Nitrogen and its application in steel plants

Uploading... Nitrogen is a non-reactive component of the atmosphere that does not support life. The percentage of nitrogen in the air is 78.06% (by volume) or 77% (by weight). The composition of air is shown in Figure 1.

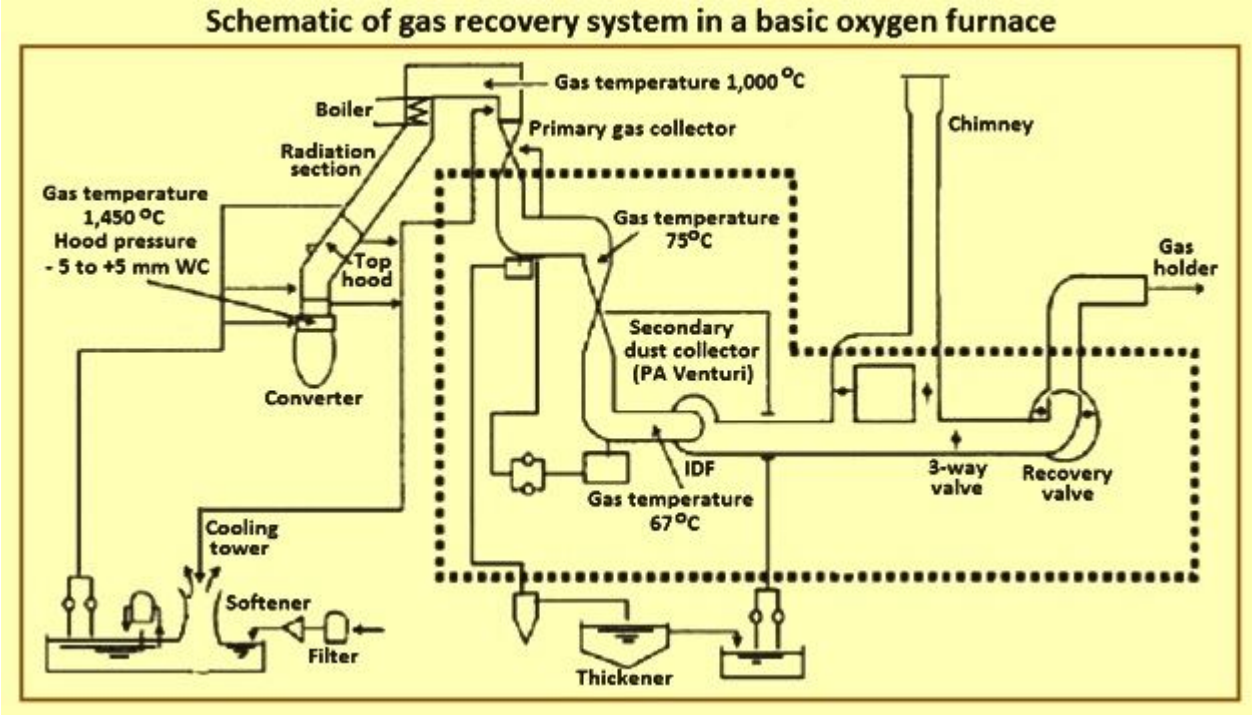

Figure 1 Composition of air

The element nitrogen was discovered in 1772 by Daniel Rutherford， a Scottish physician， as an isolable component of air. Around the same time， nitrogen was also studied by Carl Wilhelm Scheele， Henry Cavendish and Joseph Priestley， who referred to it as burnt air.

Through liquefaction and distillation of ambient air in cryogenic air separation plants，nitrogen is produced in large quantities in gas or liquid form and with high purity. It can also be produced on a commercial scale as a low purity gas by adsorption techniques (variable pressure adsorption， PSA) or by diffusion separation processes (permeation through specially designed hollow fibers). Gaseous nitrogen is abbreviated as GAN， while liquid nitrogen is abbreviated as LIN.

Liquid nitrogen is a cryogenic liquid. Cryogenic liquids are liquefied gases with a normal boiling point below -150 degrees Celsius， and liquid nitrogen has a boiling point of -195.8 degrees Celsius. Because of the large temperature difference between the product and its surroundings， it is necessary to isolate liquid nitrogen from the surrounding heat.

Nitrogen is usually stored in liquid form， although it is primarily used as a gas. Liquid storage is less bulky and less costly than high-pressure gaseous storage of the same capacity. A typical storage system consists of a cryogenic storage tank， one or more evaporators and a pressure control system. The cryogenic storage tank is in principle structured like a vacuum flask. There is an inner vessel surrounded by an outer vessel. Between the two vessels there is an annular space which contains an insulating medium from which all air has been removed. This space keeps the heat away from the liquid nitrogen in the inner vessel. The evaporator converts the liquid nitrogen into a gaseous state. A pressure control manifold then controls the gas pressure and feeds it to the process or application. Vessels used for liquid nitrogen service should be designed for the pressures and temperatures involved. Piping design should follow the specifications for such piping.

Uses of Nitrogen

Nitrogen is usually liquefied， which allows for more efficient transport and storage of large quantities. However， most applications use nitrogen after it has been evaporated into a gaseous state. Nitrogen is valued for its inertness. It is used to protect potentially reactive materials from contact with oxygen. Nitrogen is widely used in steel mills. The main uses of nitrogen in steel mills are listed below.

Used in the primary steelmaking process to produce steel (combined blowing and slag sparging in an alkaline oxygen furnace) and in the secondary steelmaking process (AOD process)

in blast furnaces for cooling the gearbox of the top charging equipment

for coal dust injection in blast furnaces

for dry quenching of hot coke pushed out of the coke oven cell

For protective gas during annealing of cold rolled steel

Blowdown of pipes， tanks and equipment

The cooling properties of liquid nitrogen are used to separate shrink-fit bearings from shafts. Conversely， liquid nitrogen can also be used in shrink fits. In a shrink fit， instead of heating the external metal part， liquid nitrogen is used to cool the internal part so that the