

THE DRY BLAST- FURNACE SLAG GRANULATION AS RESOURCE AND ENERGY ECONOMY IN THE METALLURGY

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Slag treatment is the main ecological problem of the modern Ukraine metallurgy manufacture.

The blast-furnace slag is the by-product of the ironmaking process. It has produced in the blast-furnace in the amount of 300 kg per tonne of pig iron.

Now in Ukraine the blast-furnace slag is treated by impinging much water for granulation. This treatment is mainly used for producing a raw material of the cement, aggregate and the roadbed.

This method has some serious problems to be overcome. As follows:

- too much water is necessary to granulate molten slag of high temperature;
- an alkaline element in slag is polluting the water;
- sulfide is emitted from slag into the air by the water quenching;
- the thermal energy of high temperature slag is wasted without recovery.

To avoid these problems we should make use of leading country's experience where the dry slag granulation process is taken root.

The Redcar and Davy Dry Slag Granulation Process (Great Britain) is analysed as the example of the dry granulation arrangement.

Traditionally the liquid slag is atomized by high pressure water jets which impinge on the slag stream as it leaves the runner. The rapid cooling produces the glassy structure which is necessary for cement making.

In Donetsk there is 300000 tonne of the molten blast-furnace slag per year is treated. It is known that the amount of the water for granulation is 3,5 m³/t of the slag. Significant quantities of water vapour at this point, which escape to atmosphere, amounting to some 10% of the water used for granulating.

The granulate must then be separated from the water necessitating a significant investment in plant and equipment all of which is subject to the highly abrasive granulate/water mixture. The slag, when separated, still contains about 12% of water which must be removed by the thermal drying at the cement plant.

The analysed dry granulation process is to atomize the molten slag and then to cool the particles rapidly so as to produce a glassy slag. The atomization is done using a rotary-cup, air-blast atomizer. The particles cool as they travel through the air and then cooled further in a fluidized bed. Both of these processes provide the rapid cooling necessary for the formation of a glassy slag product. The fluidized bed is a convenient method of containing the slag particles as it prevents the agglomeration of hot particles as it providing rapid cooling. The molten slag enters the heat-recovery vessel through a launder, covered to reduce heat loss. Launder delivers the molten slag directly into the rotary-cup, air-blast atomizer located in the center of the vessel. On atomization, the slag particles are projected radially outwards and slightly upwards in a spray and impinge on the vessel wall. The particles fall directly into the primary fluidized bed. The slag particles then overflow into the secondary fluidized bed where more heat is reduced to that at which the slag is discharged. The cylindrical granulator chamber may be up to 20 metres diameter. At the centre of the chamber is the rotating cup assembly. During operation molten slag is thrown from the lip of the cup in the form of droplets and slag particles with a mean diameter of 2 mm can be produced by the atomizer and so the slag product is in a form that easy to handle.

It is known that the temperature of the molten slag is over 1400 °C and the enthalpy at this temperature is 1680 – 1800kJ/kg. At the wet granulation the most part of the heat is spent at the evaporation and is lost irrevocably.

The most important advantage of the dry granulation is the heat recovery from the slag. Energy recovery is possible from the dry process, either in the form of preheated air for the use in the other process, or in the form of steam, possibly for power generation. The most satisfactory way of the utilizing the recovered heat is to use it on the blast furnace. It leads to economy of the coke and the nature gas.

The wet process is essentially polluting in nature. The pollution matters in the water are lime, H₂S (15-175 mg/l) sulphates (300-1000 mg/l) and ammonia (20-100 mg/l). This water emission in the reservoir affects the heat, chemical and mechanical pollution makes worse sanitary – biological and ecological factors of the water fauna and flora. Ions Ca²⁺, SO₃²⁻, S₂O₃²⁻, HS⁻, Cl⁻, SO₂²⁻ are always discovered in the recycling water. The salt deposit is the result of the water evaporation and the salt alkalization from the slag. The water becomes contaminated with dissolved salts from the slag and the airborne discharge is saturated vapour which results in highly corrosive acid mist. Elimination of these discharges leads to problem of containment and treatment, with commensurate cost increases. The handling of the water, with its high concentration of abrasives, is the cause of high maintenance costs. The dry process avoids these pollution problems.

The air pollution level in Donetsk exceeds the sulphur compounds maximum permissible concentration a few times.

At the dry granulation the air pollution by sulphur gas and dust emissions is reduced considerably as the process is carried out in the close vessel with emission extraction and cleaning.

The dry process in the case of blast furnace, produces a cement grade granulate of equal quality to that produced by the wet process. Hence it has increased value due to reduced energy requirements in subsequent processing.

So the dry blast-furnace slag granulation arrangement application can dissolve such problems: the dry even sized high density granules receiving for the cement manufacture; the environmental improvements as the sulphur gas

emission are reduced and there isn't polluted water discharge and vapour plume; the heat recovery from the molten blast furnace slag.

Consequently, the dry blast-furnace slag granulation arrangement installation at the metallurgical plants of Ukraine allow to the ecological improvement of the industry region and to the economy of the expensive kinds of fuel.