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Research Article

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Research and design of cleaning device for oil tube by high pressure water jet

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ABSTRACT

As we all know, it is difficult to clean oil tube, aiming at this disadvantage, we have developed the cleaning device for oil tube. The cleaning device mainly consists of power washing system, nozzle, the mobile system of drill pipe and cleaning liquid. The structure of rotary high pressure nozzle has been designed, and removal experiments have been done on site. The analysis of experiments shows when the pressure is about 106MPa, the descaling efficiency of the rotary high pressure nozzle is about 95% dirt, so the device has good prospect of application. The cleaning device for oil tube by high pressure water jet has improved the working environment thoroughly, reduced the pollution, improved productivity, and saved energy. It has actualized the synchronous and coordinated development of the expanded reproduction and environmental protection.

Key words: High pressure water jet; cleaning; device; design; experiment

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INTRODUCTION

The traditional methods of cleaning fouling tubing are chemical cleaning, physical cleaning, heating and so on. But these traditional backward equipment cleaning methods, fail to catch requirements of enterprises on the scaling of tubing [1]. And the cleaning efficiency is low, the cleaning effect is not obvious, the pollution of the environment and the high cost of cleaning fouling tubing. Therefore, that traditional method can not meet the thorough cleaning fouling serious tubing requirements [2]. A new cleaning method is imperative.

In view of the traditional method of cleaning fouling tubing cleaning efficiency is low, the cleaning effect is not obvious, the cleaning quality can not be guaranteed and other issues, Enterprises begin to study on the new device scaling pipeline cleaning in the actual cleaning tubing[3]. Scaling tubing cleaning is one of tubing recycling process. Remove oil pipe encrustation, ensure quality of scale oil pipe cleaning, can create the conditions for the subsequent work using oil recovery [4-7].

Through the study of high pressure water jet rock breaking technology, remove the fouling in the tubing using high pressure water jet, which can ensure the normal work of oil and water injection pipeline, stable oil production, can reusing serious old tubing scaling, saving the cost of oilfield development [8-11]. In view of this, the high-pressure water jet technology applied to oil field development in the oil pipe cleaning has the vital significance.

HIGH PRESSURE WATER JET CLEANING DEVICE CHARACTERISTICS

Principle

Principle of automatic high pressure water jet cleaning device is using the nozzle pipe high-pressure plunger pump and specially designed to produce high pressure high speed water jet, bonding material by the impact force of water jet powerful direct peeling, wash pipe inner wall and the outer wall of the oil pipe cleaning.

Cleaning device for cleaning oil pipe includes inner wall and outer wall, the first outer wall of pipe cleaning, cleaning after the tubing wall. Outer wall cleaning tubing precession and the high speed rotary spray gun, in order to

ensure the continuous cleaning, improve the efficiency. When cleaning the inner wall of the oil pipe, fixing the oil pipe clamping, using two-dimensional nozzle rotating cleaning tubing wall and advance and retreat, the key is the two-dimensional nozzle by a long rod gun rotation, into retreat, of high pressure water jet cleaning.

Cleaning device adopts Mechatronics design, using computer control, can screen the mouse operation, system dynamic, real-time data acquisition, and image feedback information requirements. The cleaning device can also be used for online statistics, after cleaning the finished tube is transmitted to the next procedure, after twice cleaning unqualified tubing by waste pipe is transferred to the waste.

Technical parameters

System of high pressure pump rated working pressure of 60 ~ 80MPa, rated flow of pump is 75 L/min, cleaning oil pipe nominal diameter 60 to 75 mm, can clean the tubing length 75000 ~ 98000 mm, the tubing cleaning speed is greater than 26 root/h, the cleaning spray gun speed greater than 450r/rain, gun speed is 0 ~ 25 m/min (adjustable), spray gun back speed is 0 ~ 25 m/min (back) at full speed. The tubing cleaning speed is 0.045 ~ 0.26 m/s, tubing rotating speed is 80 ~ 150r/min.

System composition and characteristics

So developed high pressure water jet hydraulic rock breaker mechanical joint, the composition of the device as shown in figure 1, its composition mainly supplied with high pressure pump of high pressure water jet power, high pressure pipeline with high pressure water jet flow channel, high-pressure jet drilling bit jet for tubing cleaning of high pressure water from now on, rotating mechanism for the rotation of the drill bit rotation, mobile mechanism for the movement of the bit, and accompanying control system, gearbox, connector, water, and so on.

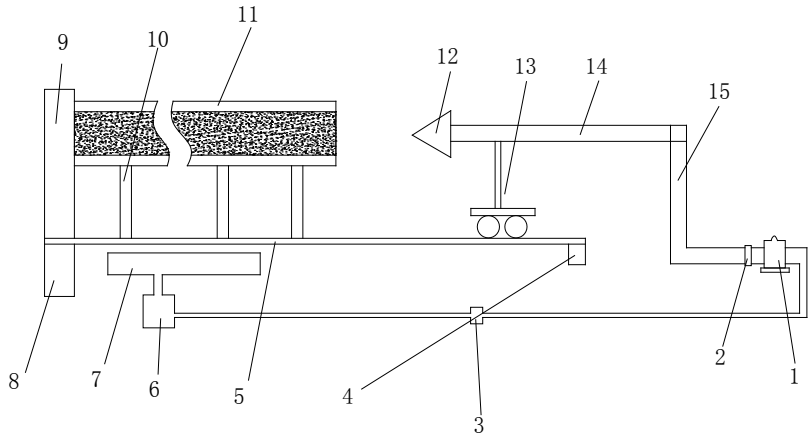

Figure 1 oil duct cleaning device

1. The high-pressure pump；2. The buffer tank；3. Water storage tank；4. Motor；5.Orbit；6.Net pools；
7. Grit chamber; 8. Motor; 9. Gearbox; 10. Brackets; 11.Tube; 12.Nozzle; 13.Block; 14.Catheter; 15.High pressure hose.

THE TUBING CLEANING PROCESS

This experiment tubing cleaning the basic process is shown in figure 2, the main process is shown in figure 1 is the first to establish joint design of high pressure hydraulic machinery cleaning device, namely, to establish cleaning workbench for wash the tubing. After cleaning workbench built, then carry out which tubing need to clean. The first was to classify which scrapped tubing, pick which scrapped tubing, and then to good tubing in the classification, main points and easy to clean the tubing and tubing is not easy to clean. In addition, the need to clean them targeted, for which method cannot clean should also be removed. And then select good tubing for high pressure water jet cleaning mechanical joint. After cleaning going to carry out a cleaning detection for quality of tubing cleaning, if the inspection qualified, to enter the next step of the operation, if you are not qualified you need to redo the tubing, until up to standard. For those qualified tubing need to rust treatment, rust preventing tubing, for later enough preparation in the normal use of the tubing.

THE DESIGN OF THE IMPORTANT PARTS OF THE HIGH-PRESSURE CLEANING DEVICE

The main composition of system

Main equipment of the laboratory application includes the following three parts:

(1) Power system, the experiment of the dynamic system is a high pressure pump, high pressure pump is made in the United States, and its main parameters are: rated pump pressure of 75MPa, flow 75L/min.

(2) The nozzle and the movement of the drill pipe system: this system is composed of a 7.5 kW electromagnetic speed regulating motor as power source, a transmission speed, and then through the reciprocating movement of the

wire rope to drive the car for drill pipe, so as to realize the cleaning of the tubing.
(3)This experiment cleaning fluid: the application of cleaning liquid for clean water, the main source because it convenient, price cheap, easy to operation and so on. In addition, for cleaning sewage processing, prevent the pollution of environment.

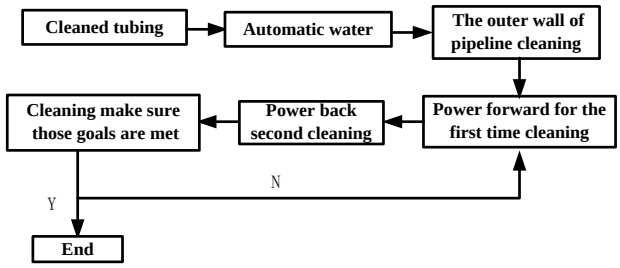

Figure 2 The process chart of cleaning pipe flow

Spin type high pressure nozzle structure
Spin type high pressure nozzle is mainly composed of the nozzle and nozzle body of two parts. Nozzle body is composed of a rotation, sleeve, rotor, circular shells yellow, shell and other parts. Spin type high pressure nozzle structure as shown in figure 3.

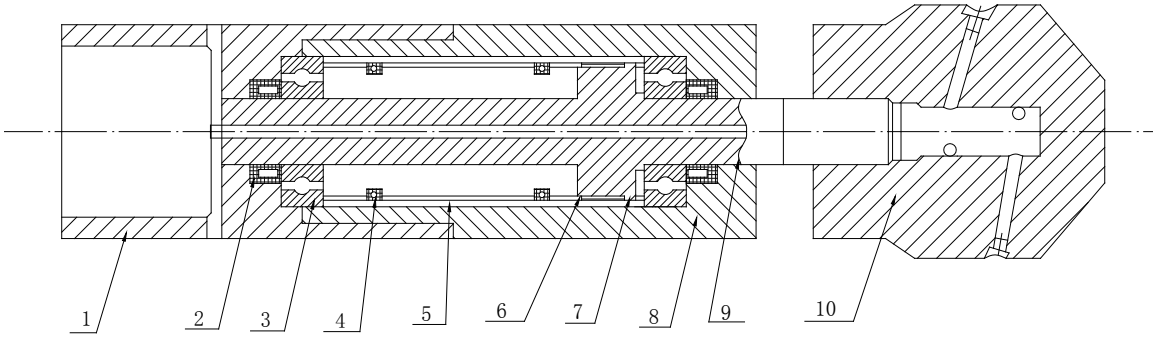

Fig 3 The part drawing of spin type high pressure nozzle
1.Inner nut; 2.Lip seal; 3.Deep groove ball bearings; 4.Ring spring; 5.Rotor;
6.Spiral torsion spring; 7. The sleeve; 8.The nozzle body; 9.The axis of rotation; 10.Nozzle

THE FIELD TEST AND THE ANALYSIS OF THE RESULTS
The analysis of desalting effect
The experimental process
Extracting batch scale tubing, with spin type high pressure spray cleaning fouling at the speed of 10 m/min tubing, and then the scale weight of erosion down ml; In turn with centrifugal pneumatic grinding tubing, said the scale weight m2 smoothed down. According to the formula (1) spin type high-pressure spray descaling efficiency eta. Scale tubing cleaning can be measured by descaling efficiency.

$$\eta = \frac{m_1}{m_1 + m_2} \quad (1)$$

The experimental results and analysis
According to the calculated free type high-pressure spray descaling efficiency, to map the descaling efficiency and spin type high pressure nozzle pressure curve, as shown in figure 4.
As you can see from figure 4, when the spin type high pressure nozzle moving speed is constant, the spin type high pressure nozzle pressure more big, spin type high pressure spray descaling efficiency is high. When the pressure is close to 100 mp spin type high-pressure spray descaling efficiency reached 96%.
Scaling tubing cleaning results

Scale tubing cleaning effect is generally measured by sizing gauge, if can gauge the past to be qualified. Spin type high pressure nozzle water jet cleaning technology after cleaning scale tubing, were observed before and after scaling tubing cleaning effect, oil tube inner surface is clean, there are obvious metallic luster.

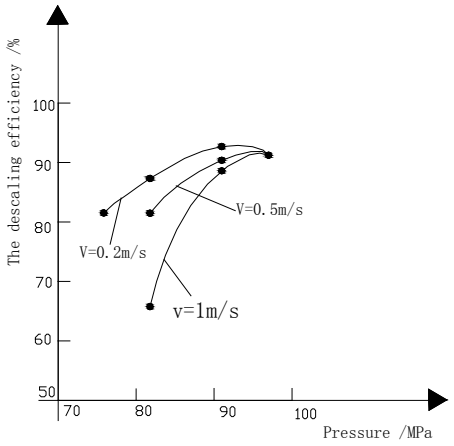

Fig 4 Relation curves of removal rate and pressure

CONCLUSION

Repeated experimental results show the main advantage of the cleaning device for oil tube by high pressure water jet are as follows.

(1)Low cost

The water jet cleaning only needs matching equipment and medium water, the usual cleaning has heat physical cleaning and chemical cleaning, but the heat physical cleaning need heat the cleaning mediums, its consumption is high. Chemical cleaning require deploying corresponding chemical solution, its cost is high. In contrast, high pressure water jet cleaning costs are relatively low.

(2) Wide application range

The adaptive environment of pressurized equipment for high pressure water jet cleaning is relatively wide, and medium water is more easily obtained, the cleaning device can be adapted to many kinds of environment.

(3) Good cleaning effect

The high pressure water jet has scour, wedge splitting, shear, grinding and other composite crushing effect on objects. Adsorption fouling in the tube can be washed down with various effects. And the high pressure water jet cleaning will not need clean the object again.

(4) Small environmental pollution

High pressure water jet cleaning only pressures on water, and makes it impact on the object surface, because the medium is water, the pollution of the environment in the process of work is relatively small. In contrast, chemical cleaning needs the acid-base solution specially configured, it will do harm to the environment.

(5) Large scale promotion

Because of its wide adaptation range and it is easy to realize mechanization and automation, so it can be used on a large scale, and manufactured on a large scale, what′s more it can reduce the cost.

(6) Save cost

In field experiments, cleaning tube using rotary high pressure nozzle has obtained apparent effect, its cleaning quality is high, its cleaning effect is good, and it has saved lots of cost for enterprise.

Acknowledgments

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