

# RESEARCH ON THE APPLICATION OF DESORPTION PACKED TOWER ON THE DESULFURIZATION IN THE BRINE

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**Abstract:** In this paper, the application principle of desorption packed tower of brine desulfurization process was briefly introduced, and several existing major problems and response measures on the actual operation process of this process was analyzed according to the application in practice. At the same time, the applications prospect of desulfurizing absorption tower on the treatment process of brine containing sulfur content was also pointing out.

**Key words:** desorption desulfurization; problem; measures

## 1 STATUS QUO

1.1 Changshan Salt Mine is the main mining base of JiuDa group. Because of their geological conditions, the  $H_2S$  content of production brine is relatively high, the average content is 35mg / L or more, the highest is up to 120mg / L. With the increase in ore recovery and the change in mining geological conditions, the  $H_2S$  content in the brine tends to increase. The minimum requirement of salt and salt chemical process for  $H_2S$  content of brine is less than 10mg / L. therefore, it is necessary to perform further purification of the brine. At the same time, the treatment of purifying brine can increase the

product quality of salt and salt chemical products, reduce the cost of salt, relieving the corrosion of brine to the equipment of transport brine and salt, save the energy consumption. Therefore, to reduce the  $H_2S$  content in the brine is major task of brine purification of our mine.

1.2 There are chemical and physical treatment methods to remove  $H_2S$  in brine. Due to the high cost of chemical treatment method amounting to more than 1.50 yuan/ $m^3$ , and the existence of follow-up processes with high technical difficulty such as precipitation separation and water treatment technologies. Therefore, physical methods were used in the

purification of  $H_2S$  contained in brine. As for the primary physical treatment without dynamics such as solar halogen, although part of the  $H_2S$  in brine can be removed effectively, it is difficult to achieve the requirement. only the use of physical treatment method with dynamic, especially air-blow method, can treat  $H_2S$  in brine effectively.

1.3 The method of air blowing including two methods of aeration tank and packed tower. The investment of former is a relatively small, but covers larger area and pollution to the surrounding environment is more serious; the investment of latter is relatively high, but the covered area is small and minor pollution to the surrounding environment. The main operation cost is the power consumption of the two methods, which less than 0.10 yuan/ $m^3$ , with low costs. From April to June 2004 of 2004, the mining technology research institute of JiuDa groups cooperated with the chemical engineering and technology research institute of Tianjin University to carry out the project of desorption oxidative desulfurization packed tower technology, and achieved the successful experience as follow: First, make use of desorption packed tower to perform desulfurization treatment of brine, the  $H_2S$  content of brine can decrease to the 3.0 mg/L and below, ensuring that the desulfurization rate of brine is more than 90%; The second is the running costs can be controlled at 0.10 yuan/ $m^3$  through the desulfurization treatment by desorption packed tower; The third is the installation of desorption packed tower cover small area,

short construction period and operation process causing little pollution to the environment, so the desulfurization projects is of great value to our company.

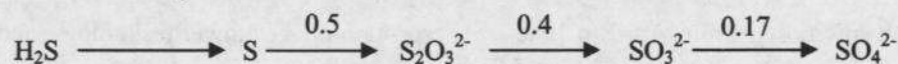
## 2 THE OPERATING PRINCIPLE OF DESULFURIZATION DESORPTION PACKED TOWER

2.1 Tianjin University is the state-level research and extension centers of packed tower technology, its packed tower is widely used in many fields such as water treatment, oil degassing. To date, there is no example of the application of desorption packed tower to the brine desulfurization project. Therefore, chemical engineering Technology research Institute of Tianjin University utilize the Aspenplus software to simulate the process that treating the brine containing sulfur with desorption packed tower technology, and a lot of valuable design data obtained by this way laid the basis for the design of the desorption packed tower.

### 2.2 Principles of desorption desulfuration

2.2.1 Desorption Purge is based on the vapor-liquid equilibrium and mass transfer rate theory. In the two-phase system of gas-liquid, the gas pressure of the solute gas in the gas phase is directly proportional to its concentration in the liquid phase. If the gas sub-pressure of the components lower than the corresponding equilibrium pressure of its solution, then the mass transfer from liquid to gas will occur. According to the "double-film theory" (two-film theory), at the both sides of

gas-liquid interface, there exist a relatively stable gas film and liquid film, the gas phase and liquid phase are turbulent, and intra film remains laminar flow. any disturbance of gas or liquid can't eliminate the two-layer films, only change the thickness of the film. There exists four steps in the process of liquid desorption: First, reaching the film from bulk liquid by the turbulence; Second, arrived on gas-liquid interface through diffusion, and dissolved in the gas film; The third is across the film by the diffusion; the forth is the entrance into the inner of gas film by turbulence. The mass transfer rate depends on the difference between balance pressure and gas partial pressure. The vapor-liquid equilibrium and mass transfer rate change in relation with the substance, temperature and two-phase contact. For the given system, the purpose of decreasing solute concentration in



### 3 THE MAIN PROBLEMS IN THE OPERATION OF DESULFURIZATION PACKED TOWER

3.1 After a long time of operation, the desulfurization packed power scaled very seriously, nearly blocked all channels.

3.2 The tower body of desulfurization packed tower and its ancillary process

liquid phase and increasing the speed mass transfer can be achieved by raising the temperature, adoption of fresh air or negative pressure operation, increasing gas-liquid contact area and time, reducing mass transfer resistance.

2.2.2 Oxidation a large number of air blow into the brine. Along with the role of  $\text{H}_2\text{S}$  desorption, it still accompanied by oxygenation and chemical oxidation of  $\text{H}_2\text{S}$ . the process of brine oxygenation is the process of  $\text{O}_2$  in the air dissolved in the brine, complying with the vapor-liquid equilibrium and mass transfer rate theories, the dissolution rate depend on the diffusion rate of  $\text{O}_2$  molecules in the dual-film. The Brine was generally weak acid, the standard electrode potential of sulfide and  $\text{O}_2$  Under these conditions as follow:

pipeline were corrupted seriously.

3.3 The ventilated channel is easily blocked by salt crystallization.

### 4 COUNTERMEASURES

4.1 Aiming at the issue 3.1, we have carried out the diluted hydrochloric acid dissolution experiment of dirt in desulfurization packed tower, the experimental results are as follows:



**Table1 the experimental data of scaling sample in desulfurization tower**

Acid Concentration		20%	10%	5%	3%	2%	1%	remark
Prepared with water	Dissolution rate	Very fast	fast	Little fast	general	Slow	Very slow	A large amount of bubbles were generated
	Dissolution time	10s	35s	100s	6min	10min	40min	
	Reaction degree	Intensive	Little intensive	Little intensive	general	general	slow	
	Dissolution	dissolution	dissolution	dissolution	dissolution	dissolution	dissolution	
Prepared with brine	Dissolution rate	Very fast	fast	Little fast	general	Slow	Very slow	Generating much white precipitate
	Dissolution time	10s	35s	100s	10min	20min	50min	
	Reaction degree	Intensive	Little intensive	Little intensive	General	General	Slow	
	Dissolution	dissolution	dissolution	dissolution	dissolution	dissolution	dissolution	

As can be seen from the experimental results that the dirt samples can all dissolved totally in the acid, but there are slight difference in the extent and rate of dissolution. Through the analysis of dirt sample components, it can be determined that the major components of dirt sample are gravel, debris (carbonate type) and a mixture of salt crystallization. However, in order to understand the operation situation more accurately of the desulfurization packed tower, we started to perform removal and pickling solution experiments from September 29, 2005. The desulfuration filling start to become very loose after 36 hours of steep in

10% diluted hydrochloric acid, and dirt attaching it can be washed and returned to the initial situation.

4.2 Aiming at the issue 3.2. Due to difficulty in the disassembly and assemble of desulfurizer packing tower, so the only way to remove the dirt is rinsing with acid when the filling covered with dirt. Descaling, so the requirements for anticorrosion of the tower is very stern, it must be able to restrain the corrosion from diluted hydrochloric acid and hydrosulphuric acid for a long time. The environment around the tower is extremely harsh, the air is full of a strong corrosive  $H_2S$  gas, which will corrupt pipeline seriously. so

in the process of building desulfurizer packed tower, any process piping that not bearing high pressure not ask for much should consider the installation of PE pipes. The other process pipes that can't be replaced by PE pipes must carry out outside anti-corrosion treatment to ensure a long life time.

4.3 The issue 3.3 mainly due to a large number of fluid air, carrying away some water of the brine. and the friction between air and delivery channel generate heat which give rise to the evaporation of some part of water in high-salt brine near the exit channel, and thus causing the salt crystallized and attached to channel exports, eventually jammed the ventilated channel. In the future

Design, as long as we make slight improvement on the exit of ventilated channel, adding on funnel-type to the outlet of channel, the problem should be able to be overcome.

## 5 Conclusion

Desorption packed tower technology have been successfully applied to the desulfurization experiment. Besides, It is low in cost and high in efficiency, when several problem existed in the operation process have been solved, the spreading of productive packed tower can be expected soon. Then it will not only solve the key problems, but also greatly reduce the equipment corrosion, save energy consumption and promote the product of salt and salt chemical products to a new level.