Operational analysis of molecular sieve purification system

1 Preface

The molecular sieve purification system is the key equipment for air separation equipment to purify air and ensure safe operation. Understanding its performance and working principle， familiar with the various factors affecting its normal operation， the actual operation and management of air separation equipment is of great value.

2 Process Introduction and Important Role

2.1.1 Process Introduction

In the air separation equipment， the molecular sieve purification system is set up after the air pre-cooling system to remove water， carbon dioxide， acetylene and other impurities in the air. It consists of molecular sieve adsorber， regenerative heating

equipment， as well as valves， pipelines， instrumentation and electrical control systems. Purification of air adsorbed impurities is done by the molecular sieve adsorber. The adsorber is filled with molecular sieves and other adsorbents (activated alumina is mainly used to adsorb water， molecular sieves are mainly used to adsorb carbon dioxide， acetylene and other hydrocarbon impurities).

The molecular sieve purification system generally uses two adsorbers to switch， one adsorption saturated， and the other regenerated into operation. After saturation， the adsorbent loses its ability to continue adsorption and can only be used after regeneration. Regeneration is the reverse process of adsorption - as the adsorbent loses its adsorption capacity after it has absorbed the adsorbed component， certain measures must be taken to drive the adsorbed component away from the adsorbent surface and restore the adsorption capacity of the adsorbent， which is called regeneration. The regeneration process is divided into four steps: pressure reduction， temperature increase， cooling， and pressure increase.

2.1.2 Adsorbent properties

In modern large air separation equipment， molecular sieves and activated alumina are commonly used to form a bunk bed. The characteristics of these two adsorbents are mainly introduced.

Molecular sieve: 1) has a strong adsorption capacity， selective adsorption performance; 2) very high dryness， high temperature and high speed airflow have good drying capacity. The lower the water vapor content， i.e.， the lower the relative humidity， the more significant the adsorption capacity. However， the adsorption capacity is smaller when the relative humidity is larger; 3) good stability， the adsorption capacity can still be maintained normally below 200°C. 4) The adsorption capacity of water is very strong， followed by acetylene and carbon dioxide.

Activated alumina: 1) high compressive strength， low wear rate， no pulverization and no bursting; 2) strong resistance to sudden changes in cold and heat; 3) good water

absorption， low price and low resistance. It is generally placed in the lower layer for preliminary drying of the air entering the adsorber.

2.2 Important role

Air， the raw material for air separation production， contains small amounts of water， carbon dioxide， acetylene and other hydrocarbon gases， as well as solid impurities such as dust. Although the content of these impurities in each m3 of air is small， the total amount of air brought into the air separation equipment per hour is considerable because the air volume of large air separation equipment is tens of thousands or even hundreds of thousands of m3 per hour. As the air cools， the frozen water and carbon dioxide are deposited in the cryogenic heat exchanger， turbine expander or distillation tower， blocking passages， pipelines and valves; acetylene collects in the liquid oxygen and poses a risk of explosion. Remove and purify these impurities， to ensure the long-term safe operation of air separation equipment， is the important role of the molecular sieve purification system.

3 molecular sieve purification system common problems and corresponding measures

1) into the air temperature is too high: processing air by the air pre-cooling system after cooling into the molecular sieve， the higher the air temperature is not conducive to molecular sieve adsorption， must ensure the normal and effective work of the air pre-cooling system (can be appropriate to increase the amount of nitrogen and dirty nitrogen sent to the water cooling tower， to strengthen the cooling effect) generally control the air out of the air cooling system temperature is not higher than 15 °C.

2) molecular sieve bed impact by airflow: maintain the uniformity of the molecular sieve bed， keep the molecular sieve system pressure stability (less than 10kPa)， with the air pressure post personnel work closely to prevent violent fluctuations in the amount of air.