

RESEARCH ARTICLE

Combating Hydrate Formation in Well Flowlines

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Abstract

The article details methods for the timely detection of ice plugs, which predominantly form on the side of the gas gathering station (GGS) at pipe bends, turns, and valve installations. Early detection of the problem is based on the following indicators:

- Decrease in gas flow rate at the metering station.
- Appearance of an uncharacteristic gas flow sound at the GGS.
- Pressure increases in the well lines.

For accurate localization of the formed blockage, acoustic monitoring, temperature measurement using infrared thermometers (since the temperature is significantly lower at the plug locations), and analysis of the pressure drop rate during a test line blowdown are used.

The authors provide a number of practical measures for eliminating hydrate formations:

- Sudden opening of the valve after a preliminary pressure build-up to mechanically shift and destroy the plug.
- Local heating of the problem area using a heat gun.
- Flowline blowdown (direct and reverse) to create a destructive pressure differential before and after the plug. At the same time, it is noted that these methods can provoke a dangerous water hammer.
- Two-way gas bleeding followed by thawing, which is highlighted as the safest but most time-consuming method.

A special emphasis is placed on the need for strict compliance with all health, safety, and environmental (HSE) rules and regulations when carrying out the work.

KEY WORDS

Hydrate formation, icing, well flowlines, wells, gas gathering station, GGS, blockage, ice plug, pressure differential, flowline blowdown, reverse blowdown, heating, water hammer, safety regulations.

INTRODUCTION

Ensuring stable natural gas production and transportation during the autumn-winter period is inextricably linked to the need to minimize risks caused by changes in the thermobaric operating regimes of wells. One of the most serious challenges for gas fields is the formation of technogenic hydrates in flowlines (shale-collectors). The process of hydrate formation involves the filling of the internal cross-section of pipelines with ice-like structures, leading to significant narrowing or complete blockage of gas flow through intra-field collectors. Such blockages can trigger severe emergency consequences, including well loading (self-killing) and mechanical pipe ruptures. In this regard, the priority tasks for the personnel of the Hydrocarbon Production Unit (HPU) are the timely detection, prevention, and rapid elimination of these "ice plugs." An effective struggle against hydrate formation requires a comprehensive approach that combines continuous monitoring of technological parameters, the use of modern

remote diagnostic tools, and the application of field-proven thermal and mechanical intervention methods. This article examines the primary indicators of hydrate blockages, methods for their precise localization at field facilities, and provides a comparative analysis of effective mitigation measures.

LITERATURE ANALYSIS AND METHODS

During the autumn-winter period, well flowlines are susceptible to icing (hydrate formation) under specific combinations of pressure and temperature. During this process, the internal sections of the pipes are filled with "ice," resulting in narrowing and sometimes complete obstruction of gas movement through the intra-field collector. This leads to emergency consequences such as ruptures of field collectors, well loading, and other failures.



Fig 1. Hydrates extracted from flowlines.

In our case, hydrates most often form at flowline bends, turns, elbows, elevations, and depressions, as well as at the locations of valves, check valves, and other fittings. Blockages primarily form in the flowlines on the side of the Gas Gathering Point (GGP), and less frequently on the wellhead side.

To prevent emergency situations and ensure the uninterrupted functioning of the HPU, it is vital to detect, prevent, or eliminate "plugs" in well flowlines ON TIME.

Methods for identifying pipeline blockages include:

1. Reduction of gas flow at the commercial metering unit: Systematic monitoring of facility parameters and regimes, gas flow rates, inlet/outlet pressures, etc.
2. Acoustic noise of gas passage at the GGP: The appearance of a distinct sound indicates that the internal pipe section has decreased, and pressure has increased. Under normal operating conditions, there should be no clearly

audible sound.

3. Pressure rise in one or more well lines: It is important to remember that pressure gauges can also freeze during the

autumn-winter period and display incorrect values. It is recommended to systematically blow down manifolds and bleed gauges to "0."

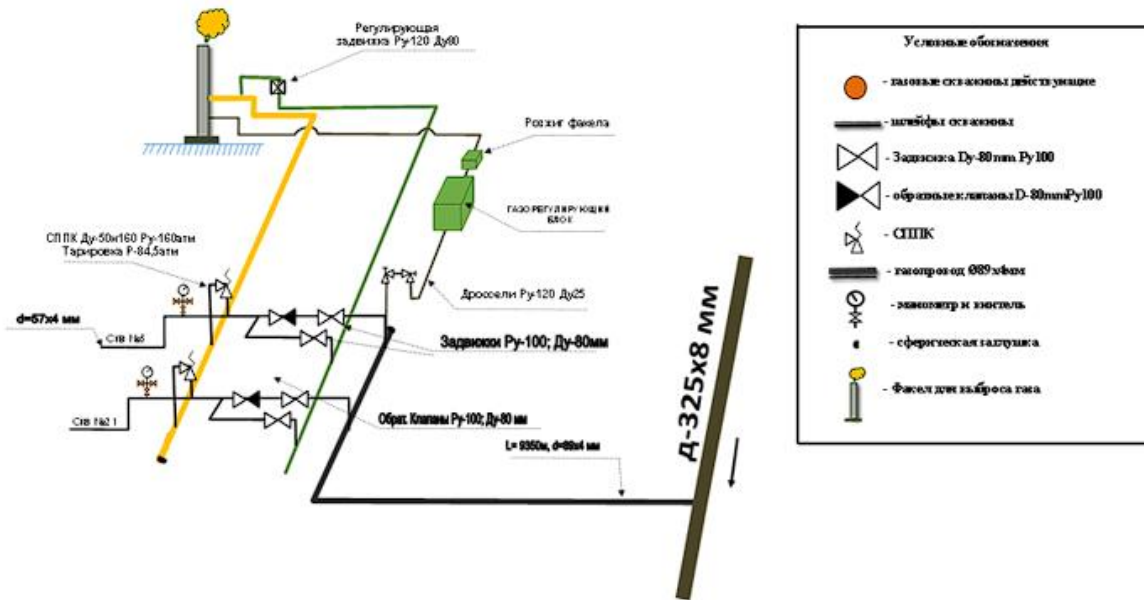


Fig 2. Schematic diagram of a Gas Gathering Point (GGP).

Identifying the exact location of the blockage can be achieved via:

1. Sound: Identifying where the acoustic noise is strongest.
2. Temperature: Temperatures are significantly lower at the site of the blockage (for above-ground sections).

Measurements are taken using infrared thermometers (Fig 3).

3. Line blowdown: If the pressure on the gauge drops instantaneously upon venting, it indicates the plug is nearby. The distance to the plug is determined by the rate of pressure drop.



Fig 3. Infrared thermometer.

Upon discovering a flowline blockage, the following measures are taken:

1. Surging: The valve at the GGP (Fig 2) located after

the check valve leading into the collector is closed. Pressure is built up upstream of the valve, followed by a rapid opening. If the "sticking" is not severe, this can displace and break up the

plug, restoring gas flow.

2. Thermal treatment: Heating identified blockage points using a heat gun (Fig 4). Thermal impact helps soften and destroy the formed plug.

3. Forward blowdown: Reducing pressure downstream of the plug by opening a valve leading to the GGP flare line. The plug may break apart due to the pressure differential created across it.

4. Reverse blowdown: Bleeding pressure in the flowline directly from the well's flare line side. The plug may break

apart due to the pressure differential created from the opposite direction.

o Note: It is important to understand that methods 3 and 4 can trigger a water hammer, which may damage flowlines at bends or turns.

5. Two-sided bleeding followed by thawing: This is the safest method. Its disadvantages include significant time consumption—the plug may not disintegrate for an indefinite period—and substantial production losses.



Fig 4. Heating a blockage site with a heat gun.

CONCLUSION

The struggle against hydrate formation in field flowlines is a critical task during the autumn-winter period; the uninterrupted operation of the gas production complex and the prevention of accidents depend on its rapid resolution. Timely identification of ice plugs requires a systematic approach and constant control of well operating parameters, including flow rate monitoring, pressure dynamics tracking, and the use of acoustic and infrared diagnostic methods. To eliminate existing blockages, several methods are applied in practice, ranging from creating a destructive pressure differential (various types of blowdowns) to local thermal impact. The choice of a specific elimination method must be

based on a rigorous risk assessment. Forced pressure release methods can provoke dangerous water hammers and damage collectors, while the safest method—two-sided bleeding followed by thawing—involves high time costs and significant production losses. Thus, the successful removal of hydrate plugs is only possible through competent situational assessment by personnel, a combination of available elimination methods, and, most importantly, strict adherence to all safety, fire protection, and environmental regulations (HSE).

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