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The Analysis of Hydrates Frozen Blocking in Fire Flooding Exhaust Gas of Heavy Oil

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Abstract
The No. 56 desulfurization tower pipeline network of Dawn production plant in Liaohe Oilfield is fire flooding exhaust gas collecting pipe. Since put into production, because of the large amount of gas and liquid, fine pipelines and big quantities of bends, the frozen blocking often occurs in winter. The site only adds methanol inhibitors on the basis of production experience, although the frozen blocking phenomenon is eased, it also shows frozen blocking phenomenon in the well interchanges and ups and downs. Now aiming at the problem, based on the percentage of hydrate cross-sectional area, through the establishment of exhaust gas pipe network model and mathematical model, we analyzed how the various factors (temperature, pressure, ground temperature, throughput) influenced the frozen blocking of pipe networks, and the results showed that the cross-sectional area percentage of 37.6% is frozen blocking break points, and the input's effect on the frozen blocking is the largest. The error in this mathematical model between the prediction of frozen blocking position and actual position is within the scope of the permit (5%). So it can guide the production work in the winter, to reduce the loss of oil field, and increase the economic benefit.

Key words: Fire flooding exhaust; Frozen blocking; Mathematical model; Frozen blocking prediction

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INTRODUCTION
The researches of the frozen blocking at home and abroad mainly focus on the study of a single gas formation mechanism in the pure water. But when there are multiple components that can form hydrate gas exist at the same time, the hydrate formation process, structure, stability, will be impact. This part has not been deeply studied at home or abroad, and there's no related article. Fire flooding exhaust components that meet this special case, now through software simulation and mathematical model is established, combining with the existing single gas hydrate formation theory to study the formation mechanism of frozen wall fire flooding exhaust[1-4], provide reference and theoretical basis for follow-up study.

1. THE RESEARCH OF MECHANISM OF EXHAUST GAS RECYCLE PIPE NETWORK IN FIRE FLOODING
Through PVTsim, OLGA software, we simulated the network model, comparing with actual history frozen blocking position, and then combined with the indoor experiment results to summarize the discriminated standards of frozen blocking.

According to the actual network configuration, we collect the data in site and the pipeline property, ups and downs in the pipeline, and use OLGA software to simulate exhaust gas collection pipe network of No. 56 desulfurization tower. The network diagram is shown in Figure 1.

This calculation's network model is based on the actual network, and there is a total of 30 internal nodes, 18 source point and a pressure terminal. In the source point, we set gas temperature, gas flow rate, and fluid types; In the internal nodes, we need to set the fluid types; In the pressure terminal, we set processing temperature and pressure. For pipes of connecting nodes, there are two specifications: 219×3.5 mm, 89×6 mm, and the steel is C20. Pipelines are a total of two layers insulation, and coated with asphalt outside.

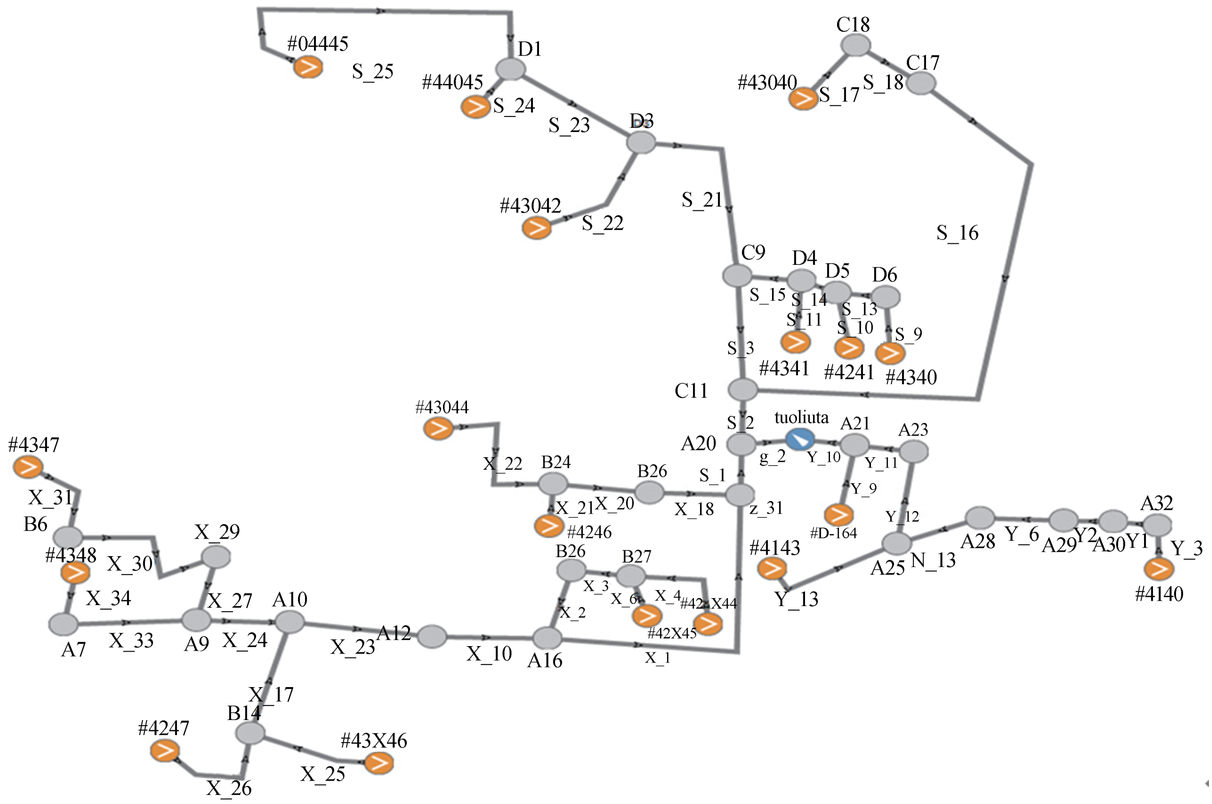

Figure 1
The Exhaust Gas Collection Pipe Network of No. 56 Desulfurization Tower

By simulating and calculating the model of pipe network, and comparing with actual history frozen blocking position, we take percentage of cross section of hydrates, pressure drop, and the liquid holdup as factors of discriminant standard of frozen blocking[5, 6].

2. THE ANALYSIS FOR INFLUENCE FACTORS OF FROZEN BLOCKING

Through the simulation of OLGA software, and the analysis of pipe length, roughness and fluctuation situation, operation condition and the influence of environment temperature on the frozen blocking from the liquid holdup rate curve, it can be concluded according to the calculation results:

(a) The longer the pipeline, the more hydrates. The hydrates are a lot of focus in the rear of the pipeline. Therefore, hydrate is not fixed in one place, it will migrate along the pipe as time, and pile up in the rear. Besides, the longer the pipeline, the greater is the temperature drop, and the greater is the hydrate generation as a whole.

(b) Roughness change has no effect on the formation of hydrate.

(c) When the liquid flows upward in vertical section, due to the effect of gravity, it appears back flow phenomenon. At the same time, the gas has a buoyancy effect, presenting the trend of accelerated upward movement, which caused the increase of slip ratio. And it means that more liquid lags behind the gas, the ability of liquid holdup drops then, but the gravity plays a leading role, so at the bottom of the pipe bend, there's much effusion, making hydrate content and the liquid rate increase.

(d) When the liquid flows downward in vertical section, due to the effect of gravity，the liquid flowing along the flow direction has a tendency to accelerate, and the gas, due to the effect of buoyancy, has the trend of accelerating upward along the pipeline, thus it causes the slip ratio to decrease, and means that the capacity of liquid holdup is enhanced. Although the decline of gas flow rate has weakened the interaction force, the effect of gravity on liquid is much larger, so it is not easy to form effusion at the bottom of the pipe in vertical downward section, and hydrate generation and the liquid rate have no obvious change.

(e) The larger the flow rate, the less the hydrate content is. Under definite differential pressure, and gradually decreasing pressure, the smaller the pressure, the less hydrate generation is. The lower the environmental temperature is, the less content of hydrate formation is.

3. ESTABLISH THE DISCRIMINANT STANDARD OF FROZEN BLOCKING

After the simulation of No. 56 station, the standard of frozen blocking should be established. In order to establish better standards, we design an indoor frozen blocking experiment, and compare with OLGA software calculation results, obtaining related results of pressure and torque which are shown as Figure 2.

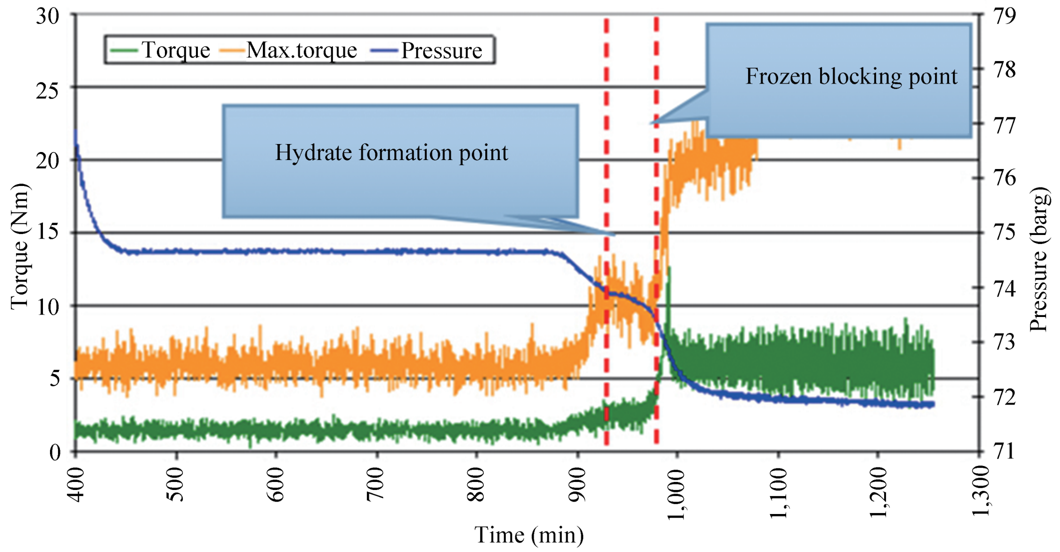

Figure 2
Frozen Blocking Experiment of Hydrates

This diagram describes the changing rules of related parameters in the processing of indoor frozen blocking experiments. Pressure happens two obvious fluctuations: after about 900 minutes, the hydrates gradually began to form, and pressure decreased, but it isn't very obvious; after about 980 minutes, the pressure drops sharply, from 73.8 bar to 71.8 bar. At the same time, it can be seen from the torque value change: the torque value also exists before the hydrate formation, and the torque value is smooth, basically no fluctuations. When the hydrate forms after about 900 minutes, the torque and the pressure have the certain fluctuation. When it forms frozen blocking after 980 minutes, the torque value also has a sharp rise[7-9].

Combining the experimental results with Figures 3 & 4, and then we summarized:

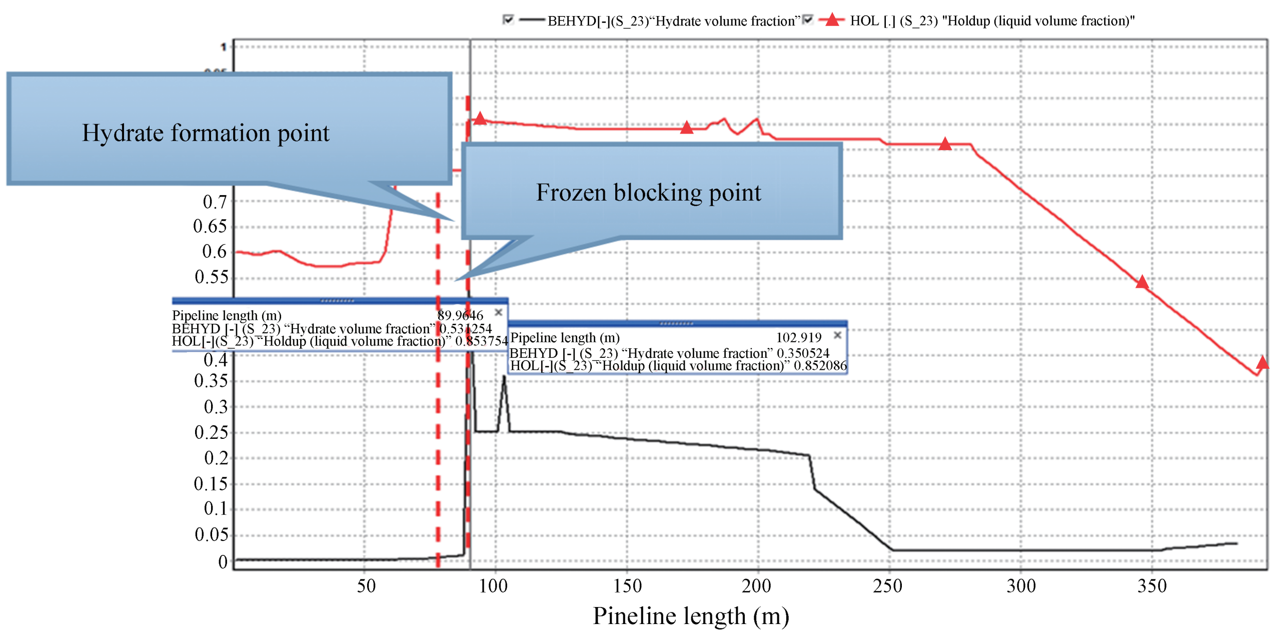

Figure 3
Operation Parameters Figure of S23

S23 began to form hydrate at 10 m, and the initial growth is slow, at 50 m, it began to rise sharply. While in the 90 m, it reached the maximum. The pressure in the process has also been changed twice, in the early stage of hydrate formation, the pressure began to reduce slowly, when hydrate percentage in section reaches the maximum, the pressure will meet well with the experimental results.

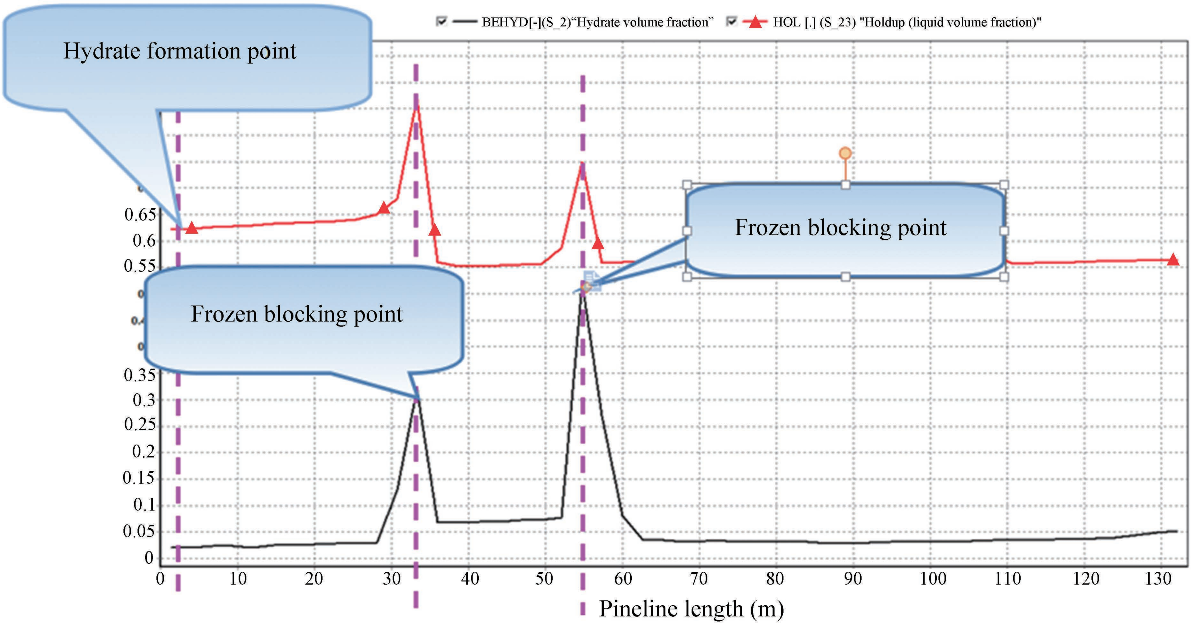

Figure 4
Operation Parameters Figure of S3

The S2 began to form hydrate at 3 m, the initial growth is slow, when at 28 m, there is a sharp rise in process after a sharp drop, again in 54 m peak, pressure in the process has also been changed twice, but slower. While in this process, there is a great changing flow rate, ranging from 230 to 150.

Through the summary from S2 and S23, we work out the following frozen blocking standard: According to the figure S23, S2, and the comprehensive analysis, when the cross section percentage reaches 37.6%, the network running status is affected seriously, so the cross section percentage of 37.6% would be a frozen blocking break point, when the percentage of cross section is greater than 37.6, it can be thought the formation of frozen blocking, otherwise, we think it is not the formation of frozen blocking[7-9].

CONCLUSION

(a) By analyzing the practical section, we are clear about the judge standard of frozen blocking. When the cross section percentage reaches 37.6%, the network running status is affected seriously. Otherwise, we think the frozen blocking will not form.

(b) Through the analysis of influence factors of frozen blocking, it is concluded that the most influential factors of frozen blocking position are pipe length and flow rate, and the second is water content.

REFERENCES

[1] Zhou, H. Y., Peng, X. T., & Ye, Y. (2000). *Natural gas hydrates*. Beijing, China: Ocean Press.

[2] Li, S. L. (2000). *Natural gas engineering*. Beijing, China: China Petrochemical Press.

[3] Fan, S. S., & Chen, Y. (2001). *The research status and trend of development of natural gas hydrate (NGH)*. Paper presented the Proceedings of the Chinese Academy of Sciences, Beijing, China.

[4] Xu, G. (2005). Natural gas hydrate research present situation and the latest international resource potential assessment. *Natural Gas Industry*, *25*(6), 18-23.

[5] Chen, G. L. (2004). Natural gas mining process of hydrate formation and prevention and control. *The Natural Gas industry*, *24*(8), 89-91.

[6] Hu, Y. F. (2001). Gas hydrate research progress and related new technology. *Natural Gas Industry*, *21*(5), 84-86.

[7] Qiu, K. (2001). Forecast and prevention measures of natural gas hydrate (NGH). *Journal of Chongqing Petroleum College*, *7*(4), 17-18.

[8] Wang, H. (2009). Properties and measures to prevent natural gas hydrate. *Journal of Western Exploration Engineering*, *21*(11), 65-67.

[9] Li, C. J. (2002). Gas hydrate formation conditions predict and prevent technology. *Journal of Pipeline Technology and Equipment*, *20*(l), 8-10.