

Along with industrial equipment, electricity is a source of energy for **heating and heat furnaces**. If

you decide to equip a small greenhouse, it can also be heated with electricity.