**Requirements for the selection of oxygen generators in the steel industry**



Domestic oxygen generator after more than 50 years of development， starting from 50m3 / h， the development of large oxygen generator， its process after the stone accumulator heat exchanger process， full low pressure plate switch type process， room temperature molecular sieve adsorption booster expander process， regular packing on the tower and full distillation argon process， oxygen generator technology with the development of steel metallurgy， chemical industry and the simultaneous development. Due to the different industries， the selection requirements for oxygen generators are also different， this paper briefly analyzes the selection requirements for oxygen generators in the steel industry.

1 The basis of oxygen machine selection

(1) Although the gas consumption of iron and steel enterprises varies from time to time， the average gas consumption per hour can be used as its consumption， and the low peak and peak are balanced by the storage of spherical tanks. The gas in the external integrated pipeline is transported to the customer area by medium pressure pipeline， and the pipeline is sent to the customer after regulating the pressure with the average amount higher than one level. As oxygen for blast furnace oxygen rich coal injection， basically the average amount， thus the statistics of the entire enterprise oxygen， nitrogen， argon amount， as the basis for selecting the type of oxygen generator.

(2) The gas used by steel enterprises is mainly in the gaseous state. The current oxygen generator process is divided into two kinds of gas external compression and internal compression. The internal compression process is compressed by the liquid oxygen pump to 3.OMPa to recover the cold volume， and the gas comes out of the tower. The external compression process is the recovery of cold gas oxygen out of the tower， and then compressed by the gas compressor to 3.OMPa sent out. From the purpose of energy saving and consumption reduction， should choose to produce gas-based full low-pressure， external compression process. Inside the compression process slightly higher energy consumption， investment costs and operating costs are also high.

(3) Iron and steel enterprises generally once a year overhaul， while the oxygen generator maintenance cycle is generally once every two years. During the overhaul period， the oxygen generator gas will produce emptying phenomenon. A large steel enterprise with output of tens of millions of tons has a workshop overhaul every month on average throughout the year， but considering the peak and low sales seasons of the market， sometimes there are more than two workshops overhauled at the same time. Although the emptying volume can be adjusted by the blast furnace to achieve the gas balance， the oxygen generator selection should also take into account the gas volume accurately to reduce the emptying volume as much as possible.

(4) The external supply of gas can be gas and liquid， so while selecting the oxygen generator， a part of the liquid and gas external supply should be considered. General oxygen generator can produce part of liquid oxygen and liquid nitrogen. The amount of liquid oxygen can be up to 3% of the oxygen， if you need to supply more liquid， you can choose gas liquefaction equipment to make up for it， with the storage system to supply liquid and cope with the gas when the fault stops.

(5) The production of iron and steel enterprises has the characteristics of uninterrupted， especially the blast furnace， converter with oxygen， nitrogen， argon， usually absolutely do not allow the oxygen machine to stop production， so the selection of oxygen machine must be considered to be able to long-term safe， stable and reliable operation.

(6) With the improvement of product grade and technical equipment of iron and steel enterprises， the requirements for gas quality are getting higher and higher， the original purity is a little lower can also blow oxygen， now when the oxygen purity is lower than 99.2% 02 can not send oxygen; and blast furnace for the protective gas with nitrogen， the purity is required in 99.99% or more. As for argon gas， the quality of steel has a pivotal role， especially high carbon steel. Therefore， the quality of the oxygen generator products is quite important， more in line with the requirements of the external gas supply.

2 Oxygen generator selection characteristics

2.1 Oxygen concentrator selection

(1) At present， the full low-pressure large oxygen generator generally adopts the external compression process of gas with regular filling tower， full distillation argon technology， molecular sieve adsorption and booster expander， the output is equal to the demand， and the purity requirement is: oxygen 99.6% O2; nitrogen 99.999%， which contains oxygen ≤ 5 × 10-6; argon 02 ≤ 2 × 10-6， N2 ≤ 3 × 10-6.

(2) operating cycle of more than 2 years， electricity consumption 0.62kWh / m3 ~ 0.65kWh / m302 (including pressure oxygen).

(3) Can be equipped with gas liquefaction equipment at the same time to regulate the excess gas， as a reserve or external supply.

(4) the air purification system without a freezer process， the southern region should also be equipped with a freezer as a backup to solve the impact of hot weather in summer.

(5) The use of steam heaters to regenerate molecular sieves to save electricity consumption.

(6) Water treatment using ion bars instead of pharmaceuticals to eliminate tedious operations.

2.2 Mechanical selection

(1) The expansion air volume of the expander can be larger (adjustable)， which can shorten the start-up time; the output of liquid oxygen and liquid nitrogen can be adjusted.

(2) Large air compressor can choose imported equipment (with the development of domestic machinery industry， can be ordered domestically)， centrifugal oxygen， nitrogen compressor can choose domestic， these products have excellent performance.

(3) cooling water pump can choose single-stage pump or multi-stage pump.

2.3 Matching valves

Matching conventional valves， should be used for more than 8 years of service life of the product， the valve body is cast steel， stem， spool sealing surface of stainless steel， the current society's valves are difficult to distinguish the real from the fake， should be clearly stated its material， and pressure test， in order to ensure quality. Other special valves should be matched according to the pressure level， the material used for each medium， and special requirements such as oil ban.

3 Introduction of oxygen generator selection case

According to the development plan of Shagang， we have signed two sets of 2 × 21000m3/h oxygen generators with Hangxiang in 2001 and 2002. The following is a brief introduction.

3.1 Main technical performance of the oxygen generator

The displacement of air compressor is about 113，800m3/h， the displacement pressure of air compressor is about 0.62MPa(A); the output of oxygen is 21，000m3/h， the purity of oxygen is 99.6%02; the output of liquid oxygen is 650m3/h， the purity is 99.6%02; the output of nitrogen is 21，000m3/h， the purity of nitrogen is <5 × 10-6O2; the output of liquid nitrogen is 300m3/h， the purity is <5 × 10-602; the output of argon is more than 5 × 10-6O2. 602; the output of liquid argon is more than 750m3/h， the purity is ≤2 × 10-602， ≤3 × 10-6N2; the electricity consumption of oxygen production (excluding oxygen and nitrogen pressure) is about 0.39kWh/m302.

3.2 Process characteristics

The 21000m3/h oxygen generator is designed to ensure long-term stable and reliable operation， energy saving， and easy operation and maintenance， and adopts the international advanced air separation technology.

(1) The process and equipment of full low-pressure， full plate-fin heat exchanger can achieve lower energy consumption of oxygen production and higher oxygen extraction rate.

(2) The air pre-cooling system is equipped with a water cooling tower to make full use of the cooling capacity of the dry nitrogen gas to reduce the cooling water temperature， and the chiller unit can be eliminated (the chiller unit is used as a backup).

(3) molecular sieve purification system using activated alumina a molecular sieve double bed structure， greatly extending the life of the molecular sieve， while reducing the bed resistance.

(4) The upper tower of the fractionation tower uses packed tower， which greatly reduces the resistance of the tower. Oxygen and argon extraction rate is further improved.

(5) The oxygen generator can extract part of the liquid oxygen. When liquid oxygen is not produced， a safe emission of liquid oxygen of 1% oxygen production is used to control the accumulation of hydrocarbons in the main cooling liquid oxygen.

(6) Full distillation of argon technology is adopted to save energy and eliminate hydrogenation and argon removal equipment， saving plant investment and operating costs.

(7) The turbine expander adopts the pressurization mechanism， thus reducing the amount of expansion air and stabilizing the working condition of the distillation tower.

3.3 Main equipment supporting range

① two sets of raw material air filter for self-cleaning， processing air volume ~ 180，000m3 / h; ② two sets of air turbine compressor for the import， the discharge volume 113，800m3 / h; supporting motor 9800kW (using thermal variable resistance soft start); ③ two sets of air pre-cooling system， including air cooling tower， water cooling tower， cooling water pump， chiller a / set. Two sets of molecular sieve purification system， including two adsorbers/sets， one steam heater/set， one switching valve/set; ⑤ two sets of fractionation tower， including the main heat exchanger， main tower， expansion heat exchanger， liquid air and liquid nitrogen subcooler， crude argon tower section， crude argon tower section II， crude argon liquefier， centrifugal crude liquid argon pump inlet， fine argon tower， fine argon heat exchanger， cold box， etc.; ⑥ four sets of pressurized turbine expanders; ⑦ two sets of oxygen two sets of oxygen turbine compressors; ⑧ one set of oxygen and nitrogen turbine compressors (the second set is nitrogen turbine compressor); ⑨ one set of liquid oxygen storage system (including two sets of 500m3 storage tanks， two sets of liquid oxygen pump imports， three sets of domestic， two sets of vaporizers); ⑩ one set of liquid nitrogen storage system (including one 500m3 storage tank， two sets of liquid nitrogen pump imports， two sets of domestic， two sets of vaporizers; ⑩ two sets of liquid argon storage system (including Two sets of liquid argon storage system (including four 150m3 tanks， two sets of liquid argon pump inlets and one vaporizer); one set of liquid equipment (including one high and low temperature expander each).

All the above are Hangxiao products.

Instrumentation and control system: DCS is Xiyanghe; transmitter is Rosemount; UPS is Meraniland 15kW， 30 minutes; pressure and differential pressure switch is Germany Hailong; vibration meter is Japan Shinkawa; precision pressure reducing valve is Germany VDO; regulating valve is Hangxiangong; solenoid valve is Japan SMC; analyzer is imported， other are domestic products. Electric control system: two main transformers; three auxiliary transformers; all adopt domestic equipment， and the high voltage motor adopts soft start.

At present， the first set of 21000m3/h oxygen generator has been put into operation in September 2002 and is running well. The second set has entered the commissioning stage and is expected to produce oxygen at the end of December 2002; the third and fourth sets of 21000m3/h oxygen generators have entered the preparation work.

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