

Development of a mobile oil well dosing control system

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Abstract: In this paper, the whole process of developing an oil well automatic dosing control system is described in detail through three aspects, such as the MGCS touch screen of the upper computer, the programmable controller (PLC) of the lower computer and the remote storage of wireless data. The system adopts "one-key" automatic operation, simple and fast. The precise control of dosage is achieved by measuring the flow meter. The wireless communication module with GPS function realizes the tracking and positioning of the dosing vehicle and the scientific management field operation. The establishment of the dosing database provides reliable data basis for the future development of big data analysis and dosing scheme. The development of this system will be further strengthened the deep integration of the automation technology and various professional field of oil field, and play a good leading role.

1. Introduction

In the process of crude oil extraction, various chemical agents were added to the oil well to implement anticorrosion, anti scale, corrosion inhibition, paraffin control, viscosity reduction function. Manual dosing has such defects as complex operation, high labor intensity. Influence of weather and human factors make it difficult to achieve the ideal effect. With the promotion of oilfield digital construction and radio communication, the manual dosing will be gradually replaced by automatic dosing control system. [1~4]

2. System introduction

Dosing box, control cabinet, dosing pump and solenoid valve are installed in the container of dosing car, which is supplied power by diesel generator. Dosing car can realize one key operation for any oil well. Meanwhile the data is transmitted to the server. The B/S architecture makes it possible to browse and query dosing data on any computer by local area networks. [5]

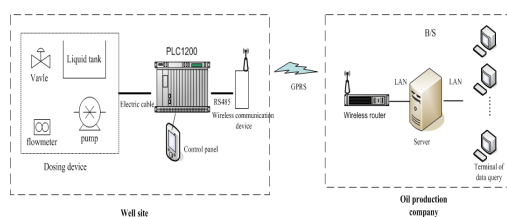


Figure 1 system structure diagram



3. System design

3.1 Upper computer design

MGCS touch screen of Kunlun Tong Tai has the advantages of convenient operation and powerful communication serial port. MGCS touch screen and PLC's real time communication and monitoring can be realized based on Ethernet communication mode, which have the merits of simplicity and stability.^[6]

3.1.1 Main interface of touch screen

The main interface consists of two parts. The left part shows control process and relevant parameters. Liquid level and weight in three dosing boxes, six valves and one pump's switching conditions (on is green; off is gray) and the rest liquid are displayed. The right part shows well name, dosage, type and six control buttons. Injection and supplemental injection of three dosing boxes is controlled by the six buttons.

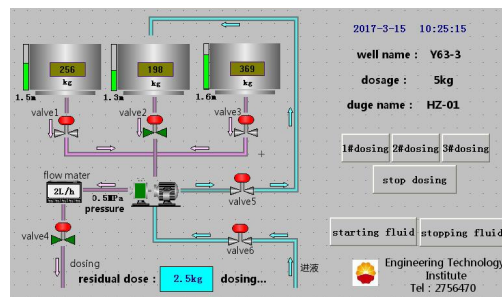


Figure2 Touch screen main interface

3.1.2 Setting interface of dosing parameters

First, the well name no more than 8 characters is transmitted to the lower computer as ASCII before dosing. The dosage and type no more than 5 characters are transmitted to the lower computer as ASCII. If the well name is less than 8 characters, the zero character should be deleted to avoid the storage by well name.

Figure3 Dosing parameter setting interface

3.2 Lower computer design

Compact modularized PLC (SIMATIC S7-1200) is used in lower computer. It can be easily designed and implemented for automatic system that needs network communication function, single and multi screen HMI.^[7]

3.2.1 Dosing control process

After receiving dosing instruction, DO is set and dosing valve is open. Turn on the pump when the valve is opened completely, and read the value of flow meter at the same time. The amount of residual dose is equal to dose flow reduced by dose added. Stop the pump and close the valve when the residual dose is zero.

3.2.2 Replenishing liquid control process

When the dosage is not enough, fluid intake instruction is received by PLC, DO is set, inlet valve is open and the pump is started until the dosing box is filled.

3.2.3 Stop control

In the process of dosing and fluid intake, it can be ended by manual intervention. Current operation is terminated when the stop button is pressed.

3.2.4 Liquid level control process of dosing box

The liquid level of dosing box is monitored in real time. When the liquid level is below lower limit or higher than upper limit, the pump is stopped and the valve is closed.

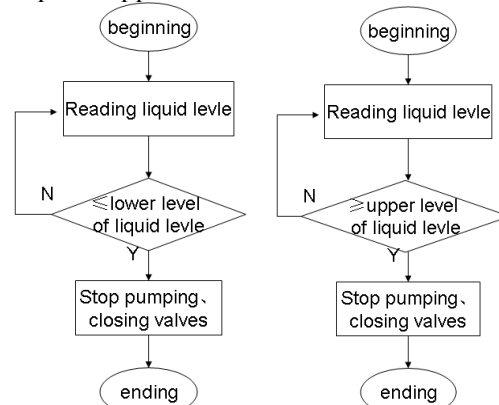


Figure4 Flow chart of dosing control

3.3 Telecommunications and data storage design

The dosing device is equipped with LANDI DTU wireless communication module. This module possesses GPS positioning function, it can transfer the data(including well name, dosage, type of chemicals, liquid level, export pressure, GPS location information) to sqlserver database wirelessly.

3.3.1 Wireless communication module configuration

Parameters about remote server IP address, server port number, APN access point, SIM card number is written to the memory. Then it linked with PLC through RS485 interface. ^[8]

Modbus communication protocol is used during the PLC program design process. Mutual transformation is ongoing between modbus and TCP/IP in wireless communication equipment. Then it will be transferred to oil field network.

Figure5 Wireless communication module configuration diagram

3.3.2 Data storage

Dosing data acquisition software is installed on server. Data protocol based on TCP/IP is to be changed to modbus data protocol. Dosing data real-time collection is achieved through analyzing modbus protocol. Sqlserver data base is needed. Frequency of acquisition is once 10 seconds.

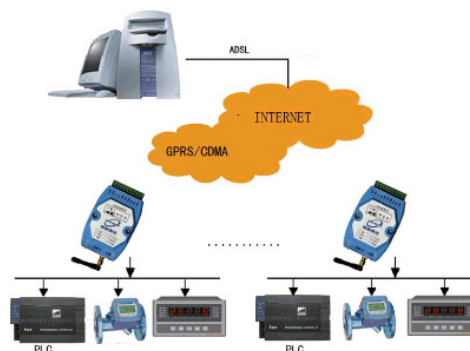


Figure 6 wireless transmission diagram

On-site testing shows that wireless communication can work at $-40\sim 80^{\circ}\text{C}$ and it has good stability on data transmission and storage in the moving state. [9~10]

4. Conclusion

- One key operation of mobile oil well dosing control system is convenient and it reduces the labor intensity greatly. [11]
- The dosage can be controlled precisely metered by flowmeter. [12]
- Wireless communication module with GPS function can realize dosing tracking and locating.
- Dosing data base provide basis for large data analysis and formulating plans.

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