Abstract

Analytic curves have been suggested which can be used for establishing a correspondence between the wellhead pressure drop rate and the lost fluid mass during leakage testing for tightness of underground storage facilities.

The analysis of the literature /1,2/ and the practical experience in the use of methods of underground reservoirs tightness control show that the following test methods are the most common:

1. The method of the balance of the test fluid (liquid) mass on the ground surface.
2. The method of the balance of the test fluid (liquid or gaseous) mass *in situ* above the brine – test fluid interface.
3. The method of the compensation of the test fluid (liquid or gaseous) mass *in situ* above the brine – test fluid interface.
4. The method based on measuring the pressure drop rate at the wellhead.

According to /2/ and /1/, leakage tests should be performed in 28 days or 45 days after finishing the construction of an underground storage facility. The pressure drop and test fluid mass imbalance during the test could be used as criteria for assessing the tightness of an underground storage facility. A reservoir can be considered tight /1,2/ if the leaks /imbalance/ do not exceed:

a) 20 – 27 l/day of a liquid fluid;

b) 50 kg/day of a gaseous fluid;

c) the pressure drop rate is decreasing and approaching a constant value, and the average pressure drop in the closed cavern within one hour during the last 12 hours does not exceed 0,05 % of the test pressure.

The method based on measuring the pressure drop rate at the wellhead is a less developed one. In this study, a number of analytic curves are suggested which can be used for assessing the test fluid mass loss in the course of the test with regard to the pressure drop value.

Based on the dimensional analysis of quantities influencing the rate of pressure change during leakage testing of underground storage facilities, the following criterion has been obtained for assessing the tightness of an underground storage facility:

$$N = \frac{\Delta V}{V} \cdot \frac{\beta P_1^2}{\Delta P_1}, \qquad (1)$$

where N = $\beta^2 P_1^2$ - a non-dimensional parameter;

ΔV - changes in the test fluid volume during the leakage test of the reservoir, m^3;

V – the volume of the test fluid pumped into the reservoir during the leakage test, m^3;

β - the test fluid compressibility, MPa^{-1};

P_1 – the initial average pressure of the test fluid pumped into the reservoir during the leakage test, MPa;

ΔP_1 - changes in the test fluid pressure during the leakage test, MPa;

From curve (1) it follows that