

Development of Centrifugal Mechanical Pulverization Residuum Burner

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Abstract: China Space flight Science Block Company Eleventh Research Institute develops centrifugal mechanical pulverization residuum burner for carbinol equipment gasification furnace, which belongs to QiLu Petroleum and Chemical Company Second Fertilizer Plant. Some problems have been solved, such as burning out of burner and ablation of the brazing welding line by analyzing the mode and parts of breakages of burner. Cemented carbide nozzle of oil burner is developed, and brazing solders are discussed. At last the lifetime designed of the burner reach that of the same international products.

Keywords: burner, lifetime, cemented carbide, brazing solder

1. INTRODUCTION

The burner of the carbinol equipment gasification furnace, which belongs to QiLu Petroleum and Chemical Company Second Fertilizer Plant, is centrifugal mechanical pulverization, every gasification furnace has one burner. The residuum outflow of each burner is 1.85kg/s, the pressure difference of the burner is 8MPa, and the pressure of the gasification furnace hearth is 6.5MPa.

2. THE STRUCTURE OF BURNER

China Space Flight Science Block Company Eleventh Research Institute manufactures gasification furnace burner for QiLu petroleum and Chemical Company, which is typical mechanical pulverization burner. Material of burner nozzle is cemented carbide. Material of swirler is alloy steel, rigidity of that is up to HRC 50 after hardening. Cemented carbide braze welded joint with stainless steel shell, manufacturing process is difficult [1]. The structure of burner is shown in Fig.1.

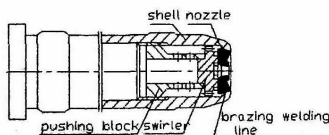


Figure 1: Simplified drawing of centrifugal mechanical pulverization burner

3. USING OF BURNER

In the first instance, we produced 17 burners after three times of manufacturing. The out flow

characteristic, and the atomizing and burning characteristic of the burner are comparatively ideal, but we found that the lifetime of the burner is relatively short.

One of reason that the burner may be rejected is that the burner shattered by the high-temperature radiation of the furnace liner. When the gasification furnace is blowing down because of the wave of voltage, operating system can't provide essential steam protection in good time and draw out the burner as soon as possible, so that the burner is scrapped. In another case, the burner may be rejected in normal start-up and stopping of the furnace, or in normal operation. What we concern is the second case. In that case, the surface of cemented carbide between the brazing welding line of the top of the burner and the platform of the nozzle, and cracks often appears in the brazing welding line after using.

4. ANALYZE BURNING OUT OF BURNER

We main analyze burning loss of cemented carbide and crack of the brazing welding line.

4.1 Analyze Cemented Carbide Nozzle

The outlet section of cemented carbide nozzle burn out burst apart, not burn out subsiding uniformly. The melting point of alloy is very high, and the stainless steel burner block abuts on burning out section of alloy keep sharp edge, it shows that alloy does not melt in high temperature.

Analyzing the burning out surface shows that the surface burn out more deeply, appears more roughly, results in denudation, appears in continuous cusp, burn out more quickly and the lifetime shorten, when alloy comes to burn out.

This burning out caused by interaction between the local environment of alloy and alloy characteristic.

To determine the nature, alloy surface is covered

with turbulent flow that caused by jet flow of nozzle center and ambient. The temperature and pressure of fuel gas vortex at alloy surface change persistently, changeable environment cause alloy surface's temperature stress. Specially fine drops of oil in reversed-flow region impacting alloy surface intensified temperature stress and deformation. Cemented carbide is brittleness multiphase material which is manufactured by powder metallurgical technique, its conductivity is very small, local multivariate temperature stress brings easily stress at multiphase material's interface, stress concentrate and develop into micro-crack.

Binder phase Cobalt moisten constituent elements of alloy in varying degrees. When fritting alloy, if some local part does not moistened, that part may become initial point of stress concentration and micro-crack. Extending of this micro-crack may form burning out or result in denudation. According to this mechanism, alloy with lower brittleness, higher buckling strength, better impact toughness is used as nozzle material to improve alloy's corrosion resistance.

4.2 Analyze the Crack of The Brazing Welding Line

Generally speaking, there are three probabilities in the crack of the brazing welding line: (1) true crack; (2) there is not welded in some local part because moistening material does not humidify the farther interface; (3) loss or erodent of solder in the working process.

When the burner is used, the crack often appears in the brazing welding line. The structure of burner guarantees that intensity problems not appear. The welding line's main function is sealed. When burner works, in the inside of burner heat stress will be come into being. Then the heat stress may lead restriction crack. When the nickel basis solder is used, if over many cored solder is used, it will humidify the spout of burner so that there is something wrong with the performance of spouting oil (mainly the atomization characteristic). Therefore, it is all right if brazing solder just flows. That will make the scale of welding parameter be narrow. Both the stochastic state of surface and clearance cause local welding line not to be humidify, then it will lead some crack. Furthermore, if there is much sulfur in the residual oil, it will react with nickel basis solder and produce sulfide NiS whose melting point(about 797°C) is lower than that of solder(about 1050°C). At last solder should be run out.

Whatever kind of cracks is there, we can take measures to eliminate these cracks technically. First of all, brazing welding treatment and surface treatment should ensure welding line be moistened completely; secondly, diminish probable erode; thirdly, use braze welding solder with good plastic deformation in order to fit different nozzle material's heat stress.

5. CONCLUSION

In a word, the burner of gasification furnace works in the high temperature and high pressure, and heat stress is brought because the local temperature and concentration of the environment continually change.

At the same time there is cauterization of the sulfur. The cemented carbide suitable for the burner should have proper rigidity and good hot ductility. Braze welding solder should not be eroded by the sulfur. Through many experiments and actual application, some conclusions are drawn:

(1) Using cemented carbide YT5 as the material of the top of burner, the character of cemented carbide YT5 is listed in the Table 1^[2].

Table 1: The character of cemented carbide YT5

Cemented carbide designation		YT5
Component (%)	WC	82
	TiC+TaC	8
	Co	10
Density (10^{-3}kg/m^3)		12.5-13.2
Rigidity	Average HV30	1450
	Product index HRA	≥ 89.5
Bending strength (kgf/mm^2)		≥ 140
Conductivity ($\text{W/m} \cdot \text{K}$)		0.00627
Coefficient of linear expansion ($10^{-6}/^\circ\text{C}$)		5.5
Elastic modulus (10^4kgf/cm^2)		59 ~ 60

(2) Using gold basis-solder

The gold basis solder is applied extensively in braze welding process. This kind of solder has good braze solder performance, such as wet ability, the ability of resisting erodent and distortion. The only shortcoming is expensive. It cost almost the same money as the gold.

(3) Assessing the process of the gold basis solder

Choose the gold basis solder jointing with the YT5, the performance of the welding should be assess. Firstly, the experiment of spreading ability is made in order to confirm if the cemented carbide nozzle and the stainless steel surface need nickel plating. Then do the experiment of the tie-in intensity. At last give the reverse pressure to the mold and do the devastating experiment in order to check the tie-in technics^[3].

The centrifugal mechanical pulverization residuum burner produced by the method of above for carbinol equipment gasification furnace, has good atomizing characteristic and combustion performance, and the lifetime of the burner reach that of the same international products.

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