

Study on the Application of Drying Furnace Waste Gas Treatment Technology in Painting Workshop

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ABSTRACT

With the continuous development of our country's economy, the demand for automobile is higher and higher after people's living standard is improving day by day. In just 40 years of reform and opening up, China's automobile production and per capita possession have made a qualitative leap and a breakthrough in quantity. Greatly promoted the automobile industry's great development.

1. Introduction

The rapid development of the automobile industry has led to the sustainable development and progress of the economy. With the improvement of the economic level, it is the pollution and destruction of the environment and the increasing demand for energy. The development of automobile industry contributes to energy consumption and environmental pollution.

2. Application of Waste Treatment Measures

2.1 Hardware Topology

Taking PLC as the control core, the field sensor transmits the collected temperature and pressure to the PLC, air valve actuator by 4~20 signals, and feedback the position state of the air valve to the PLC. By the switching signal

PLC controls fan and pump and air valve actuator after calculation and logical judgment. Safety linkage through hard wire and drying system. The upper computer monitors the state of the system through the workshop network.

2.2 Fan Control

The control fan is used to provide constant pressure high temperature exhausts gas to the heat exchanger. The oven that needs TNV system to deal with exhaust gas in painting workshop includes electrophoretic oven and topcoat oven. The exhaust gas temperature is between 200°C and 300°C. A three-way air valve is set up in the roof chimney position to control whether the high temperature exhaust gas leads to the waste heat reuse heat exchanger or directly to the atmosphere. The waste gas of electrophoretic oven and topcoat oven is collected through air pipe and then put into the waste heat reuse heat exchang-

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er. When the high temperature exhaust gas is put into the waste heat reuse device, it will be hindered by the pipeline and heat exchanger, and the oven exhaust gas will overflow in the workshop, so the high temperature exhaust gas is discharged into the atmosphere by the induced fan after heat transfer^[1]. If the speed of the fan is too high, the negative pressure in the oven will affect the process. It is the basic requirement of the operation of the waste heat system to ensure the constant air pressure in the exhaust gas duct. The pressure sensor is set up in front of the heat exchanger. The pressure measurement value is fed into the PLC, with 4~20 mA signal. The wind pressure data are taken as the PV input of the PID instruction and the output 4 and 20 signals are used to control the frequency output of the fan converter.

2.3 Pump Control

Hot water is needed in the pretreatment process section and air conditioning system of painting workshop, so it is very reasonable to integrate the residual hot water circulation into the hot water system of workshop. The water system relies on the pump to maintain the circulation, the pump is set up for 2 parallel pumps and 1 standby, and when the system stops and starts again, it is switched to another pump to work, so that the pump is worn and lubricated in the same amount. The high temperature exhaust gas contains trace oil steam, which condenses on the heat exchanger after cooling the heat exchanger. This is harmful. Condensed oil will affect the heat transfer efficiency of heat exchanger, the biggest harm is that there is fire risk in high temperature environment. Therefore, in order to avoid this phenomenon, the heat exchanger outlet exhaust gas temperature to maintain above 100°C. Adjust the heat transfer by changing the flow rate of circulating water under constant wind pressure^[2]. When the water flow rate is small, the water absorbs less heat from the exhaust gas, the temperature of the exhaust gas at the outlet of the heat exchanger is higher, and when the water flow rate is large, the heat taken away by the water becomes more, and the temperature of the exhaust gas at the outlet of the heat exchanger will decrease. The outlet temperature of the heat exchanger is fed into the PLC, temperature data with 4~20 mA signal as the PV input of the PID instruction. The output of 4 and 20 signals is used to control the frequency output of circulating water pump inverter. This ensures that the heat exchanger exhaust temperature remains at a set value to avoid condensation of oil steam on the heat exchanger.

2.4 Air Valve Control

Air valves are used to control high temperature ex-

haust gas to heat exchangers or straight to the atmosphere. When the consumption of hot water in the workshop is reduced, the circulating water heat of the waste heat system may exceed the demand, so the circulating water may reach the boiling temperature. In order to avoid the occurrence of water overheating, the upper limit of water temperature is set to 90 °C. When the water temperature reaches the upper limit, the electrophoretic drying waste gas is discharged directly into the atmosphere, and only the topcoat drying waste gas is used to supply high temperature gas to the waste heat collector. Automatically execute sequence start after cooling of circulating water^[3]. In order to prevent system oscillation, when the water temperature is reduced to 80°C, the sequential start action is performed automatically.

2.5 Start-up Sequence

When starting, the circulation of waterway is the precondition of the waste heat reuse system, and the circulating water pump is the first equipment to be opened. Then the induced fan starts, when the induced fan accelerates, the air valve actuator is powered on, and the air valve action drains the high temperature exhaust gas to the heat exchanger. When shutdown, first reset the air valve to drain the exhaust gas directly into the atmosphere, then close the fan, and finally close the circulating water pump.

2.6 Protection

The protection measures in the waste heat reuse system can be divided into temperature protection, pressure protection, position protection and time protection. The severity can be divided into warning and fault, alarm warning and protection action, which are performed respectively.

(1) Temperature protection

The temperature collected in the waste heat reuse system is divided into flue gas temperature and circulating water temperature. The chimney exhaust temperature is used to determine whether the high temperature exhaust gas meets the recovery conditions. The temperature acquisition point in front of the heat exchanger monitors the gas temperature of the heat exchanger to determine whether it is overheated and perform protective action. The temperature collection point after the heat exchanger monitors the gas temperature after the heat transfer to the atmosphere, which is used to judge whether the oil vapor condensation will occur and to control the circulating water flow rate properly^[4]. The temperature collection point of the

1 Cng: Cryptography Next Generation.

recirculating water after heat exchanger monitors the temperature of the heated water, which is used to determine whether the circulating water is overheated and perform the protective action. In winter season, in order to avoid the freezing and freezing of circulating water, the winter mode is set for the pump. In winter mode, the waste heat reuse system does not perform the pump shutdown when it stops in sequence.

(2) Pressure protection

Pressure protection is divided into hydraulic protection and wind pressure protection. Monitoring water pressure can determine whether the pump is running normally and whether the pipeline is blocked. The abnormal condition of fan and air valve and air duct can be judged by wind pressure.

(3) Position protection

Position protection is a logical judgment of the position of the air valve to find out whether the position of the air valve is abnormal. The mechanical jam of the air valve and the leakage of compressed air will show the abnormal position of the air valve.

(4) Time protection

Time protection is reflected in the program using timer to filter the fluctuation in the system and improve the stability of the system. When water temperature and flue gas temperature fluctuate, filter by delay before judging whether it is necessary to carry out protection action. In the program, the air valve actuator is given action time to determine whether the air valve is abnormal.

2.7 Linkages with Drying Systems

The waste heat reuse system exists in the form of high cohesion as an independent part of the automobile painting workshop and is associated with the drying system in a low coupling manner^[5]. In the waste heat reuse system, temperature collection, pressure collection, air valve operation, pump operation, fan operation and so on are connected by complex hardware circuit and PLC program logic. This reflects the high cohesion of the waste heat reuse small system. When the workshop starts production and all relevant oven chimney exhaust temperature meets the needs of the waste heat reuse system. The waste heat recovery system can be started sequentially. During production, if the air valve of the waste heat reuse system fails and stuck to the waste heat recovery or semi-open and semi-closed state after the system is shut down, the

heat exchanger may be burned out or even at risk of fire. Under the condition of no fault, the waste heat reuse system will not affect the normal operation of the oven system.

3. Application of Energy Saving and Emission Reduction Technology for Automobile Coating

3.1 Energy Saving and Emission Reduction Technologies for Pre-drying Equipment

Because the energy consumption in the process of automobile painting is closely related to the pre-drying temperature, in the process of automobile manufacturing, the parties concerned can accurately grasp the drying temperature and control the drying temperature within an appropriate range to save energy. However, in the present situation, the energy saving and emission reduction technology of the pre-drying device is often adversely affected by temperature and humidity, and the drying time will be obviously longer if the air enters the process. In addition, it is difficult to ensure the effectiveness of automobile maintenance, which increases the energy consumption in the process of automobile painting. To really solve this problem, staff must use low-size, powerful air-conditioning cyclones to inject powerful air-conditioning cyclones into the dry environment of the car^[6]. This reduces energy consumption during painting and achieves the goal of energy saving and emission reduction. It is also important to select energy saving and environmental protection materials in the process of automobile painting. Staff should select reasonable energy saving and environmental protection materials, such as powder or waterborne special coatings, according to the specific process of automobile painting, in order to minimize the painting process. The harmful substances produced can not only promote the smooth progress of automobile painting process, but also save energy and reduce emissions in painting process. It is reasonable to introduce new machinery and equipment in the process of automobile painting in order to first contact with the current automobile situation in China and provide good conditions for the application of energy saving and emission reduction technology in the process of automobile painting.

3.2 Wheel Technology

a new zeolite roller enrichment technique has been created in the automotive painting process, which can be used in combination with high temperature incineration to treat low concentrations of volatile organic compounds. In

the treatment of volatile organic substances, zeolite rollers can be used to condense a large amount of waste gas with low concentration and form a small amount of waste gas with high concentration. This can effectively reduce equipment investment and waste gas treatment operating costs, thereby reducing waste. When a large amount of low concentration waste gas is treated, if the zeolite roller is not used to burn directly, if the amount of waste gas is too large, the operating cost of waste gas treatment will be very high. After concentrated with roller, deal with a small amount of high concentration exhaust gas. After the waste gas enters the waste gas treatment equipment, it can effectively save the waste gas treatment cost^[7]. Volatile organic compounds can also reduce the amount of combustion during combustion, thereby reducing the operating costs of waste gas treatment. After the concentrated roll is cooled, the air through the cooler will be heated to form recycled air, thus saving energy and reducing emissions.

3.3 New Equipment

For automobile manufacturers, it is necessary to constantly study new equipment to adapt to the rapid development of the times, such as energy-saving air conditioning with thin film pretreatment technology and rough painted windows. Continuously optimize and upgrade mechanical equipment, such as drying room system optimization and waste heat recovery at each station, on the premise of meeting the requirements of new process technology. For example, in traditional spray rooms, water is usually used to treat paint fog, but the treatment process requires fresh air, and the treated air does not combine with fog, so it can be recycled. The less you use, the more energy you consume. With the development of science and technology, the use of robots is increasing, and dry paint capture technology has matured, circulating air can be effectively used. In this process, we combine the use of waterborne coatings. It can also effectively reduce investment costs, reduce wastewater treatment and reuse the resulting solid waste. With the continuous progress of science and technology, equipment control technology has become more and more intelligent, reducing the waste of personnel management. The intelligent control of drying room can adjust the air volume ratio according to the number of vehicles, effectively reduce the exhaust gas emission, and achieve the purpose of energy saving and emission reduc-

tion. In addition, energy consumption can be effectively reduced by saving the environment in which the vehicle is located. Advanced transmission equipment can be used to effectively reduce the capacity of electrophoretic tanks, while robots can be used to reduce the jet area that meets the technical requirements of energy saving and emission reduction^[8].

4. Concluding Remarks

To sum up, with the continuous strengthening of our awareness of environmental protection, the waste gas treatment in automobile painting has attracted more and more attention. Through effective control measures, the waste gas treatment technology has been increased. Improving the protection of the environment is the direction we should continue to work hard.

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