

# Application of nitrogen generator in mining and beneficiation in coal mining industry

Nitrogen is a non-toxic inert gas with certain safety. The main function of nitrogen in coal mining industry is to put out fire to ensure the safety of the surrounding area.

Using our carbon molecular sieve pressure swing adsorption to produce nitrogen has high cost performance and is relatively economical for later maintenance.

The function of injecting nitrogen underground to extinguish the fire is reflected in:

(1) When a large amount of nitrogen is injected into the fire prevention and extinguishing area, the oxygen concentration in the goaf decreases; Nitrogen partially replaces oxygen to enter the coal fissure surface and exchange adsorption with the micro surface of coal, so as to reduce the adsorption of oxygen on the coal surface and inhibit or slow down the oxidation of residual coal to a great extent.

(2) For the fire prevention and extinguishing area with certain closed conditions, after long-term continuous injection of nitrogen, a large amount of nitrogen can form a positive pressure in the goaf, so as to reduce the air leakage in the goaf and make the residual coal in an anoxic environment and not easy to oxidize.

(3) When nitrogen with lower temperature flows through the coal, it absorbs some heat generated by coal oxidation, which can slow down the speed of coal heating and reduce the temperature of surrounding medium, so that the oxidation of coal can be delayed or terminated due to the destruction of heat accumulation conditions.

(4) After the combustible and explosive gas in the goaf is mixed with nitrogen, with the increase of inert gas concentration, the explosion range gradually decreases (i.e. the lower limit increases and the upper limit decreases). When the mixture ratio of inert gas and combustible gas reaches a certain value, the upper and lower explosion limits of the mixture coincide, and the mixture loses its explosion capacity.

#### Special nitrogen generator for coal field



The principle analysis of nitrogen fire prevention and extinguishing of nitrogen generator is as follows:

#### 1. Danger of gas explosion

In coal mines, once there is a fire in the goaf, it will cause the explosion of mixed gas in the goaf. The limit of mixed gas explosion depends not only on the percentage of this gas in the air, but also partly on the temperature and pressure of the mixed gas. The increase of temperature and air pressure expands this limit, and vice versa. When the oxygen content is less than 7%, the explosion of the mixture is significantly reduced. Based on this theory, the oxygen content in the fire area is reduced after nitrogen is injected, and the possibility of explosion can be greatly reduced as long as the oxygen content is less than 7%.

#### 2. Prevent spontaneous combustion of coal

Three factors of coal spontaneous combustion: coal has spontaneous combustion tendency; Continuous oxygen supply conditions; Heat tends to accumulate. If the leakage air volume in the goaf is not enough to take away the heat generated by coal oxidation, the coal

temperature will gradually rise, and the coal is in spontaneous combustion and heating. When the temperature reaches above the critical temperature of coal, the rapid aggregation of oxidation accelerates, a large amount of heat is generated, and the coal temperature rises rapidly. When it reaches the ignition temperature of coal, it will catch fire and burn, that is, it will enter the state of spontaneous combustion. Based on this coal oxygen compound theory, a certain flow of nitrogen is injected into the oxidation zone of goaf to reduce the oxygen content in the zone, so as to destroy an element of coal spontaneous combustion and reduce its oxygen content below the critical value of coal spontaneous combustion, so as to achieve the purpose of preventing coal spontaneous combustion.

### 3. Cooling effect

For the goaf with internal fire, its temperature is greater than the external temperature. When nitrogen is used for fire extinguishing, the temperature of product nitrogen is between 0 ~ 5 °C, which is much lower than the gas temperature in the fire area. In addition, the flow range of nitrogen after injection into the fire area is large, which has a significant cooling effect on the goaf.

### 4. Effect of reducing air leakage

Air leakage in goaf is one of the main causes of spontaneous combustion. For the closed or semi closed goaf, theoretically speaking, the total amount of mixed gas in the injected space is increased after nitrogen injection, which can reduce the ground pressure difference between the inside and outside of the closed area and reduce the air leakage from the outside to the inside of the closed area.

If there is a crack in the ground sealing wall in the roadway, when there is negative pressure in the sealing area, the air can enter the sealing area through the wall crack or bypass the sealing wall. In order to prevent air leakage in the closed area, the necessary flow of nitrogen can be continuously injected into the ground space between the front and

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