ENGINEERING SCIENCES

DEVELOPMENT OF SOFTWARE FOR PREDICTING OPERATING PARAMETERS OF UNDERGROUND GAS STORAGE FACILITIES

Volodymyr Volovetskyi[1]
Yulia Romanyshyn[2]

DOI: https://doi.org/10.30525/978-9934-26-472-6-1

At present, Ukraine has thirteen underground gas storage (UGS) facilities located all over the country with a significant active volume (about 32 billion m^3) [1]. All UGS facilities are connected to the gas transportation system of Ukraine and ensure both the stability of gas supply to consumers and gas transportation to Europe, etc.

UGS facilities consist of both underground and above-ground infrastructure that provides for the transportation of gas from wells and onward through pipelines to the gathering and processing system for processing, further dehydration, metering, compression and delivery to existing connected gas outlet pipelines to consumers in accordance. UGS facilities have different numbers of connections to main gas pipelines which can both increase their operational efficiency and lead to complications related to the choice of the optimal mode of operation. Therefore, it is necessary to quickly determine the optimal parameters of UGS operation which requires the use of modern computer technologies and the development of special software for modeling and predicting the operation of gas storage facilities.

At the moment, modern software for modeling and predicting gas storage operation modes is developed mainly for individual technological processes rather than for a complete integrated solution of various tasks.

It is known from practical experience that the accuracy of modeling of one technological process is significantly different from the accuracy of calculations for another which leads to irrational costs of research and software development. In this regard, before developing software it is necessary to conduct a detailed analysis of known methods for their application and to develop a clear algorithm.

[1] Branch R&D Institute of Gas Transportation Joint Stock Company "Ukrtransgaz", Ukraine
[2] Ivano-Frankivsk National Technical University of Oil and Gas, Ukraine

The UGS facilities is a complex facility that includes various above-ground and underground equipment and technological processes which can be divided into the following phases:

– gas injection;

– neutral period;

– gas withdrawal.

During the injection period, the gas is delivered from the diversion pipeline to the processing plant which contains separation equipment to remove liquid contaminants. It is then metered, compressed and delivered to the separation unit and through the pipelines to the wellheads and tubing string to the producing horizon.

During the production phase, the gas is transported from the well bore and then through a column of risers to the wellhead and through the flowlines to the gathering and processing system, where it is cleaned of mechanical and liquid contaminants in separators. Then, the gas is dewatered, metered and compressed before being delivered to the outlet pipeline to consumers.

All UGS facilities differ from each other in certain features, including geological structure, reservoir pressures, filtration parameters of formations, depth of productive horizons, design volume of buffer and active gas, number of wells, characteristics of both process equipment and booster compressor stations and so on. These features determine the individual technological scheme of the UGS facility.

Underground gas storage involves a certain sequence of various technological processes, the main ones of which should be modeled as separate units within an integrated system that must have software. The main technological units of the gas storage facility for which individual models are to be created include:

– reservoir system;

– wells;

– plumes;

– separation equipment;

– dewatering;

– booster compressor station.

In view of the above, to improve the efficiency of UGS facilities operation, it is advisable to develop software for operational predicting of its optimal mode. The functionality of the software should ensure the solution of the following main tasks:

– predicting the main parameters of UGS operation for different periods;

– calculation of the minimum and maximum UGS capacities under different conditions;

– determination of optimal UGS operation modes taking into account various factors.

The development of the software will allow to predict the operating parameters of the UGS facilities, to calculate various operating modes and to determine the optimal one.

Implementation of the developed software in production will allow to control the technological process both during gas injection and gas withdrawal from UGS facilities.

References:

1. Storchak S. O., Zajetz V. O. (2016). Pidzemni skhovyshcha gazu Ukrainy – nadiina osnova dlia stvorennia Skhidnoievropejskogo gazovogo khabu [Underground gas storage facilities of Ukraine – a reliable basis for the creation of the Eastern European gas hub]. *Naftogazova galuz Ukrainy*. No. 3, pp. 24–25.