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Simulation Analysis of Closed Hydraulic System Based on Amesim

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Abstract: In the process of coal mining, drilling operation is essential, but in the process of drilling, because of various internal and external conditions, the drilling tool is easily stuck. In order to deal with the problem of drilling, the drilling machine is working normally. This paper, taking the ZDY3200S drill as an example, has designed the analysis of its original hydraulic system. The new closed hydraulic system, which is simulated and analyzed by AMESIM software, is of great significance to deal with the sticking problem and improve the drilling efficiency.

Keywords: Stuck, ZDY3200S drill, AMESIM.

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1. INTRODUCTION

In the process of mining and drilling in coal mine, the drilling operation is needed in many times. Gas drainage is carried out in the borehole, and the phenomenon of spontaneous combustion of coal in the process of underground mining can be avoided. In the process of drilling, because of the formation of formation, poor drilling fluid performance, improper operation and other reasons, the drilling tools cannot be free to move in the well. This phenomenon is called the drill. When the sticking phenomenon occurs, if the drilling machine fails to respond in time, it will easily cause drilling accident and even damage the drill rig. Therefore, timely response to the sticking phenomenon is of great significance for improving production efficiency and protecting drilling rig and drilling tools [1].

The drilling rig is a kind of full hydraulic tunnel drilling machine with low speed and large torque and can drill into large bore holes. The rig provides the necessary drilling equipment for drilling large diameter gas drainage holes and other engineering holes in underground coal mine. At present, the hydraulic control system consisting of manual valve or electromagnetic valve and quantitative (variable) pump is widely used in all hydraulic drilling rig of ZDY3200S type drilling rig. This control system has poor adaptability to different drilling strata, which leads to low drilling efficiency, and also increases the probability of drilling, and has high energy loss [2]. In order to improve the adaptability of drilling rig to different drilling strata to maximize the service life and efficiency of drilling tools, as well as reduce the energy loss rate

to improve the energy utilization rate, it is necessary to achieve high efficiency of drilling rig and upgrade the level of automation.

For the hydraulic control system of the drilling rig, the key technical problem is to make the output characteristic of the system of the hydraulic system match the change characteristic of the external load, which is to realize the adaptive control in the drilling process of the drill. The closed type hydraulic system control technology can solve the problem of output adaptability in the working process of the hydraulic system, which can be effectively solved, so that the adaptive ability of the hydraulic system to the external load is strengthened, and the efficiency of energy utilization is also greatly improved.

2. BRIEF INTRODUCTION OF CLOSED HYDRAULIC SYSTEM

In the closed system, the actuator is generally motor, and the closed system uses a two-way variable hydraulic pump to change the flow and direction of the hydraulic oil in the main oil path through the variable of the pump, so as to achieve the speed and change of the actuator [3]. Heavy duty machinery plants, large tonnage cranes usually use closed system composed of swash plate axial piston variable displacement pumps and quantitative motors. The flow rate of the swash plate variable piston pump is directly proportional to the drive speed and displacement, and it can be steeples variable.

The oil outlet of the variable pump in the closed loop is connected to the inlet of the motor, and the oil outlet of the motor is connected to the inlet of the pump. A closed hydraulic oil path is formed, and the direction of the flow of the pump and the pressure oil are changed by adjusting the angle of the variable pump, thus the speed and the rotation direction of the motor are changed. There is leakage of oil in the closed hydraulic system [4]. In order to make up for the leakage and loss, a small displacement pump is attached to the shaft of the main pump of the closed system.

3. SIMULATION OF CLOSED HYDRAULIC SYSTEM

Based on the Amnesia software, in accordance with the modeling steps, select the appropriate modules in the sketch mode.

The simulation model of the closed hydraulic system, which is connected and selected hydraulic marks, is shown in Fig. 1.

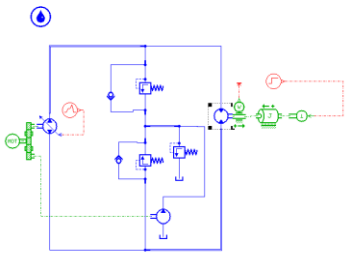

Fig 1. Closed hydraulic system

After the system model is built, we enter the sub model and select the mathematical model for each component. Next, the parameters are set for each sub model in the parameter mode, and the parameters set are shown in Table 1.

Table 1. Basic parameters of the drive system

Motor speed	1500r/min
Variable pump flow	100ml/r
Variable pump speed	1500r/min
Flow of fuel pump	20mi/r
Speed of fuel pump	1500r/min
Overflow valve pressure	200MP
Pressure gradient	20MP
Overflow valve pressure of fuel pump	20L/min/bar
Motor flow	130ml/r
Motor speed	1500r
Maximum load torque	320N.M

The piecewise linear source signal is set as a fixed value of 1, so that the pump discharge is the maximum value. When the step signal is set to 0, there is no load. The simulation time is set to 10s and the sampling period is 0.001s, which can simulate the speed response of the system when it is not loaded. The results are shown as shown in Fig. 2.

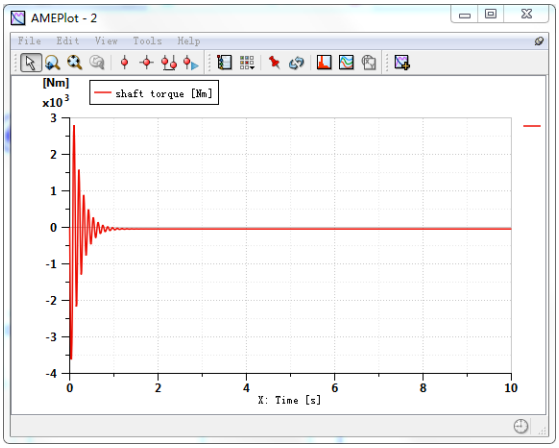

Fig 2. Motor speed change

It can be seen that there is no control system, the speed overshoot is very large and the response is faster. This is in line with the characteristics of the pump control motor system: the hydraulic pump control motor speed regulation system is a two order oscillation system, which is equivalent to the load turning inertia on the motor output shaft and the high pressure oil volume product formed by the hydraulic spring. The spring resonance system has larger bandwidth and faster response. Due to low damping, the overshoot is large.

When the step signal is set to 1s, the step is 320, the simulation time is 2S, and the sampling period is 0.001s.

The signal to torque conversion can get the external disturbance torque of 320N.M, and simulation system can be obtained at this time.

The speed response and torque variation at loading time are shown in Fig. 3 and Fig.4.

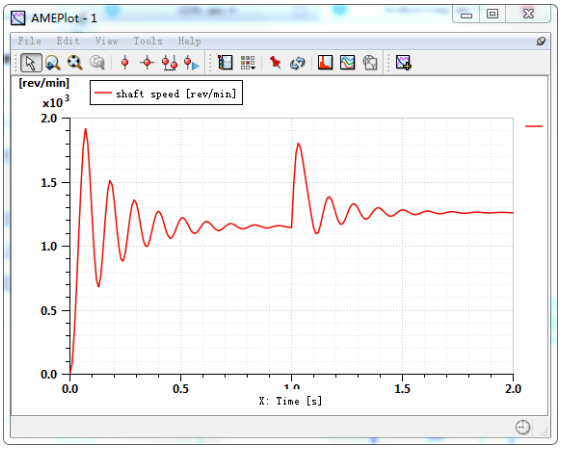

Fig 3. Motor speed change

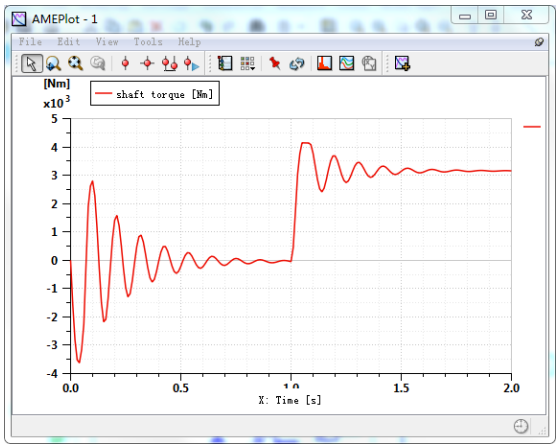

Fig 4. Torque change of motor

It can be seen that the system is greatly influenced by the load, the overshoot of the speed increases, the fluctuation is large, the adjustment time is long, and the most important thing is to decrease the speed of the motor after the load is reached. This is in line with the characteristics of the pump control motor speed control system: there is no integral link in the transmission function of the system, and there is a steady error in the step response of the load interference; that is, the system itself cannot eliminate the interference of the motor load. With the increase of the load, the volume efficiency of the system is reduced and the output speed of the motor is reduced accordingly, resulting in the hydraulic machinery [5]. The change of the hydraulic transmission ratio in the steeples transmission affects the tracking of the speed ratio of the steeples transmission target of the hydraulic machinery, but on the whole, the closed hydraulic control system designed in this paper has a good effect and has a certain applicability.

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