Experience in Developing the Oil Fields of the Krasnodar Territory with Maintenance of Formation Pressure

I. M. Zhivitsa, V. S. Kolbikov

About 15 years ago artificial maintenance of formation pressure was begun in several Kuban oil fields. Gas and air repressurization was intensified in 1947-48 in the oil pools of the Khadyzhen group (Asfal'tovaya Gora, Shirokaya Balka, Kura-Tsitse, and others). Maintenance of formation pressure has been used yet more widely since 1954 with the discovery of several large fields (Klyuchev, Novo-Dmitriyev, Akhtyrsko-Bugundyr, and Anastasiyevsko-Troitsk) to the west of the Khadyzhen group. Artesian water and in some cases formation water were used in these fields.

In the first stage there was great difficulty in completing the injection wells because of the complex geology of the objectives of the flooding.

This complexity, as indicated by the results of geophysical, physical-petrographic, and hydrodynamic investigations, lies in the fact that the majority of the productive sections are rapidly alternating systems of strata of siltstone and shale with greatly varying thickness.

Under similar geological conditions the success of completing injection wells depends entirely on the correct selection and use of technological procedures.

Practice has shown that the principal role in selecting procedures necessary for securing an initial maximum receptance for the injection wells and for maintaining it belongs to experimental production work, which is carried out not only under different geological conditions (in one or several pools) but also in different wells, some new and some long in operation. Thus, the most effective technical procedures are determined and approved, and the acid treatment of the wall zone of the injection wells is decided upon. Hydrofracture of the strata with or without propping depends on the geologic features of the objectives for flooding. Flushing with HCl, swabbing, and other measures are evaluated.

HCl and acid mud treatment were used for increasing the permeability of the rocks in the wall zone of the wells. The acid mud contains (in percent to a volume of 10-12-percent HCl solution) 1-3% hydrofluoric acid, 1.0 to 1.5% acetic acid, and 0.2-0.25% surface active agents. The technology of the method is similar to HCl treatment.

Flushing a well with HCl is carried out to cleanse the walls of the pump compressor pipes and production casing as well as to remove salts (largely iron) from the surface of the stratum in the wall zone. This is accomplished by injection into the pump compressor pipes of 2 to 3 portions of 0.5 to 1.0 m$^3$ of a 10-12 percent HCl solution with 1-2% acetic acid. Between these portions, 3-4 m$^3$ of water are injected.

Hydrofracture of the strata is carried out as a rule taking into account the geological and technical conditions of the field.

In drilling injection wells, particular attention is given to the perforation of the productive strata. In the case of interbedding of the reservoirs with shales, it is important to perforate selectively only the permeable varieties.

For evaluating the results of using these procedures under specific geological conditions and for estimating the effectiveness of introducing processes of maintaining formation pressure in the general technology of development, a short analysis of the development of the main oil pools of the Krasnodar Territory is given below.

**OIL POOL OF THE FIRST HORIZON OF THE MAYKOP SEDIMENTS OF THE KLYUCHEV FIELD**

Fig. 1a shows the structural features and the distribution of exploitation and injection wells. To the south and north of the margins of oil productivity, the productive horizon is limited by a lithologic pinch-out of the sands at distances of 3-3.5 km and 8-10 km, respectively. The productive horizon consists of alternating siltstones, sands, and shales. The reservoirs are persistent areally (average effective thickness of 8 m) but have a relatively low permeability (about 40 millidarcies). The oil pool is supported by water on its entire periphery except for a narrow belt on the west. The water-oil contact is at −2030 m, and the initial formation pressure was 235 atm.