Estimates of the compressibility of the pore space when the effective pressure changes by the example of the Uvyazovskoye UGS

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The paper analyzes the effect of reservoir pressure on the volumetric compressibility of gas reservoirs on the basis of experimental results of changes in their porosity when simulating gas injection and extraction. Based on the existing concepts of rock physics [Zhukov and Kuzmin, 2021], developed mathematical models [Kuzmin, 2020] and the results of core studies, the maximum amplitude of subsidence and elevation of the Uvyazovskoye UGSF land surface, reaching 61 mm when the reservoir pressure changes by ± 5.0 MPa, was estimated.

Models of distribution of vertical displacements of the earth surface for periods of gas injection and withdrawal are constructed, showing that displacements from 5mm and more, which can be obtained by repeated leveling observations, occupy an area of about 96 km2 of the UGS territory. The maximum vertical displacements are observed in the direction towards the center of the deposit, which confirms its reliability when compared with field observations at a number of other UGS facilities and hydrocarbon fields [Kuzmin, 2021; Comparison of forecasts, 2021].

The main conclusion of this work is that the methodology of estimation of changes in vertical surface displacements taking into account changes in porosity and compressibility of gas reservoirs depending on the chosen mode of operation of Uvyazovskoye UGS, taking into account the actual data on porosity and compressibility of gas storage facility reservoirs, which can be used at other similar facilities, is proposed and implemented in practice.


