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RECOMMENDATIONS ON INSTALLATION OF CHOCK FLANGES ON WELLHEAD OF THE UNDERGROUND GAS STORAGE

E. B. MAKASHEV*, B. K. KUMAR, E. A. MOHAMED and D. B. KUMAR

Kazakh National Technical University after K. I. Satpaev Institute of Geology and Oil Gas Business, Republic of Kazakhstan, ALMATY CITY

ABSTRACT

Underground gas storage is an engineering facilities in reservoir beds of geological structures, mine openings, as well as in manufacture capacitance, build up in mineral salt deposits, intended for injection, storage and subsequent extraction of gas, which includes a part of subsurface, confined with mine allotment, well stock for various applications, gas treatment & gathering facilities and compressor rooms. Underground gas storages are constructed alongside the gas pipeline routing and major gas-consuming centers, destined for the following purposes[1]:

- To cover seasonal irregular gas consumption, as a result of heating demand in winter period.
- To reduce capital costs for gas pipeline and compressor plants.
- To arrange conditions for regular work of gas sources and gas main facilities (GM) with constant average annual supply at installed power (IP) efficiency ratio close to 1.
- To form national gas reserves (fuel and raw materials for chemical factories) in essential regions of the country.
- To preserve associated gas in new oil-producing regions, and hydrocarbon condensate at its temporary impossibility to use.
- To improve reliability of distant gas supply system in general.

Key words: UGS-Underground gas storage, GM-Gas main, WF-Water factor, GDS-Gas-distributing station, KS-Compressor station, GSS-Gas-supply system, EPO-Experimental production operation.

INTRODUCTION

The major component of fuel-and-power sector of the Republic of Kazakhstan is the gas supply system (GSS), which constitutes the complex of correlated production plants,

*Author for correspondence; E-mail: makasheve@mail.ru

system of distant transportation and underground gas storage and distribution system, which maintain continuous process of gas supply to consumers.

Specific part in high reliability operation assurance of gas-supply system, stable and assured supplies of gas to consumers is devoted to underground gas storages (UGS).

Three underground systems are used to maintain irregular gas consumption in Kazakhstan: UGS «Bazoi»; UGS «Akirtobe»; UGS «Poltoratskoye».

UGS engineer installations include -

- Gas injection and extraction wells (wells are equipped with automatic downhole valves to prevent open flowing).
- Compressor plant and pipeline system.
- Gas cooling, dewatering and purification facilities (drip pockets, filters, absorbers and adsorbers).

The essential condition for the effective construction and operation of UGS is its structural integrity, i.e. prevention of possible gas leakages, particularly in overlying permeable bed[2].

History and geological model

Gas consumption in southern regions of Kazakhstzn is determined by the following conditions: increase in gas demand and previously created underground gas storages in these regions partially do not cover seasonal irregular distribution, which refer to high priority of operation demand and reliability improvement of UGS. Therefore a number of issues on improvement of reliability and operating efficiency of Akirtobe UGS are set to consideration.

“Akirtobe” UGS was created in 1986 in water-carrying reservoir bed, laying at the foundation of oversaline formation of upper Permian at a depth of 770-840 m, represented by sandstones, siltstones and clay layering.

Akirtobe structure was discovered in 1965 during regional seismic exploration works. Detailed survey was carried out in 1772-1773 by reflection exploration of subsalt confining bed of lower Permian.

During September 1973 till August 1977, 35 prospect wells were drilled, 34 of them

opened a reservoir bed, and one (No. 23) was drilled to control the structural integrity of overlying seal bed.

In January 1984 at eastern elevation of Akirtobe coverage, the drilling of production wells was carried out. Later four more confirmation wells were drilled (No. 74-77).

Exploration drilling showed the elevation of overlying bed of salt-bearing section at lower-upper Permian. As a result at the foundation of over saline formation of upper Permian the complex of overlying beds was marked out, which are considered as potential for reservoir bed, overlying seal and control horizon, to monitor leak resistance of the storage[3].

Due to X-axis undulation, the structure is complicated by two echelon joint domes: eastern and western.

The size of eastern dome on closed contour is minus 190 m – 6,5 × 3,5 Km^2. Dome area – 20 Km^2, crest value – 40 m.

The size of western dome on edging contour is minus 190 m – 5 × 2 Km^2. Dome area – 9 Km^2, crest value – 20 m.

Geological models of "Akirtobe" UGS are shown in Fig. 1. Three-dimensional view of confining reservoir bed is shown in Fig. 2.

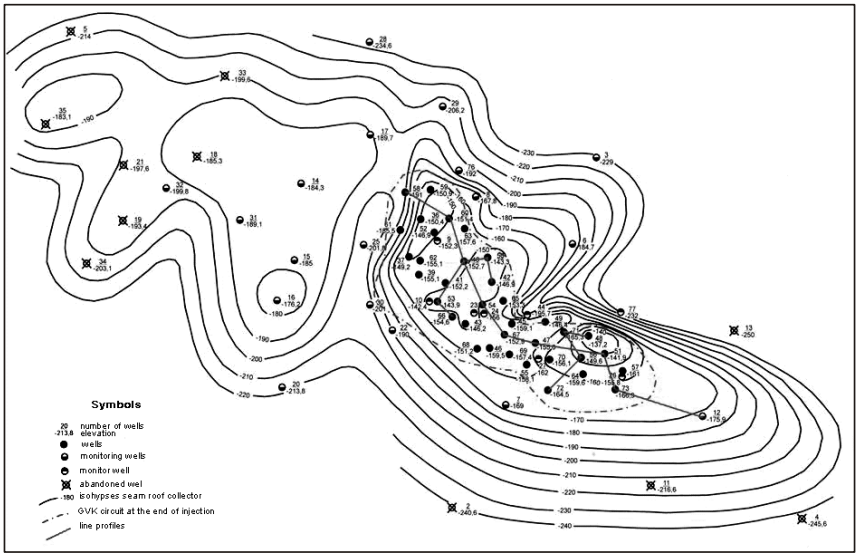

Fig. 1: Contour map of "Akirtobe" UGS confining reservoir bed

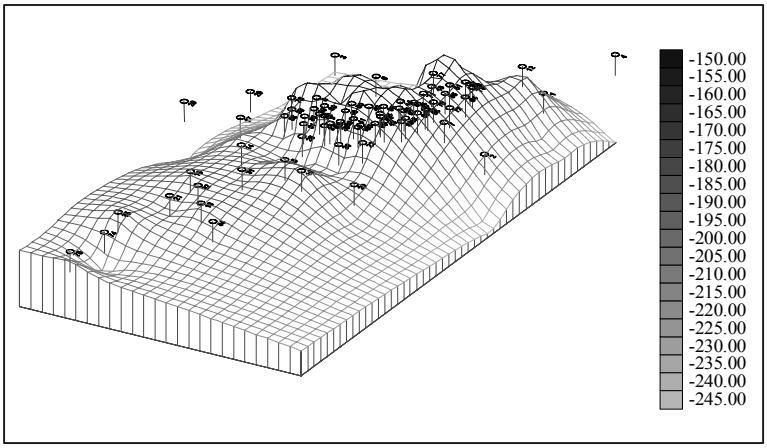

Fig. 2: Three-dimensional model of confining reservoir bed

Current state and construction of storage

The construction of underground gas storage is performed according to project with two stage of installation: pilot development stage and full progress stage.

Specifications accepted in the course of arrangement design:

- Maximum daily injection – 5,8 mn m^3;
- Maximum daily extraction – 8 mn m^3;
- Number of wells – 38 (23 for installation);
- Formation pressure – from 8,6 MPa to 5,9 MPa;
- Wellhead pressure – from 7,0 MPa to 3,5 MPa

All the wells are lined out into two gas distribution points: GDP-1; GDP – 2.

During construction of underground gas storage, the centralized gas collection and treatment configuration was adopted. Collection, distribution, flow rate measurement, primary gas separation and measurement is carried out during extraction at gas distribution points. During injection, the gas received from compressor station flows through collector and via inlet manifold system directed to relevant wells through the plumes. Gas measurement is carried out at inlet manifold system via orifice plates.

Well hookup to gas distribution points is performed on linear scheme. 13 gas wells are connected to GDP No. 1. During pilot development period, there was 8 gas wells

connected. 10 gas wells are connected to GDP No. 2. During pilot development period, there was 7 gas wells connected.

Gas from the discharge pipe line with pressure of 3,1-3,9 MPa and temperature 15-25°C flows to compressor station of underground gas storage through the gas interconnection, where it is purified from contaminations and measured at gas metering point. After measurement, gas passes through two-stage compression and via gas collector pipeline under 9,0-7,0 MPa and 50°C (maximum 60°C) is delivered to gas distribution points. From the GDP, it is distributed between gas wells through dedicated transfer units.

Gas well performance control is carried out by periodic measurement of gas flow rate and quantity of stratal waters at metering separator, with the capacity of 1 mn m^3. As provided by the project for each GDP, there should be one separator assembly installed, which allows to carry out periodic (3-4 times a month) gas and liquid measurements in wells. After measurement, gas flows into gas collector of process rout[4,5].

Potential for efficiency increase of well operation in Akirtobe UGS

During gas extraction season at UGS in 2011-2012, achievement of scheduled extraction volumes failed to succeed. Actual volume of topping gas reached 122 mil.m^3, this is 28 mil.m^3 blow the intended extraction rate (150 mil. m^3).

Primary reason of low extraction volume as compared to intended rate is:

- Dynamic water breakthrough;
- Unavailability of effective control system over separate production wells of UGS.

The main reason of poor efficiency of storage wells are imperfection of reservoir bed penetration by production wells and high water coefficient due to opening of water-saturated bed[6].

To reduce water coefficient of Akirtobe UGS wells, it is suggested to apply well workover technology with sealing of perforated water-saturated part of reservoir bed and install orifice plate on wellhead. To determine efficiency of this method with due regard for Akirtobe UGS conditions, it is suggested to carry out pilot survey of sealing. Test wells should be installed at crest position, must have high efficiency rate, operate at high water coefficient and water out during operation. The following wells comply with the specified requirements; these are No. 36, 59, 60, 39 at GDS-1 and No. 45 at GDS-2.

Well No. 60 mainly operates with stratal water and hinders operation of GDS-1. Well No. 60 should be excluded from service in the current extraction season. Well No. 42 - the product contains stratal water. After blowing-out, the wellhead pressure raised from 22 to 50 Kgf/cm^2 during 35 minutes. This well can be used for operation. Wells No. 51, 46, 68, 49 and 67 operate at low water coefficient and may be serviced in the current extraction season. Wells No. 65, 42 and 54 of GDS-1 operate at high water coefficient and may be serviced provided that choke diameter is reduced. Wells No. 48, 71, 56, 64, 49, 67, 45, 69 55 and 72 of GDS-2 operate at high water coefficient and may be serviced provided that choke diameter (throttle).

Topside choke installation advisory

The major problem of withdrawal cycle at «Akirtobe» UGS is early water breakthrough. According to exploration works, some recommendations were given regarding installation of choke flanges at UGS, produced at GDS-1 and GDS-2, for throttling of gas flow via separate lines (Fig. 3).

Fig. 3: Chock flange

As a temporary measure to prevent wells from early water breakthrough was installation of chock flanges directly on wellheads. Choke orifice diameter was specified with regard to pressure difference between tube and annular space of the well and the volume of stratum fluids. Chock flange is installed at the point between two stop valves by means of flange couplings, which is not time-consuming. Such assembly restricts water inflow, creating a balance between gaseous and aquatic medium[7].

CONCLUSION

Performing analysis of dependence of operating wells from daily output, formation pressure and increasing extraction of stratal water of UGS, it should be noted that installation of chock flanges is considered to be efficient and essential.

Therefore, the most important and primary objective of Akirtobe UGS in terms of increase of current production rates, gas extraction volumes throughout the season, reduction of well drowning and water coefficient, as well as potentials for design performance increase is stimulation of well production capacity with introduction of chock flanges.

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