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# DETERMINATION of THE LEVEL of FLUID DESCENT in THE WELL in THE FORMATION HIDRAVLYKI AUTOPSY

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## Abstract

It is known that when performing technological operations in the well, hydrodynamic pressure is created. As a result of the increase in hydrodynamic pressure, macro–micro cracks may form in the layer in the zone around the well. As a result of macro–micro cracks, a hydraulic fracturing event may occur in the well at a certain critical value of hydrodynamic pressure in the well–being System. As a result, the technological process carried out in the well is maintained and urgent measures are taken to eliminate complexities. In the presented article, the level of fluid descent in the well during hydro allocation is determined.

***Keywords:*** *Oil and gas wells, drill pipes, static gravity.*

## INTRODUCTION

At the moment of hydraulic fracturing, the fluid level in the well drops by h, while there are changes in the GIV-2 weight indicator (deviation of the arrow in a larger direction, i.e. the weight of the pipes increases).

This phenomenon formed the basis for the method of determining the magnitude of the decrease in fluid level in the well.

Various technological operations are carried out in drilling oil and gas wells. Among them are the lowering of drill pipes into the well, flushing the well bottom, expansion of the well walls, etc. It is known that when performing technological operations in the well, hydrodynamic pressure is created. As a result of the increase in hydrodynamic pressure, macro–micro cracks may form in the layer in the zone around the well. As a result of macro–micro cracks, a hydraulic fracturing event may occur in the well at a certain critical value of hydrodynamic pressure in the well–being System. As a result, the technological process carried out in the well is maintained and urgent measures are taken to eliminate complexities. Suppose that in the process of drilling oil and gas wells, an operation is performed to lower drill pipes into the well. In this case, the hydrodynamic pressure of the fluid in the well increases, as a result of which the hydraulic fracturing process occurs in the reservoir. The situation is also sudden, the clay solution in the well will go into the reservoir through cracks in the area around the well, as a result of which the level of fluid in the well will decrease to its length, and the weight of the drill pipes will increase. In this case, an accident will be recorded in the well and the technological process will be stopped. The purpose of the research work performed examines the purpose of determining the level of fluid descent in the well at the moment of the occurrence of an accident. The static weight of the pipes located in the well in the liquid is determined as follows [1]

$$G_s = \frac{1}{K} G_T = qL \frac{1}{K_s}\left(1 - \frac{\gamma}{\gamma_м}\right) \qquad (1)$$

Here K- is the proportionality coefficient (determined by the practical method in the well);

$G_T -$ weight of drill pipes in liquid;

$q -$ weight of one meter of pipes

$L -$ length of pipes;

$\gamma, \gamma_м -$ specific gravity of liquid and metal in accordance with.

Suppose that in the operation of lowering drill pipes into the well, a hydraulic fracturing process occurs at depth (in the zone around the drill ax), as a result of which the weight of the drill pipes suddenly increases. On it

$$G_s' = \frac{1}{K} G_T' = \frac{1}{K} q\left[h + (L - h)\left(1 - \frac{\gamma}{\gamma_м}\right)\right]$$

Here

$G_s' -$ weight of drill pipes at the moment of hydraulic fracturing;

$G_T' -$ the weight of the drill pipes in the fluid (theoretical) in the event of an accident;

$h -$ the level of fluid descent in the well after the accident.

It should be noted that modern drilling equipment allows you to estimate the weight of drill pipes or protective belts located in the well.

If we solve together the formulas (1) and (2) that we have, we get the following.

$$h = \frac{\Delta G K}{q\left(\frac{\gamma}{\gamma_м}\right)}$$

Here

$\Delta G = G_s' - G_s -$ time of the occurrence of an accident.

Let's solve an example of a practical issue.

$$\Delta G = 1T, \quad K_c = 1{,}2$$
$$q = 0{,}036\ T/м, \quad \gamma = 1100\ кг/м^3$$
$$\gamma_м = 7800\ кг/м^3$$

If we put the data in its place in Formula (3), we get that the level of fluid drop as a result of an accident in the well

$$h = 236\, м$$

Thus, in practice, we obtain the calculation formula. By this calculation formula, in the operation of drilling in deep oil and gas wells and lowering protective pipes into the well, if, as a result of an increase in the hydrodynamic pressure of the liquid, a hydro–autopsy event occurs in the well-formation system, then the level of fluid descent can be practically determined. In oil and gas production, understanding the behavior of fluids inside the well is essential for efficient reservoir management. The level of fluid descent in a well directly affects bottom-hole pressure, production rates, and the overall performance of the well. Traditional measurement techniques may not always provide accurate results due to operational limitations. Therefore, formation hydraulic analysis, or hydraulic autopsy, is widely used to evaluate the internal hydraulic processes of the well system. Formation hydraulic autopsy is an analytical method used to study the hydraulic condition of a well by interpreting pressure, flow rate, and fluid properties. It is called an "autopsy" because it examines the well's behavior after certain operational events, such as shut-in periods, pressure drops, or production decline. By analyzing these parameters, engineers can identify the causes of fluid level changes and pressure losses.

**Methodology for Determining Fluid Descent Level**

The determination of the fluid descent level involves several steps:

**Pressure Data Collection** – Bottom-hole and wellhead pressures are measured during production or shut-in conditions.

**Fluid Property Analysis** – Density, viscosity, and compressibility of the produced fluids are evaluated.

**Hydraulic Calculations** – Pressure gradients are calculated along the wellbore to estimate the height of the fluid column.

**Interpretation of Results** – The point at which pressure equilibrium occurs is identified as the fluid level.

This approach allows engineers to determine the depth to which the fluid has descended inside the wellbore with a high degree of accuracy.

**Practical Importance**

Determining the level of fluid descent is important for:
Optimizing artificial lift systems
Preventing formation damage
Improving well productivity
Diagnosing wellbore and reservoir problems

Hydraulic autopsy helps engineers make informed deices by reservoir pressure, fluid properties, well geometry, and production regime. During production, fluids may partially drain from the wellbore, causing a decrease in the fluid column height. This phenomenon is known as fluid descent. Accurate determination of the fluid level is essential for evaluating reservoir energy, diagnosing production problems, and optimizing artificial lift systems. Direct measurement methods are not always feasible due to technical and economic constraints. Therefore, indirect analytical methods, such as formation hydraulic autopsy, are widely used. This method provides a reliable interpretation of well behavior based on pressure and flow data. Determining the level of fluid descent in a well is an important task in oil and gas production engineering. The fluid level inside the wellbore has a direct impact on bottom-hole pressure, inflow performance, and overall well productivity. Formation hydraulic autopsy is an analytical method used to study pressure distribution, fluid movement, and hydraulic losses within the well–reservoir system. This paper presents a detailed discussion of the principles, methods, and engineering significance of determining the fluid descent level in a well using formation hydraulic analysis. In oil and gas production engineering, accurate knowledge of wellbore fluid behavior is essential for efficient reservoir exploitation. The fluid column inside a well creates hydrostatic pressure, which directly affects bottom-hole pressure and inflow from the formation. Any change in the height of this fluid column influences the production regime of the well. As production continues, reservoir pressure gradually decreases due to depletion. When reservoir energy becomes insufficient to sustain a full liquid column, fluid descent occurs. Determining the level of this descent is necessary for evaluating well performance, diagnosing production problems, and selecting appropriate artificial lift systems. Formation hydraulic autopsy provides a reliable and cost-effective approach to this problem. Determining the level of fluid descent in a well using formation hydraulic autopsy is a critical task in modern petroleum engineering. This method provides a detailed understanding of the hydraulic interaction between the wellbore and the reservoir. By accurately identifying the fluid level, engineers can optimize production, reduce operational risks, and enhance recovery efficiency. Formation hydraulic autopsy remains an essential analytical tool for diagnosing and improving well performance throughout the life of an oil or gas field. Accurate hydraulic autopsy of a well requires comprehensive and reliable input data that describe reservoir conditions, wellbore geometry, fluid properties, and operating parameters. The quality of the results obtained from formation hydraulic analysis strongly depends on the completeness and accuracy of the collected data. The required data can be grouped into several main categories. Hydraulic autopsy requires a multidisciplinary dataset combining reservoir, wellbore, fluid, and operational information. The integration of these data allows engineers to accurately reconstruct pressure profiles, determine the level of fluid descent, and diagnose hydraulic inefficiencies in the well–formation system. Production and flow rate data play a fundamental role in hydraulic autopsy, as they represent the dynamic operating conditions of a well. Unlike static reservoir or wellbore parameters, production data reflect the real-time response of the well–formation system to pressure changes and hydraulic losses. Accurate evaluation of oil, gas, and water flow rates is essential for understanding fluid movement, flow regimes, and pressure distribution within the wellbore.

Variations in production rates directly influence frictional pressure losses, fluid column stability, and gas–liquid interactions. An increase in flow rate may lead to higher pressure losses and accelerated fluid descent, while reduced production can result in partial wellbore loading. Therefore, production and flow rate data provide critical insight into the causes of fluid level changes and overall well performance.

In formation hydraulic autopsy, production data are used to reconstruct hydraulic conditions during different operating stages of the well. Historical trends in flow rates help identify periods of instability, production decline, or abnormal behavior. By integrating production and flow rate data with pressure and fluid property information, engineers can accurately determine the level of fluid descent and diagnose hydraulic inefficiencies within the well.

The interpretation of results is a critical stage of formation hydraulic autopsy, as it transforms calculated and measured data into meaningful engineering conclusions. While pressure profiles, flow rates, and fluid properties provide quantitative information, their correct interpretation determines the accuracy of fluid descent level identification and well performance diagnosis. This stage requires a comprehensive understanding of well hydraulics, reservoir behavior, and production dynamics.

Interpretation focuses on analyzing the relationship between pressure distribution, production rates, and hydraulic losses within the wellbore–formation system. Deviations between calculated and observed parameters often indicate underlying problems such as excessive frictional losses, formation damage, liquid loading, or inefficient artificial lift operation. Proper interpretation allows engineers to distinguish between reservoir-related issues and wellbore-related hydraulic constraints.

In hydraulic autopsy, the results are not evaluated in isolation but are compared with historical production data and known operating conditions. This integrated approach enables the identification of trends, anomalies, and performance degradation over time. Consequently, the interpretation of results provides the basis for informed decision-making, optimization of production strategies, and implementation of corrective measures to improve well efficiency.

Hydraulic calculations form the analytical foundation of formation hydraulic autopsy, as they quantify pressure behavior and fluid movement within the wellbore. These calculations are essential for evaluating hydrostatic pressure, frictional losses, and total pressure gradients acting on the produced fluids. Accurate

hydraulic modeling enables the reconstruction of pressure profiles and the determination of the level of fluid descent in the well.
In producing wells, hydraulic conditions are influenced by flow regime, well geometry, and fluid properties. Single-phase and multiphase flow systems require different calculation approaches, with particular attention to gas expansion and liquid holdup effects. Hydraulic calculations integrate these factors to estimate pressure distribution along the wellbore under actual operating conditions.
Within the framework of hydraulic autopsy, calculated pressure profiles are compared with measured wellhead and bottom-hole pressures. This comparison allows engineers to identify pressure imbalances, diagnose hydraulic inefficiencies, and locate the depth at which the fluid column becomes unstable. Therefore, hydraulic calculations are a critical step in transforming raw field data into reliable engineering conclusions. Pressure data collection is a fundamental step in formation hydraulic autopsy, as pressure measurements provide direct insight into the hydraulic and reservoir conditions of a well. Accurate pressure data are essential for constructing pressure profiles, estimating pressure gradients, and identifying the level of fluid descent within the wellbore. Without reliable pressure measurements, hydraulic calculations and subsequent interpretations may lead to incorrect conclusions.
In well analysis, pressure data are obtained under both flowing and shut-in conditions. Flowing pressure reflects dynamic well behavior, while shut-in pressure provides information about reservoir energy and pressure recovery. The combination of these measurements allows engineers to distinguish between reservoir-driven effects and wellbore-related hydraulic losses.
Pressure data collection must consider measurement depth, timing, and operating conditions. Factors such as transient flow, temperature variations, and tool accuracy can significantly influence recorded values. Therefore, careful planning and validation of pressure data are required to ensure consistency and reliability in hydraulic autopsy studies.

## CONCLUSION

The determination of the level of fluid descent in a well using formation hydraulic analysis is a reliable and effective method. Hydraulic autopsy provides deep insight into the internal hydraulic processes of the well and the interaction between the wellbore and the formation. By applying this method, engineers can improve production efficiency, reduce operational risks, and enhance the overall performance of oil and gas wells.

## REFERENCES

1. A method for determining the value of hydraulic fracturing pressure in a well / Safarov Y. I., Rashidov Kh. Ya., Akhundov F. A., Tagiev A. A. – 01/30/86 Fork. izodr. № 44.
2. Beggs, H. D. (2003). Production Optimization Using Nodal Analysis. Oil & Gas Consultants International, Tulsa, Oklahoma.
3. Brown, K. E. (1984). The Technology of Artificial Lift Methods. Vol. 1–4, PennWell Publishing Company, Tulsa.
4. Economides, M. J., Hill, A. D., Ehlig-Economides, C., & Zhu, D. (2013). Petroleum Production Systems. 2nd Edition, Prentice Hall, Houston.
5. Guo, B., Lyons, W. C., & Ghalambor, A. (2007). Petroleum Production Engineering: A Computer-Assisted Approach. Elsevier Science & Technology Books.
6. Hagedorn, A. R., & Brown, K. E. (1965). "Experimental Study of Pressure Gradients Occurring During Continuous Two-Phase Flow in Small-Diameter Vertical Conduits." Journal of Petroleum Technology,