THERMOTROPIC INORGANIC AND POLYMER GELS TO ENHANCE OIL RECOVERY

Description
New technologies have been developed to enhance oil recovery using thermotropic inorganic and polymer gel-forming systems (GALKA, METKA, ROMKA), which are low-viscosity solutions under surface conditions and are capable of generating gels in-situ. The systems produce deflecting shields in reservoirs to control filtration flows, thus increasing oil recovery and decreasing water cut in production wells.

Gelation occurs under the action of the thermal energy of the reservoir or the injected heat carrier. The gelation time can be varied from several minutes to several days in the temperature range of 20-300°C. The gelation time depends on the temperature and component ratio of the gel-forming system. The gelation process reduces the reservoir rock permeability to water by a factor of 4-35. The higher the initial water saturation and the reservoir rock permeability, the larger the permeability reduction.

The safety of the reactants for man and the environment enables a wide application of the gel technologies in Russia’s oil fields, especially at a later stage of their development.

Results of ROMKA system injection in the test area of AB1 reservoir in Urievskoye oil field. Performance of production well 1438 (injection well 1810)

Technical appraisal and economic benefits
The technologies applicable in a temperature range of 20-300°C, including the thermal treatment of high-viscosity oil pools. They produce a 10-50% reduction in water cut in production wells. The additional oil recovery is 1 to 3 thousand tons per one well treatment. The payback period is 5-10 months. The technologies are implemented using standard oil-field equipment and domestic reagents of large-tonnage production.
The gel-forming systems can be prepared using water of any salinity. They are injected into a reservoir via injection or producing wells using standard equipment. The technologies are environmentally safe and efficient.

**Application areas**
Oil and gas production; water cut reduction in oil and gas wells; enhancement of oil and gas recovery at various stages of reservoir development; for deposits of hard-to-recover reserves (having low permeability, high heterogeneity, and high water content), including high-viscosity oil pools.

**Development stage**
The technologies have been commercially tested in oil fields of Russia (Western Siberia and Komi Republic) and in Vietnam. Since 1997, the technologies have been commercially used in oil fields of Western Siberia. At present, they have been commercially applied in oil fields of Russia; in particular, the LUKOIL and YUKOS companies treat 160-200 oil wells per year. Over the past 5 years, more than 1.5 million tons were additionally produced in Western Siberian oil fields using the technologies developed at the Institute of Petroleum Chemistry of the Siberian Branch of the Russian Academy of Sciences (IPC SB RAS). In 2000, IPC SB RAS, in conjunction with Khimeko-GANG Ltd. and Aurat JSC, launched production of a commodity solid form of the GALKA inorganic gel-forming system. The technologies (GLAKA thermogel, S, U, and NT grades) were awarded the Golden Mark of the International Contest Exhibition “All-Russian Brand (3rd Millennium). 21st Century Quality Trademark” (2001) and the Gold Medal of the ARCHIMEDES-2002 International Industrial Property Salon (2002).

**Patent situation**
The development is covered by 11 patents granted in Russia (1991, 1993, 1996, 1997, 1999, 2000, and 2001), China (2002) and Vietnam (2003); the trademark was registered; the know-how is protected.

**Commercial offers**
Economic contracts, license agreements, know-how transfer.

**Estimated cost**
US$ 500-3,000 per one ton of the gel-forming system

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