Research on Underhole Field CMS Based on AI Communication

Xin Liu

1Daqing Oilfield Production Engineering Research Institute, Daqing, Heilongjiang, China, 163453

*Corresponding author e-mail: Liuxin@petrochina.com.cn

Abstract. With the rapid development of computer technology, AI technology is applied to various industries, especially the communication industry. Through AI, communication can automatically identify and screen useful information, which will provide more accurate information decision-making for the system. Oil exploitation is a very dangerous work, which requires real-time monitoring of the working state of the system such as wind, water, gas and so on. Through the comprehensive detection of all kinds of information, mining enterprises can ensure the safety of the oil field, which can also ensure the safety of production. Although China's oil exploration enterprises have many monitoring systems, which can detect a variety of information data. However, there are still many problems in these monitoring systems, such as isolation of each other, inflexibility of sensors, narrow range of data acquisition and so on. At the same time, due to the lack of comprehensive communication platform, the linkage of various production links in the oil well is poor. Therefore, we urgently need a comprehensive monitoring system, which can control the underground field information. Therefore, based on AI communication technology, this paper develops a comprehensive monitoring system.

Keywords: AI, Underground Field, Comprehensive Monitoring System

1. Introduction

At present, oil resource is the most important energy resource in our country, which leads to people's life cannot do without oil. However, in the process of underground oil exploitation, there are many casualties in China, which is far more than other oil countries. With the improvement of economic level, China's requirements for oil exploitation are gradually increasing [1]. Therefore, petroleum enterprises must formulate many measures, which can ensure to avoid the occurrence of dangerous production activities. Therefore, we must develop a comprehensive monitoring system for oil wells, which can reduce the occurrence of existing accidents. Through the comprehensive monitoring system of oil well, we can reduce the occurrence of underhole accidents. With the application of dan6400 system, petroleum enterprises in various countries have better requirements for underground oil production system, which urges petroleum enterprises in various countries to continuously develop mine monitoring system [2]. Through AI communication technology, we can adopt a unified and reliable data
transmission platform, which can integrate all kinds of underground monitoring and control. Through the integrated monitoring system, we can truly realize the comprehensive digitization of oil exploitation, which can ensure the visualization and controllability of the production process [3].

2. Status quo of underhole workover technology

2.1. Fishing technology of underhole hydraulic booster

underhole hydraulic booster is mainly composed of three parts: seat seal hanging tool, hydraulic lifting tool and flushing fishing tool. The fishing string is composed of special lifting and releasing retrievable fishing tools, underhole fishing booster and centralizer. After the tool goes down to the top of the fish, we can lower the tool for fishing. After catching the falling object, lift the string to the allowable working load of the workover rig [4]. Then we can pump pressure from the wellhead and hang the tool seat on the casing, which will continue to increase the wellhead pressure. The piston starts to move upward under the hydraulic force, which will drive the fishing tool to move up and release the falling object. In the process of unfreezing, if we can't unfreeze smoothly, we need to exit the fishing tool, which can pull out the fishing string and fishing tool. There are two characteristics in the fishing technology of underhole hydraulic booster. First, we can generate a pull force of 1200 kn at the top of the fish, which will cause the string above the force amplifier to be free of force during the fishing process. Second, we need to exit fishing tools effectively, which will not cause new underhole accidents. Although the fishing technology of underhole hydraulic booster has been initially implemented, it is aimed at conventional wells with small deviation. Therefore, the underhole hydraulic booster fishing technology can not solve the fishing problem of high angle section and high curvature well, which needs to be further improved [5].

2.2. Continuous sand washing technology

There is a great difference between horizontal well sand flushing and vertical well sand flushing. By analyzing the characteristics of horizontal well plugging removal by sand flushing, continuous sand flushing is a better way for horizontal well plugging removal. At present, there are many ways of horizontal sand flushing. Among them, Shengli Oilfield uses continuous backwashing sand. Sand washing process string is composed of wellhead and underhole. The wellhead is composed of high pressure self sealing, working cylinder and backwash valve. The underhole part is composed of safety valve and cyclone sand washer [6]. The safety valve plays the role of safe pressure relief when the flushing resistance is too high. During the flushing process, the uppermost end of the tubing string is always closed by the backwash valve, the liquid flows through the wellhead self sealing and enters, and the returned liquid is discharged from the self sealing side hole. Among them, the whole process requires continuous operation without stopping the pump, and the swirling sand washer rotates at high speed in the process of sand flushing, which can form a swirling flow in the casing. By stirring the sand in the horizontal section, we can wash the sand thoroughly. In order to prevent the sand washing string from sticking when lifting, we installed an anti sticking joint at the bottom of the middle string. At the same time, chamfered tubing is used in the lower part of the main body of the sand washing string, which can further prevent sticking when lifting the string [7].

2.3. Casing subsidy technology for horizontal wells

The horizontal well has a special wellbore structure, which makes the conventional subsidy technology difficult to complete. The key tool of horizontal well casing subsidy technology is the development and application of multi-stage combined hydraulic cylinder subsidy tool. The key technologies are sand flushing, casing location determination, reaming repair and casing subsidy. At present, the technology of casing subsidy in horizontal wells is not mature, which needs further research and development [8].

3. System overall design
3.1. Design ideas

Through ZigBee wireless sensor network, we can make full use of the flexibility of wireless network, which can take a unified monitoring method to realize the comprehensive monitoring of underground production process [9]. Through the integration of multiple networks, we can achieve a common platform for multiple systems to ensure the scalability of the system. The specific design ideas are as follows: through ZigBee wireless sensor network, we can automatically collect the data of mine production process, equipment and mining environment, which will comprehensively detect the underground field information [10]. The schematic diagram of the whole system is shown in Figure 1.

![Figure 1. Schematic diagram of CMS](image)

3.2. Network topology

The system needs a high-speed, stable network, which will better handle all kinds of security monitoring information. We can achieve fast transmission and processing from the basic level mine to the top management organization, which will provide a safe and reliable transmission channel. Through the transmission channel, we can ensure a safe production supervision, which will make the real-time transmission of monitoring information [11]. Through the normal and orderly information work, we can provide a real and accurate basis for decision-making. The network topology is shown in Figure 2.

![Figure 2. Network topology](image)

3.3. Distributed monitoring system
Some information detection signals are weak, such as micro seismic, which can be monitored by conventional geophone. Therefore, we must carry out distributed monitoring system, which will better carry out monitoring [12]. Through the distributed monitoring system, we can better form the underground field CMS, as shown in Figure 3 [13].

![Distributed monitoring system](image)

**Figure 3.** Distributed monitoring system

### 3.4. Overall structure design of the system

The system consists of working face layer, transmission layer and ground control layer. The structure of the system is shown in Figure 4.

![Overall structure design](image)

**Figure 4.** The overall structure design of the system

### 4. Conclusion

Underhole workover operation is an important part of oil underhole operation, which can ensure the smooth development of underhole operation. At the same time, by improving the workover efficiency, we can increase the economy and efficiency of oil exploitation. Through AI communication technology, we can design the underground field comprehensive detection system, which can better monitor the underground fault. Therefore, we must strengthen the oil well workover operation, which will improve the safety of oil exploitation.

### References

[1] Duan Jianhua. Oil floor water inrush comprehensive monitoring technology and its application [J]. Oil geology and exploration, 2020, 48 (04): 19-28.
[2] Fan Dapeng. Analysis on monitoring system of electric haulage shearer based on multi-sensor [J]. Electromechanical engineering technology, 2019,48 (01): 158-160.

[3] Fu Dongbo, Xu Gang. Application case analysis of CMS for roof and rock burst in Oil mine [J]. Oil science and technology, 2013,41 (S2): 14-16.

[4] Han Xiaobing, Tian Feng. Application of safety monitoring system in digital mine [J]. Oil mine safety, 2009,40 (02): 4-6.

[5] Jiang Lei. Underground gas wireless CMS [J]. China Oilbed methane, 2010,7 (04): 45-47.

[6] Liu Xin. Research and application of underground mine pressure CMS [J]. Contemporary chemical research, 2020 (04): 84-85.

[7] Long Jun. design of Oil mine automation and mine safety CMS [J]. Digital technology and application, 2017 (06): 7-8.

[8] Wang Jianpeng. Oil mine CMS based on wireless sensor network [J]. Shanxi electronic technology, 2012 (03): 20-22.

[9] Wu Kaixing, Duan Mali. CMS of wide angle image correction based on mine robot [J]. Oil exploitation machinery, 2012,33 (05): 230-232.

[10] Yang binwen. Design of Oil mine gas CMS based on GPRS [J]. Science and technology information development and economy, 2011,21 (22): 98-100.

[11] Zhang Lulu, Chen Yijin. Application of skyline based 3D CMS for digital mine [J]. Surveying and mapping information and engineering, 2011,36 (05): 32-34.

[12] Zhao Ziwei, Hu Jingyun, Lin Feng, Peng Fuhua, Li Shulin, Yu Zhengfang. Preliminary application of ground pressure CMS in Dahongshan Iron Mine [J]. Mining technology, 2013,13 (03): 57-60.

[13] Zhu liwang, Yang Liu, Li Gaopeng. Design of mine safety CMS based on ZigBee technology [J]. Journal of Henan University of science and Technology, 2014,42 (06): 51-57.