Design of Hydraulic System for Municipal Solid Waste Compressing Transfer Station

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Abstract: In this paper, the research and design of the garbage compression station hydraulic system using hydraulic cylinders to achieve garbage loading and compression, through the PLC control technology combined with the PLC to receive equipment operation information, analysis and command instructions to control the hydraulic actuator to achieve automatic and efficient waste Processing, fundamentally solve the shortcomings and shortcomings of the original system, to ensure the stability of the system, reliability, with a wide range of development prospects for many compressed garbage transfer station to promote the use of.

Keywords: garbage compression equipment, hydraulic system, horizontal compression.

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1. INTRODUCTION

The horizontal garbage compression station is a kind of garbage compression equipment which is used more now, and it is also a kind of daily waste. It is also a kind of product with more frequent problems. The horizontal garbage compression station is mainly used to compress the living garbage and extrude the water and air in the garbage so that the space of the garbage container is fully utilized, and the seal of the garbage container is better. This can not only reduce the number of transshipment, reduce the transportation cost, but also ensure that the garbage will not be freely scattered during the transportation process. The two-pollution problem is often used in conjunction with automatic garbage handling vehicles. The equipment consists of the feed hood bucket, the main compression mechanism, the auxiliary push feeding mechanism, the garbage compression container, the walking hooked device, the pullout and pin device, the walking plate car device, the hydraulic control system and the PLC electric control system.

2. ARRANGEMENT AND PRINCIPLE

The transport vehicle of the garbage compressed container is placed on the mobile crate by the hook, and then the mobile board is driven by the oil cylinder to move the garbage compressed container to the position aligned with the main garbage compression box and stop the oil cylinder movement of the car. The main compression box walking hook device to work, while the main compression box and the rear door is formed by the combination of tuitou.

The garbage truck loading the domestic garbage into the horizontal garbage compression station, first weighing the total weight of the weigher, recording the data automatically from the weigher, and driving up the second layers along the road. The tail of the garbage truck is backward in front of the feed hood, until the rear wheel touches the concrete pier in front of the feed hood, and the garbage is poured into the feed cover. In the bucket, the breadth of the feed hood is 6 meters, and two garbage trucks can be dumped at the same time. The main garbage compression box is filled with garbage and opens the head to compress the process. If the garbage dump is not automatically falling on the upper part of the chamber, the push head of the auxiliary compression box can be started to push and press, through the auxiliary garbage pressure. After squeezing the trash of the crate, the garbage pushed above the inlet of the feed hood will fall into the chamber of the main garbage compression box, and the head of the main garbage compression box is then compressed.

Fig. 1 shows the Overall layout of the garbage compression station. The whole set of equipment mainly consists of the feed hood bucket, the main compression mechanism, the auxiliary push feeding mechanism, the garbage compression container, the walking hooked device, the pullout and pin device, the walking plate car device, the hydraulic control system, the PLC electric control system and so on.
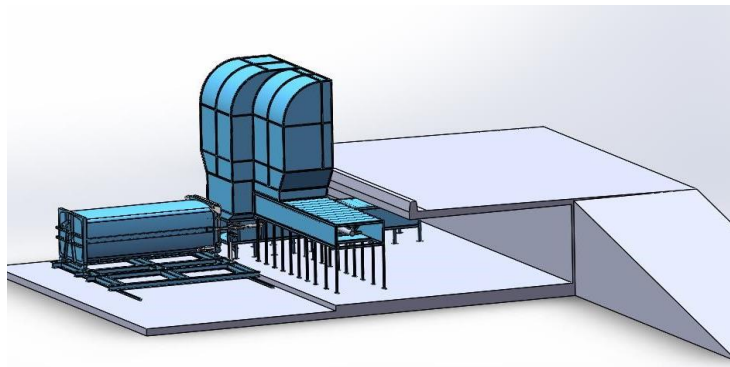

Fig. 1. Overall layout of the garbage compression station

3. DESIGN OF HYDRAULIC SYSTEM

The garbage compression equipment is mainly through the hydraulic actuator to perform the action. Therefore, if the equipment has a stable performance, the related parameters of the equipment must be carefully analyzed.

3.1 Design parameters of hydraulic system

According to the actual working condition of horizontal garbage compressing equipment, the system requirements are as follows:

(1) Tuitou cylinder moves with manual and automatic control switch knob.

(2) Tuitou movement automatic operation, push back cylinder must reset state.

(3) Tuitou automatic cycle adjustable.

(4) The auxiliary push oil cylinder acts first, pushing the garbage into the main compression bin, and the main compression cylinder moves immediately.

(5) The main compression cylinder is released three times to determine whether the pressure reaches the rated pressure. To reach the rated pressure head back.

(6) The design of garbage on the control panel shows the progress. After the garbage is full, the alarm device is required, and the automatic cycle stops.

Based on the above analysis of the functions of the hydraulic system, the action of horizontal garbage compressing equipment can be divided into automatic feeding, manual automatic pushing, compression advancing and returning. The feeding head and the main compression head are independent and cannot be linked together. The main compression cylinder must go back to the initial position, and the auxiliary feeding cylinder can move.

Table 1. Main design parameters of hydraulic system

Main design parameters of hydraulic system			
Number	Name	Company	Specifications
1	System power	KW	22
2	Rated pressure of the system	MPa	25
3	System working pressure	MPa	16
4	Pump delivery	ml/r	63
5	Compressor hourly treatment	T	125
6	Main compression cylinder stroke	mm	3440
7	Auxiliary push cylinder stroke	mm	3440
8	The main push speed	mm/min	1.6
9	Assistant head speed	mm/min	1.6
10	Oil temperature	°C	30~50
11	Shape size	mm	14434×11100×7355

3.2 Design of hydraulic system schematic diagram

The hydraulic system is one of the core systems of the equipment control. A series of actions of the garbage compression equipment are realized by the hydraulic system. Through the hydraulic control, the actuating components are driven to complete the equipment's feeding, compression and release functions.

Calculation of the inner diameter D of the hydraulic cylinder and the diameter of the piston rod d. Before calculating the relevant parameters of the hydraulic cylinder, it is necessary to understand the force in all directions first, and the diameter of the piston rod and the diameter

of the piston rod are derived from the working pressure of the hydraulic cylinder in the above table. Figure 2 is an analysis of the force of a hydraulic cylinder.
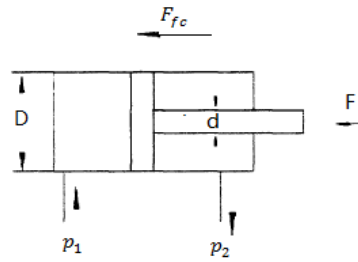

Fig. 2. Analysis of force of hydraulic cylinder

P1 is the working pressure of the hydraulic cylinder, P2 is the back pressure of the oil back chamber of the hydraulic cylinder, F is the maximum load of the actuator, the Ffc is the friction of the seal at the hydraulic cylinder, the D is the diameter of the piston rod, and the D is the inner diameter of the hydraulic cylinder. Because the exact value of Ffc is not easy to get, so the mechanical efficiency of commonly used hydraulic cylinder is estimated by η_{cm}. The relationship between Ffc and η_{cm} can be expressed as follows:

$$F + F_{fc} = \frac{F}{\eta_{cm}}$$

The range of η_{cm} is 0.9-0.97, and $\eta_{cm}=0.95$ is used in this system. As shown in Figure 2:

$$F + \frac{\pi}{4}(D^2 - d^2)p_2 + F_{fe} = \frac{\pi}{4}D^2p_1$$

$$D = \sqrt{\frac{4F}{\pi p_1 \eta_{cm}\{1 - \frac{p_2}{p_1}[1 - (\frac{d}{D})^2]\}}}$$

(1)

In medium low-pressure system, cylinder wall thickness is usually determined by structural process requirements, generally not checked. In the high-pressure system, it needs to be checked. The main oil cylinder: the inner diameter of the cylinder is D=180mm, and the thickness of the cylinder is =24.5mm. Check according to the following formula.

$$\delta \geq \frac{D}{2} \left(\sqrt{\frac{[\sigma]+0.4p_y}{[\sigma]-1.3p_y}} - 1 \right)$$

(2)

Take all the data into the calculation, $\delta \geq 23.28$mm.The wall thickness accords with the requirement of strength.

Checking the diameter of the piston rod d.

$$d \geq \sqrt{\frac{4F}{\pi[\sigma]}}$$

(3)

F - the force on the piston rod.

$[\sigma]$ - the allowable stress of the piston rod material.

Bring into each data,

The main oil cylinder d ≥ 33.6mm, is in accordance with the requirements.

Auxiliary material oil cylinder d ≥ 33.6mm, is in accordance with the requirements.

The Hooked oil tank cylinder d ≥ 15.4mm , is in accordance with the requirements.

The Pullout cylinder d ≥ 33.6mm, is in accordance with the requirements.

Combined with the technological process of hydraulic equipment, the hydraulic schematic diagram of the system is shown in Figure 3.
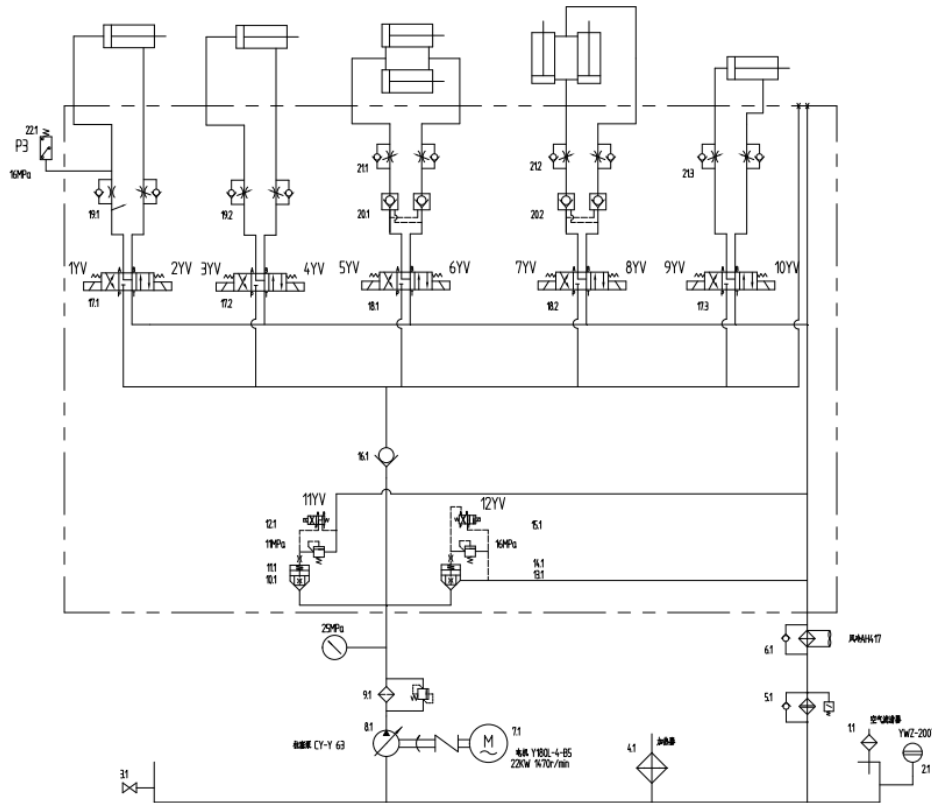
1.1-- air filter 2.1-- liquid level meter 3.1-- ball valve 4.1-- heater 5.1-- oil filter 6.1-- air cooler 7.1-- motor 8.1-- plunger pump 9.1-- inlet oil filter 10.1-- 11.1-- cover board 11.1-- cover plate 12.1-- solenoid valve 1-- superimposed one-way throttle valve 20.1-- superposition hydraulic control one-way valve 21.1-- superposition one-way throttle valve 22.1-- pressure relay.

Fig. 3. Hydraulic system schematic diagram

4. CONCLUSION

Through the compression treatment of garbage compression station, the environmental problems brought about by domestic waste are greatly improved, and the popularization and use of garbage equipment have promoted the vigorous development of the environmental protection industry in China. After careful analysis of the working characteristics and performance requirements of the horizontal garbage compression station, the control scheme of the hydraulic system is determined according to the design function requirements of the horizontal garbage compression equipment, the working principle of the hydraulic system of the garbage compression station is designed, the main parameters of the hydraulic system are designed and calculated, and the drawing system is drawn. The hydraulic schematic diagram is completed and the selection of hydraulic components is completed.

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