

Discussion on natural gas pipeline "ice blockage"

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Abstract—The reason of "ice block" in the natural pipeline is analyzed in this article. The formation of "Ice blockage" is affected by some reasons that the water in the pipeline, natural gas hydrate and some environmental factors, and the environmental factors includes temperature, geography and pipeline pressure. The harm of ice blockage is correctly understood and the method of preventing ice blockage is worked out by analysis.

Index Terms—Ice blockage, Natural gas hydrate, Pipeline, Natural gas, stress corrosion, Vacuum drying method, desiccant drying method

1 INTRODUCTION

WITH the decreasing of petroleum resource, utilization of natural gas resources has gradually become the focus of attention. Natural gas resources are relatively concentrated, mainly distributed in the six basins and the resource reserves accounted for 62.5% of the national total reserves. "Ice blockage" is more common in pipeline and harm to natural gas pipeline.

2 THE ORIGIN OF NATURAL GAS PIPELINE "ICE BLOCKAGE"

The origin of "ice blockage" is relatively complex, in general it can be divided into two cases: there is lots of water in the pipeline, and the water freezes into ice in low temperature environment; the formation of natural gas hydrate.

The reason for the formation of seep: a. the groundwater is into the pipeline trench. Even if the purge emission meet engineering requirement, the water cannot be discharged from pipeline as many reasons that the existence of local deformation of pipeline in construction process; b. the water is appeared by pressure test of air. For example, sometimes the pressure test is arranged in the rain without the air humidity factor due to the moist in autumn in Xinjiang, and at the same time, the filtering drying facilities is not considered in compressed air equipment and the humid air is into the pipe to cause the moisture condensation.

Hydrate is a white crystal that formed in natural gas fractions and water under certain pressure, temperature conditions and similar in appearance to the dense snow, the density is 0.88-0.9g/cm². The study shows that hydrate is a cage-like crystalline inclusion complex that water molecules form cage crystallization through hydrogen bond. There are two kinds of hydrate structure, hydrate of low molecular weight gases (such as CH₄, C₂H₆, H₂S) are body-centered cubic lattice, the molecules of a gas larger (C₂H₈, C₄H₁₀) is similar to the diamond crystal structure. There are there conditions for forming hydrate:

- 1) Hydrate formation depends on the low temperature and high pressure;
- 2) The existence of a hydrate formation;
- 3) Having the right amount of water, but not necessarily free water.

Moreover, the gas hydrate formation will be accelerated by some conditions such as the high velocity area. The throttle valve is particularly prone to affect the hydrate formation, one is Thomson effect, and the temperature of natural gas will have a large drop when the natural gas passes a throttle valve. The other is that gas passes the valve cavity narrow with high flow rate and the gas agitation. The formation of hydrate will be increased by mixed processing vessel and heat exchanger in pipeline. The position of the second nucleation plays an important role in the formation of hydrate. Good nucleation formation location including defects in pipeline, a joint, pipe joints, residue, forging sharpen, silt and sand. The free water will also accelerate gas hydrate formation though it is not a necessary condition of hydrate formation.

3 THE HARM OF "ICE BLOCKAGE" IN NATURAL GAS PIPELINE

- 1) The harmful stress corrosion was happened in the internal pipeline, because the acid liquid is produced when the natural gas carbon dioxide and hydrogen combined with water in pipeline. Internal corrosion is an important factor affecting the service life of the pipeline system and it is an important cause of pipeline accidents. So the pipeline internal corrosion caused by accidents accounted for a large proportion in gas pipeline accident.
- 2) The remaining water is collected in the low-lying place. Once the water is frozen into ice, it will produce the throttle on the pipeline, or even blocked, affecting import gas balance pipe network, so that part of pipe network paralysis.
- 3) Natural gas hydrate will form embolism in high-pressure pipeline to drop baric gradient and wreck gas supply equipment.

4 RESPONSE TO "ICE BLOCKAGE" METHOD

- a) Identify problem and timely reported to the relevant units in the winter.
- b) If the ice blockage is not serious, chemical agents are

used to inhibit hydrate formation. Ethylene glycol and methanol are brought into the pipeline to inhibit hydrate formation. And also taking measures to reduce the pressure. Hydrate will not form or the forming hydrate will thaw when the pressure is low enough. Decompression is used as a remedy for the melt has formed hydrate. Be sure timely clean the pipe after the completion of assignments to prevent alcohol to corrode the pipeline.

- c) The compressor will be first shutdown when the blocking is serious. The fluid temperature is maintained in the hydrate formation temperature above the average by heating. To reduce heat loss of natural gas pipeline through adiabatic or buried pipeline, generally, using the steam countercurrent double-pipe heat exchanger and the water jacket heater in the throttle before heating natural gas to maintain the temperature. Take the electric heat tracing of ice blockage point of pipeline external heating. Attention to drainage in the use of high temperature steam heating, and the long-term heating until the pressure drop back to normal.

5 PREVENTION AND TREATMENT OF "ICE BLOCKAGE"

The ice block formed by the water pipe. The pipeline dry construction method can be used. There are basically three types, namely: the desiccant drying method, vacuum drying method, the dry-air-drying method. The desiccant drying method is generally used for methanol, ethylene glycol or three glycol as desiccant, desiccant and water can be arbitrary proportion of solubility, and vapor pressure of water formed in the solution is greatly reduced, so as to achieve the purpose of drying. Residues desiccant and hydrate in the pipeline can inhibit the formation of hydrate. Vacuum drying method is that using a vacuum removes free water by reducing pressure under controlled conditions. The principle is that making the water evaporated by creating a vacuum pressure corresponding to the temperature in the tube. At present, dry air drying method is widely used in our country. There are two construction methods in dry air drying method. The first is the direct application of dry air purge on the pipeline, second is to dry out the pipeline pigging method. From the drying efficiency and effect, the latter is better than the former; from the application scope, the latter in diameter pipeline, while the former is applicable to all the pipeline, including a variable diameter pipeline.

For the formed by natural gas hydrate blockage, at present, there is no effective treatment, and trying from the following aspects: first, natural gas dehydration, when the water content of natural gas is lower than a certain range, under the same conditions, the ice blocking phenomenon will be effectively curbed. The city should be required as the gas source supplier to do this work; the second is to heat the gas, using electric heating or fluid with hotline; The third is reduced, but this is usually as a remedy, which is used to melt has formed hydrate; The last is formed by adding chemical agents to inhibit hydrate, which has been mentioned in the above, a com-

monly used is methanol, ethylene glycol.

6 CONCLUSION

With the crude oil resource is reducing, the natural gas resource is gradually replace oil resources status, while natural gas transportation pipeline, prospect considerable, it will make a great contribution to the national energy mix.

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