International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

http://ijpsat.ijsht-journals.org
Vol. 27 No. 2 July 2021, pp.25-28

Research Of Oil Pipelines On Selling The Maximum Hydraulic Impact Pressure In A Two-Component Flow

Zhonkobilov Ulugmurad Umbarovich[1], Zhonkobilov Sobir Ulugmurodovich[2], Razhabov Ulugbek Momoshoevich[3], Zhonkobilov Kuvandik Ulugmurodovich[4]

[1]Doctor of Technical Sciences of Karshi Engineering Economic Institute

[2]Doctoral student of Tashkent Institute of Irrigation and Agricultural Mechanization Engineers

[3]Senior Lecturer of Karshi Engineering Economic Institute

[4]Student of Karshi Engineering Economic Institute

Abstract – The article is devoted to determining the intensity of hydraulic shock in pressure pipelines, taking into account the two-component flow. Based on the processing of the results of experimental studies, a dependence is proposed for calculating the maximum pressure during hydraulic shock. Достоверность полученной взаимосвязи доказана сопоставлением расчетных с опытными данными.

Keywords – Water Hammer, Oil Pressure Line, Water Hammer Intensity, Ball Valve, Cut-Off, Optimal Technological Mode. Optimal Time For Shutting Down The Pipeline.

I. Introduction

The problem of optimal control of the automatic re-heating system of oil pipelines (ball and cork valves, shut-off valves, etc.) is reduced to obtaining reliable information about the intensity of hydraulic shock and does not lose its relevance, since its goal is to reduce product losses as a result of leak – tightness of pressure oil pipelines [1,2,3,4,5].

Modern pressure pipeline systems mostly transport multiphase mixtures. The need to equip such systems with various types of emergency shut-off valves poses a task for researchers related to determining the optimal time of pipeline shut-off in order to reduce the intensity of hydraulic shock, as well as the optimal response time of automatic shut-off systems to prevent false shut-off during changes in technological operating modes [6,7,8,9,10].

The issues related to determining the optimal shut-off time of pipeline systems were considered earlier by us and it was pointed out that it is necessary to conduct experimental and theoretical studies to study the phenomenon of hydraulic shock in gas-liquid flows [2,3].

II. Research Methodology

The most well-known and practically tested in the theory of hydraulic shock for a single-phase flow is the formula of N. E. Zhukovsky and its modifications [2,3]. This formula is also confirmed by the methods of the theory of elasticity of continuous media. However, the complexity and variety of flow forms of a two-phase mixture does not allow using traditional methods to determine the magnitude of the hydraulic shock [2,3,11,12,13]. In this regard, the most acceptable way to establish a quantitative and qualitative picture of the phenomenon of hydraulic shock in two-phase flows is an experiment.

At the experimental installation, studies were carried out to determine the values of hydraulic shock [2,3]. The experiment was carried out with the movement of a water-air mixture, which is given in [2,3]. The speed of sound in the medium was determined as follows: the hydraulic shock was reproduced by blocking the flow by switching on quick-working cut-offs installed at the beginning and end of the pressure pipeline. Pressure sensors with amplifiers were mounted in the pipe: one at the end of the pipeline in front of the cut-off, and the second in the middle of the pipeline for more accurate recording of the impact amplitude on the oscillogram when shock waves are applied.

After the flow is blocked, the compression wave propagates at a certain speed from the cut-off device located at the end of the pipeline, while the sensor registers an increase in pressure. Then the shock wave is perceived by a sensor located in the middle of the pipeline. The sensor consists of two parts: a membrane and an amplifying one. The first perceives pressure fluctuations, the second amplifies them and transmits them to the four-channel ID-2I amplifier, noting the process of hydraulic shock on the oscillogram. Due to the noisiness of the main parameters, it is not possible to identify the general trend, although on the basis of the data obtained, a certain pattern can be noticed; Based on the experiments carried out, a fairly good correlation was established between the parameters P / Pst and Fr (Fig. 1).

At the given values of the flow rate (velocity) of the liquid, the pressure ratio changes linearly depending on the Fr number, and with an increase in its pressure ratio, the pressure ratio decreases. This can be explained by the fact that an increase in the Frcm number at a constant liquid flow rate leads to an increase in the gas content of the flow, which, in turn, causes a decrease in the magnitude of the water hammer.

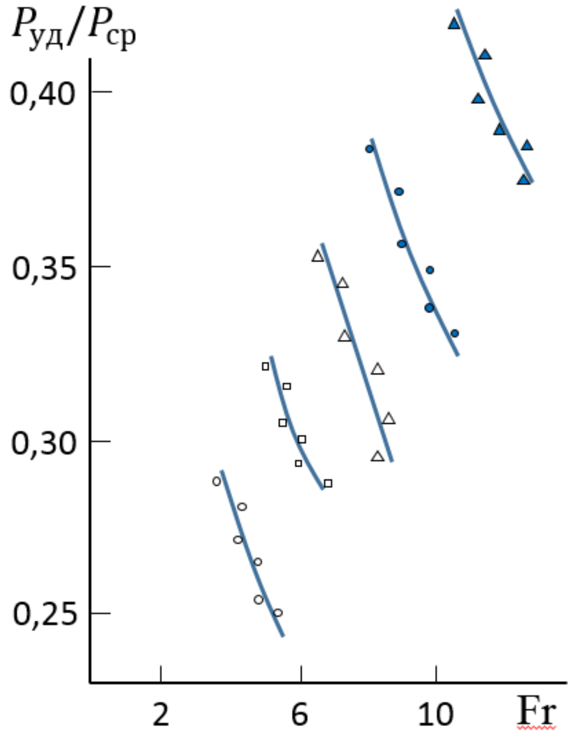

Fig. 1. Dependence of the relative shock pressure on the Fr number at different values of the average fluid velocity ϑ in the pressure pipeline:

○○○ - at ϑ=0,56 м/с; □□□ - at ϑ=0,85м/с; △ △ △ - at ϑ=1,24 м/с; ●●● - at ϑ=1,49 м/с; ▲ ▲ ▲ - at ϑ=1,76 м/с.

A slight increase in the flow rate of the liquid phase leads to a noticeable increase in water hammer and, in contrast to a single-phase flow, the magnitude of the water hammer during the movement of two-phase mixtures is also a function of the system pressure. This is quite natural, while the density of the two-phase flow is determined by the magnitude of the pressure [3].

III. Research results

The processing of experimental data using the methods of mathematical statistics made it possible to obtain the following empirical formula for determining the magnitude of the shock pressure at an instantaneous stop of the two-component (gas-liquid) pressure flow in pipes: $P^0_{уд}=10^{-2}P_{ст}(6{,}29+5{,}71Re_{ж}-2{,}68\ Fr)$, (1)

Where $P_{ст}$ - system pressure; $Re_{ж}$ - Reynolds number for a two-component liquid, *Fr – Froude number.*

According to the experimental data (Fig. 2) [2,3], an estimate of dependence (1) is given, which is in good agreement with the experimental data.

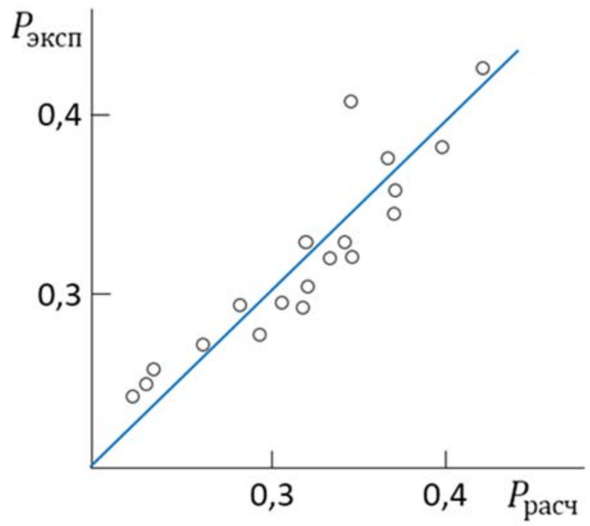

Fig. 2. Comparison of the results of experiments and calculations according to the proposed dependence (2).

If we take into account the time when the flow is cut off by the cutter, then the shock pressure will have the form:

$$P_{уд} = P_{ср}\, P^0_{уд}\, \frac{cT}{2l}, \qquad (2)$$

where T is the time when the flow is blocked by the cut – off device; c is the speed of sound propagation in a gas-liquid mixture.

The dependence (2) can be used to estimate the magnitude of the hydraulic shock during the movement of gas-liquid pressure flows in pipes.

Based on the conducted studies, it was found that the value of the hydraulic shock for a gas-liquid mixture is directly proportional to the flow rate of the liquid phase, the number of Fr with a negative correlation coefficient and the average pressure in the pressure pipelines.

An empirical formula (2) is proposed for determining the maximum pressure of a hydraulic shock during the transport of gas-liquid mixtures, which can be used to estimate the time of an emergency pipeline shutdown in such systems

IV. CONCLUSION

Based on the above, we can draw the following conclusions:

1. According to the proposed dependence, it is possible to determine the values of the maximum pressure of a hydraulic shock during the transport of gas-liquid mixtures, which can be used to estimate the time of an emergency shutdown of the pipeline in such systems.

2. The recommended scientific approach to solving the task prevents accidents and ensures normal operation of the pumping pipelines of the gas-liquid flow.

3. The conducted studies ensure resource saving and do not allow for pressure-hydraulic systems when transporting gas-liquid flow in the event of a hydraulic shock.

REFERENCES

[1] Zhukovsky N.E. On hydraulic shock in water pipes. - M., Gostekhizdat, 1949 – - 104 p.

[2] Arifzhanov A.M., Jonkobilov U. U., Babaev A. R. To determine the maximum pressure in pipes with unsteady movement. // Toshtimi Akhboroti Chorak Journal, No. 3-4, Toshkent, 2018. - 61-65 b.

[3] Zhonkobilov U. U. Determination of the maximum pressure during hydraulic shock in pipes. Innovative development. International Scientific Journal. Perm, No. 4, 2018, pp. 25-27.

[4] Adamkovsky A., Henlik S., Yanitsky V., Levandovsky M. The influence of the rigidity of the pipeline support on the course of the hydraulic shock, Eur. J. Mech. B Fluids 61 (Part 2) (January/February 2017) 297-303.

[5] Anderson H. H. Centrifugal pumps. LLC "Trade and technical press". England, 2001 – - 314 p.

[6] Asli K. Kh., Nagiyev A. K. Some aspects of physical and numerical modeling of hydraulic shock in pipelines / / Nonlinear dynamics. 60 (4) (2010) 677-701.

[7] Burdarias S., Herbi S., Kinetic scheme for unsteady flows under pressure in closed water pipes [J]. Journal of Computational and Applied Mathematics, 2010,(234): 2098-2105.

[8] Gidawi M. S., Zhao M., Duncan A.M., David H. A. Review of the theory and practice of hydraulic shock, Appendix. Mechanics. Ed. 58 (2005) 49-76.

[9] Guo J, Zhang L. Transient shutdown processes in a complex pumping system with several pumps in parallel [J]. Journal of Procedural Engineering, 2012,(31): 428 – 434.

[10] Henlik S. Numerical modeling of hydraulic shock during the interaction of a liquid and a structure in a pipeline with viscoelastic supports, J. Structure of liquids. 76 (2018) 469-487.

[11] Kalyatka A., Vaishnoras M., Valincius V. Modeling of the phenomena of hydraulic shock caused by a valve in a district heating system[J]. Journal of Computers and Liquids, 2014, (94): 30-36.

[12] Wang R., Wang Z., Wang H., Yang H., Sun J. Methods for assessing hydraulic shock for water distribution systems, Issue of the 12th int. Conference on Computing and Management for the Water Industry, CCWI 2013, Procedural Engineering, volume 70, (2014), pp. 1717-1725.

[13] Zuo, K., Qiu, S., Lu, U. et al., 2013. Characteristics of the hydraulic shock of the built-in primary circuit of a pressurized water reactor. Nucl. English Des. 261,165-173.