

Development of coalbed methane resources accounting for the Kuznetsk coal basin geological peculiarity and for the regional energy market extension outlook

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Russia has huge resources of coal varying in quality (from brown coals to anthracites) and occurring in coal basins of different age. Geological resources of major coal basins are estimated at 4 139 billion tons with methane summary resources in these basins amounting to 83.7 trillion m³.

Among the basins where the commercial methane production is viable first of all we should like to mention the Kuznetsk coal-bed methane basin. It has unique characteristics and accounts for 67% of total Russian coal resources. Methane resources of the Kuznetsk basin are estimated at 13 trillion m³ [1, 2].

Coal producing industry Kuzbass has many branches, it includes 108 coal producing enterprises (59 mines and 49 open-pit mines), and 32 coal-preparation factories and mills. In 2008 these industrial enterprises produced 184.5 million tons of coal of which 55.6 million tons were coking coal.

According to results of geologic exploration works in Kuzbass, in conformity with assessment criteria and exploration degree, the most prospective areas were defined which were characterized by significant immersion depth of carboniferous deposits and comparatively smooth plicate dislocations. Sectional tenor of coal in this area makes on average 5-7% and rises in some intervals to 7-12%. Coals belong to classes from Γ to K (Ro of 0.7-1,2%) and have methane content of up to 25-30 m³/t. Degasification zones are of 200-300 m on average and somewhere shrink to 150-100 m. These areas account for about 6 trillion m³ or nearly 50% of the Kuzbass methane resources. Average density of the methane resources is 2.0-2.5 billion m³/km². Permeability of production formations varies widely from less 1 to 80 mD [3, 4].

Major features of mining and geologic conditions of the Kuzbass most commercially promising areas are as follows:

- the coal layers extend to the depth of 4000 m;
- at the depths of 400 - 1200 m developed with application of modern industrial techniques of methane production the quantity of productive strata (single seam thickness > 1 m) is 15 or more, while the total thickness of these formations attains to 40 m;
- average thickness of coal seams is 2 m, some seams being as thick as 10-12 m;
- consequently coal-bed methane resources are irregularly distributed in depth, which might require a rather sophisticated development system.

In 2003 JSC Gazprom started works to ascertain feasibility of coal-bed methane commercial production in Kuzbass. 4 pilot wells were drilled in the Taldinskaya area to study thickness, structure, gas content, permeability and occurrence depth of the coal seams. The pilot works allowed evaluating the south-east of the Taldinskaya area as the most commercially promising site and in 2009 1 parametric well and 7 exploration wells were drilled there. Considering the Taldinskaya geology, they applied hydraulic fracturing and propan injection (8-20 tons) in exploration wells for intensification of the gas recovery. Later on the wells were equipped with progressive cavity pumps. Gas desorption began when the water level in wells was reduced to 120-150 m (and in well YM-5.4 only up to 90). Gas flow rates reached 6-8 thous. m³/day. The implemented works resulted in elaboration of methane production techniques, allowed to obtain gas debits and calculate the coal-bed methane resources of the Taldinskoe field. These resources passed evaluation tests and were entered by the State Committee for Reserves of the Russian Federation into commercial reserves of C₁+C₂ classes to the amount of 45 billion m³. The produced gas goes to fuel electricity production and gas-vehicles.

Estimation of the Taldinskoye field pilot wells' production capacity was applied to substantiate variants of efficient use of the methane to be produced at different stages of Kuzbass first-priority areas developing.

Gazprom prepares to commercial development of methane commercial production of Kuzbass first-priority areas and to classification of these areas as

industrial. Geological exploration is underway at the Naryiksko-Ostashkinskaya area, and as far as the preliminary data allows to conclude, this area appears to be very promising for methane commercial production.

At present coal-bed methane is evaluated in two completely different aspects:

- as a separate hydrocarbon mineral deposit, the commercial production of which can be organized on the basis of well technologies within non-developed coal seams;
- as a coal hazard associate which at the same time is useful mineral by-product of the main commercial product (coal produced using the technologies of mine degasation to ensure gas safety of works).

While the production of coal in the Kuznetsk basin grows, development involves deeper horizons with higher methane-bearing parameters, one can see extension of degasation works scope and increase of methane volume extracted by the shaft ventilation and degasation means to ensure gas safety of works.

Regarding the increase of rational complex coal-bed methane deposits development efficiency we consider it reasonable to combine exploration works and primary degasation of the mine fields and compulsory methane recovery:

- at the fields of operating mines – 5-7 years before second working;
- at the fields of final detailed exploration (further exploration) which are prepared to shaft construction;
- at the sites of dilution to operating mines fields where detailed or further exploration is executed.

Methane resources of the patented mining claim of Kuzbass coal producers are estimated to about 300-500 bln.m³. Minefields primary degasation development will allow solving a set of problems of coal producers and several regional-level problems. Positive effect of the primary degasation for coal producers will consist in:

- minimization of accidents connected to explosions and unpredicted methane outburst;

- lifting of gas factors restrictions related to use of highly efficient scouring equipment;
- reduction of costs of ventilation and water drain at the deep horizons;
- possibility to fully use methane-air mixtures in mining degasation systems;
- coal production cost reduction.

The effect for the region will consist in:

- reduction of contaminants emission into the atmosphere in coal production;
- reduction of electricity shortage of the region;
- increase of the tax share in the regional budget.

Coal dominates in the fuel and energy balance of the Kemerovo region, it accounts for 63.7% of the total energy consumption, while gas stands for 10% of the total consumption, metallurgical coke – for 9.5%, diesel fuel – for 3.9%, other fuels – for 13%.

The Kuzbass energy system is one of the most powerful in Russia. The preset capacity of power stations exceeds 4757 MW; energy system total thermal power is almost 7000 Gcal/hour. Annually Kuzbass produces up to 26.3 billion kW-h of electricity and over 41 million Gcal of heat. At the same time enterprises in the region's south suffer from lack of electric power. Over time the scarcity can become a serious hindrance to economic development of Kuzbass southern part housing the largest and most advanced coal industry, metallurgy and tourism projects. For the period up to 2020 the shortage is estimated at 1500-1600 MW.

Increasing electric power generation with application of presently employed technologies will inevitably worsen the ecological situation in the region. Electric power deficit elimination requires approximately 3 billion m³ of methane per year. But even this figure can grow considerably taking into account the Kemerovo region development perspectives.

The Kuzbass coal-bed methane resources suffice to satisfy both existing and future needs of the region. Various options of heat and electricity production can

be applied, including operation of mobile gas-fired plants in the areas of consumption (provided methane delivery to such areas) or big stationary thermal power stations supplying electricity and heat to consumers.

In 2008 Kemerovo region consumers were supplied with 3.556 million m³ of natural gas from fields in the northern regions of Tyumen and Tomsk regions. The gas share of the boiler and furnace fuel balance does not exceed 10%. The industrial sector consumes nearly 90% of the delivered gas. In terms of gas consumption by commercial and residential consumers the region falls considerably behind the European part of Russia. The level of network gas supply availability is less than 5%, while the rural areas are hardly at all connected to gas supply. Kuzbass production capacity makes it possible to fully substitute gas supplies with coal-bed methane.

Connecting the Kemerovo region to gas supply, converting to gas-motor fuel municipal and coal producers' transportation fleets will significantly improve the ecological situation in the region.

Reference

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