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Research Article

Design and Application of Intelligent Diagnosis System for three Pumping Stations of Stamping Automation

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Abstract: This paper focuses on the maintenance of automotive stamping automation equipment. Through long-term self-study and accumulated experience, we independently developed a process monitoring system based on the three pumping stations of clutch, tension pad and lubrication in the stamping automation production line, which is used for real-time monitoring and diagnosis in the automatic production process without stopping the machine, and for the detection of oil temperature change, high-pressure pipeline leakage and oil return pipe In this paper, the improved case has strong practicability, low development cost, and has been recognized by peers in terms of cost efficiency improvement, which is easy to be popularized.

Keywords: Intelligent diagnosis; HMI process monitoring; Stamping automation; Hydraulic lubrication system

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1 Research on current situation of equipment

Through the investigation and study of the on-site stamping automation equipment, five problems are found.

(1) With the influence of seasonal temperature changes, the oil temperature of pump station also changes. In summer, the high temperature will burn the sealing ring of pipeline, in winter, the temperature is low, the response speed of compressor is delayed, and the operation performance of equipment is unstable all year round.

(2) The oil level inspection can only be roughly observed by observing the glass tube of the connector. Between the maximum value and the minimum value, the default is that the liquid level is normal, and the hidden problems can not be found artificially.

(3) The welding seam of high-pressure pipeline cracked in random state, and the hydraulic oil leaked quickly. Only when the leakage reached the minimum liquid level requirement of the program, the system would be shut down automatically, and it was too late when the personnel found out.More than 30 barrels of hydraulic oil are wasted, and the direct economic loss caused by each leakage is more than 60000 yuan[1-2];

(4) The oil return pipeline of slide block is often blocked by foreign matters, which leads to that the lubricating oil can not return to the oil tank normally, and the liquid level of the lubricating pump station is low. If the lubricating oil is added blindly with the liquid level of the oil tank as the reference standard, the oil will overflow directly after it flows back to the oil tank, resulting in cost waste and environmental damage;

(5) Due to the factors of labor cost, it is impossible to arrange personnel to be on duty all the time, and the traditional inspection, spot inspection, maintenance and other methods can not achieve effective monitoring(Figure 1).

Figure 1. FAW Volkswagen Chengdu stamping workshop

2 Make a plan

In view of the five uncontrollable problems found in the survey, we conducted special research and discussion, and finally worked out the following five countermeasures to overcome the above five technical difficulties;

The original temperature control valve of water-cooling analog quantity on the pump station is improved to digital water-cooling on-off valve. The cooling program is written with S7400 PLC. When the oil temperature is higher than 45℃, the first cooling valve is opened; when the oil temperature is higher than 50℃, the second cooling valve is opened; when the oil temperature is lower than 45℃, the second cooling valve is closed; when the oil temperature is lower than 40℃, the first cooling valve is closed; When the temperature is lower than 35℃, the heating function will be started automatically. Thus, the temperature is fixed at the optimal temperature of 40℃ - 45 ℃.

Liquid level inspection improves the traditional physical inspection method to HMI digital quantity and histogram display. Based on the visual diagnosis interface of "three major pump stations monitoring system" independently developed by windows, the liquid level height of dirty cavity, clean cavity and heat conduction cavity of pump station is displayed in real time by histogram respectively. The normal liquid level is green, the alarm liquid level is yellow and the shut-off liquid level is red; The current liquid level value is displayed on the top of the histogram in real time, and the data acquisition update cycle is 500ms[3];

Through the real-time monitoring and acquisition of the liquid level value, it can be realized in S7400 In the PLC program, the preset liquid level standard value is used to follow and compare with the current liquid level value in real time. Once the following error is detected to exceed the allowable range, the system will consider it as an abnormal state and immediately require the equipment to shut down after circulating shutdown. The HMI diagnosis interface will display the word leakage and highlight to remind the maintenance personnel to check and confirm in time;

By using the powerful data management function of SQL Server database, the monitoring system of three major pumping stations archives the collected data in real time, and tries to call, read and check the stored data through the trend, so as to easily check whether the oil return in the pipeline is normal and whether there is oil return blockage without shutdown.

Maintenance personnel can browse the process status data of a certain day, week, month and year by moving the mouse in the center console regularly without being on duty, so as to provide reliable reference data for equipment maintenance.

3 System function

3.1 After opening the software, it will automatically enter the radar scanning interface of the system.

It is divided into four parts: the first section: the system login window displays the current login user name, developer information, system time and FAW Volkswagen logo. The second section: Corresponding to the control unit function button, the safety control unit is used to divide the area, whole line area, destacking area and press area. The third section: The middle radar area is the main window area, displaying the corresponding function window. At the bottom of the window is the functional unit, which is divided according to the functional areas. The menu and submenu functions are developed for each functional area. Click the corresponding functional module with the left mouse button, and the main window will immediately switch to the diagnosis display of this area(Figure 2).

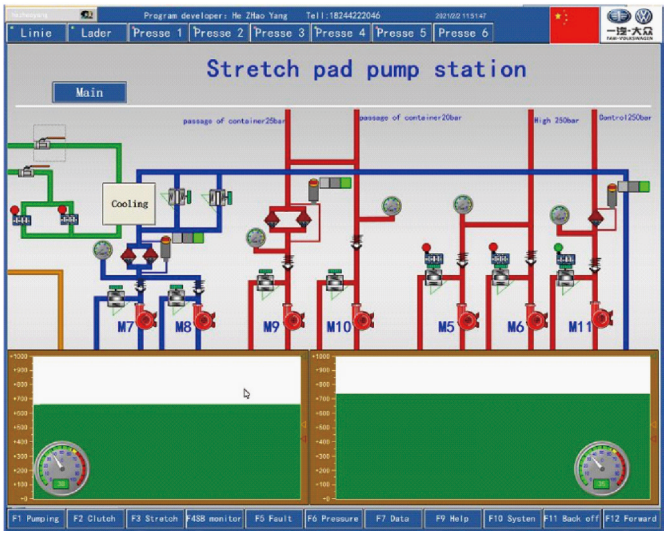

Figure 2. Remote oil system monitoring

3.2 Click the user button in the upper left corner of the main window with the left mouse button to open the login interface

For the sake of operation safety, in order to use the intelligent diagnosis system of stamping automation, it is necessary to apply to the maintenance management department for login permission in writing, and obtain the personal user name and password before login. After successful login, you can operate the corresponding functions of the software. Otherwise, when you click the function button, the system will automatically prompt you that you have no right to access. It is forbidden to do any page switching check on the system.

3.3 Click the F1 pump station button at the bottom of the window / directly press the shortcut key F1 - > to pop up the menu lubrication pump station, clutch pump station and stretching pad pump station.

Each submenu is followed by a > symbol, which means that there is a next level submenu in the current menu, including motor / pump top, oil circuit control and temperature and liquid level submenu. Put the mouse over the corresponding menu to highlight it. After clicking, the active window will automatically activate Live menu information. If the pop-up dialog box shows that there is no corresponding permission, it indicates that the current login permission assignment is low, and the higher permission option cannot be opened. (in order to ensure the security and prevent the data from being changed by mistake, some buttons need expert permission to enter. You can apply for account authorization in writing.)

3.4 Click F1 pump station - > select oil temperature and oil level in the pop-up menu, and the following activity information will be automatically displayed in the activity window, respectively displaying the real-time value of oil temperature and oil level of clutch dirty cavity and clean cavity, the real-time value of oil temperature and oil level of stretching pad dirty cavity and clean cavity, the real-time value of oil temperature and oil level of lubrication station dirty cavity, clean cavity and heat conduction cavity, the state of each cooling valve group, and the temperature heating state of each pump station.

Alarm status information lamp. The green display is normal, the Yellow display is warning, and the red display is alarm off. The process data of each control area is connected through the oil temperature / level curve below to view the historical data in real time. The data value can be recorded every 500 ms, and any data storage time can be set according to the needs. The 200GB hard disk can store data for 10 years.

3.5 Oil temperature, liquid level and heating curve

Click this button to open the temperature and oil temperature recording curve. Through the curve, we can analyze and judge the blockage of oil return pipeline, pipeline leakage, oil channeling, use verification of analog temperature control valve after repair, cooling effect analysis of IO temperature control valve, etc(Figure 3).

Figure 3. Global monitoring of three pumping stations

4 Fault diagnosis

Click the "oil temperature and oil level curve" button, the process data will be displayed in the active window, and the name of the current data recording area will be displayed in the title bar of the window. Select the corresponding recording curve, corresponding recording time and window range value according to your needs, and click OK to display the analysis in the historical record data window[4-5]. White dirty cavity temperature, red clean cavity temperature, green clean cavity liquid level and blue dirty cavity liquid level can be quickly diagnosed by dragging the window scroll bar or clicking the record operation button in the toolbar. Such as pipeline leakage, blockage, the flow between pumping stations and other hidden equipment failure(Figure 4).

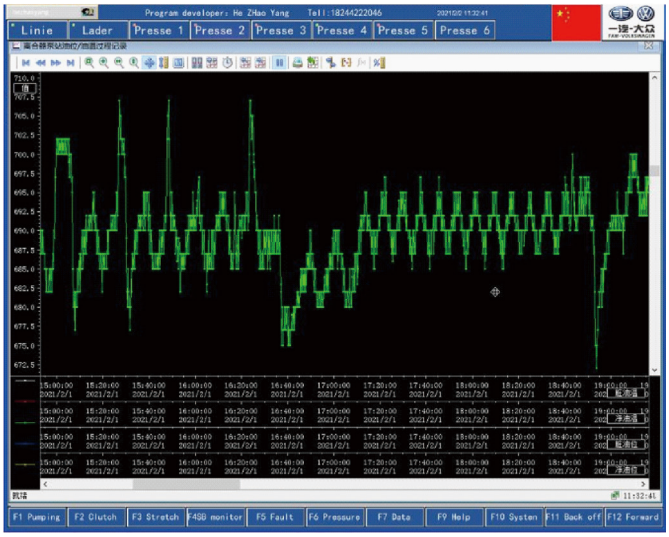

Figure 4. Equipment history process diagnosis

5 Summary

Before the system: It is not accurate for maintenance personnel to inspect the glass tube of the connector to check the liquid level, and it can not effectively control such problems in time. After the development of the system, four hidden problems were diagnosed in just three months. (1)The oil return pipeline is blocked (cloth, cotton and hemp, raw tape, etc.) 3 times; (2) It is diagnosed that the leakage of the seal causes the oil migration between the lubrication pump station and the clutch pump station;(3) It is diagnosed that the cooling system of the pump station is unstable; Improved to digital cooling solenoid valve; (4) It is diagnosed that the oil temperature is abnormally low due to the stuck core of the cooling valve; After the system was developed, it was recognized by departments and workshops. It was awarded the first prize of company level Youth Innovation and creative project, the second prize of energy conservation and emission reduction, the first prize of efficiency improvement, the talent of improvement and the key person. It also applied for the national software copyright registration certificate of the people's Republic of China;

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