Super viscous oil reservoir formations of Ufa unit of Republic of Tatarstan and their properties

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Over 450 concentrations of super viscous oils (SVO) were discovered in Tatarstan for the time being. All of them are related to productive deposits of Permian period occurred at depths up to 300-400 metres consisting of terrigenous and carbonate deposits.

Described are reservoir formations of the fields where recoverable reserves of SVO are confined by argillo-arenaceous thickness of Ufa terrigenous unit.

Studying reservoir properties was based on laboratory analysis of core samples in terms of: Macro- and micro-scopic description, grain-size analysis, determination of effective porosity, permeability, volumetric and weight oil saturation, carbonate content, mineralogical density.

According to macro-analysis data, thickness cross-section presents sandstones with rare interlayer and lenticle of siltstones and clays. The colour of calcareous sandstones varies from grey to black. Incoherent rocks prevail while closely consolidated types are rarely observed.

The grain-size analysis revealed that 0.25-0.1 mm size grains are dominated in the sandstone composition, their concentration in rocks amounts to 69% that enables belonging oil rocks to fine-grained sandstones.

Reservoir properties of rocks widely vary as follows: Effective porosity varies from 2.4 to 44.5% (average 31.5%), carbonate content from 0.6 to 30.1% (average 6.7%), mineralogical density from 2.3 to 3.3% (average 2.7%), and oil saturation from 0.1 to 14.9 rock weight % (average 7.8%).

Reservoir porosities of reservoirs correlate to each other. Correlations between porosities are set in logarithmic values. Good direct correlation dependence (coefficient of correlation 0.5352) was identified between porosity and permeability as well as clear inverse relation between carbonate content and porosity (coefficient of correlation = -0.7659). More tight positive correlation is observed for Porosity – Mass oil saturation (coefficient of correlation 0. 75087). This correlation indicates that super viscous oils are associated with highly porous and permeable rocks.

Correlation analysis using parameters of effective porosity, oil saturation and carbonate content revealed conditions of productive rocks (Table 2). Highly productive reservoirs are III Grade rocks with a porosity over 19.95%, mass oil saturation over 4% and carbonate content below 10.47%. II Grade rocks are medium productive reservoirs while I Grade rocks – low productive ones. These conditions allow for identification of reservoir zones of various oil deposit volume and these conditions can be used for reserve calculations.

The sandstones can be specified as high oil saturated with viscous oil content more than 7 weight %, medium oil saturated – 3-7% and low oil saturated – less than 3%. Invasion of rocks by SVO is typical for medium, and specifically for low saturated rocks, which resulted in roughly laminated, banded, mottled and mottled-banded textures.

The vertical cross-section of a productive reservoir has clearly pronounced regularity: Poorly and semi-consolidated porous (35-42%) rocks are at the top of a reservoir. The middle part of a reservoir has compacted (porosity of 12-24%) calcareous sandstones. The lower parts usually have closely and semi-consolidated low porous (5-12%), frequently water saturated sandstones with interlayer of clays and siltstones.