Application of solar energy heat utilization in oilfield heating system

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Abstract: This paper introduces the heating measures in the process of crude oil exploitation and transportation, meanwhile, it puts forward several process modes of solar heating technology, and illustrates the system principle and operation process of solar heating transportation of crude oil through actual cases, which opens up a new idea for the application of new energy technology in the petroleum industry and is conducive to the further promotion and application of new energy technology.

1. Introduction
In the development, exploitation and transportation of petroleum industry, it is a very important work to heat the crude oil exported from oil and gas wells, stored in tanks and pipeline. The purpose of heating transportation is to raise the temperature of crude oil, prevent crude oil from condensing in the pipeline, reduce wax deposition and kinetic energy loss. Heating transportation is divided into direct heating transportation and indirect heating transportation. Direct heating transportation is carried out by heating with furnace or mixing with hot liquid and wellhead oil, gas and water; indirect heating transportation is carried out by means of hot water accompanying, steam accompanying or electric meter skin effect.

Heating furnace is usually used to heat crude oil. Heating furnace is a kind of equipment widely used in oil and gas production and transportation. In oil and gas gathering stations, gas gathering stations and combined stations, heating furnaces are used to heat crude oil, well products, production water and natural gas to meet the requirements of oil and gas gathering and transportation process. In the long-distance pipeline of crude oil and natural gas, the heating furnace is also used to heat the crude oil and natural gas to meet the requirements of long-distance transportation of crude oil and natural gas.

2. Solar heating and conveying technology
Heating furnace is the main energy consuming equipment of hot crude oil pipeline. At present, from the perspective of energy saving, we should vigorously carry out the research on new technology and equipment of combustion energy saving, and use solar energy to replace part of the heating energy.

Considering the current crude oil heating and transportation technology and the principle of solar heating, there are two ideas of solar heating crude oil transportation: 1. Solar heating system preheat crude oil; 2. Solar heating system preheat heat medium of heating furnace. Solar heating system can be divided into direct heating and indirect heating. The process flow chart is as follows:
For a certain quality of crude oil, an oil transportation process is only effective in a certain environment. In other words, for different kinds of crude oil and different geographical environment, the transportation process is different.

For a specific working environment, which kind of solar heating process is needed, we must also consider the characteristics of the solar heating system itself, especially the limitations of its own conditions such as temperature, pressure, flow, thermal efficiency and so on.

For example, considering the flow and thermal efficiency and the floor area of the solar system, the solar heating system is generally not suitable for large oil transportation stations and depots. If the
pressure problem is considered, if the existing collector (pressure 0.3MPa) is used, the solar heating system can only choose indirect heating. However, direct heating (when the pressure of the heating medium is higher than 0.3 MPa, it can not be used) and indirect heating may be used for the heating medium of the preheating furnace of the solar heating system.

3. Application of solar heating technology

3.1 Heating and transportation system of crude oil in Liaohe Oilfield

The working principle of the system is described as follows: under normal solar radiation conditions, the circulating pump 14 is opened, and the hot water from the small heat storage tank enters the heat exchanger 12 through the automatic control valves 5 and 3. At this time, the valves 4 and 6 are closed. After heat exchange with crude oil, the hot water entering the heat exchanger enters the heat collector array through automatic control valve 8, and then enters the small heat storage tank through automatic control valve 9 after being heated by the heat collector. Valve 7 is now closed. The hot water exchanges heat with the crude oil in the heat exchanger 12 and heats the crude oil. The heated crude oil enters into the water jacket furnace through the outlet of the oil delivery end, and the water jacket furnace 13 automatically ignites and heats according to the temperature of the crude oil.

When the temperature of the small heat storage tank is high and there is excess heat stored, the circulating pump 15 will automatically open. After the hot water enters the large heat storage tank through the automatic control valve 11 for heat storage, it will return to the small heat storage tank through the automatic control valve 10 and then be sent to the heat exchanger. When the temperature in the collector is too low to raise the water temperature, the hot water will return to the small heat storage tank through the automatic control valve 7 after the heat exchange between the heat exchanger and crude oil. At this time, the automatic control valve 8 will be closed, and the large heat storage tank will supply heat to the small heat storage tank.

When the water temperature at the outlet end 16 of the heat exchanger is close to that at the inlet end 17, the inlet valve 1 will be automatically closed, and the crude oil will directly enter the heating furnace through the valve 2 for heating. At night in winter or when the system is overhauled or stopped, the water in the system is sent back to the hot water tank through the automatic control valves 4 and 6, and then the automatic control valves 5 and 3 are closed.

Figure 5 Flow chart of solar heating crude oil transportation system

3.2 Solar heating crude oil transportation system in Huabei Oilfield

The working principle of the system is as follows: the crude oil enters the solar heating system from the oil transportation port 1, and then uses the solar energy to heat and transport the crude oil. Generally, there are two design methods, namely direct heating and indirect heating.

The direct heating method is that the fluid directly enters into the solar collector and is directly heated. The direct heating of crude oil is the most efficient way in the heating process of crude oil. The principle is shown in Figure 6.
4. Conclusion
China's energy development is facing a very severe situation and challenges, and the energy supply situation is very tense. There is great potential for institutional and technological innovation in China's energy sector. China can achieve sustainable energy supply for a long time in the future. The key is to adhere to the sustainable energy development strategy with strengthening energy conservation and improving energy efficiency as the core.

Therefore, comprehensively Strengthening energy conservation, implementing sustainable development strategy and using solar energy to heat crude oil can open up a new sustainable development road for China's petroleum industry, which is conducive to the sustained, stable and healthy development of China's economy.

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