

Technology and Innovation



The company sticks to its business-driven innovation strategy by stepping up its R&D reform and talent development to push forward all-round innovation and foster the new engine for growth.

In 2017, the company saw positive progress in reforming its R&D system and tackling technical bottlenecks in its core operations. An update of key technologies facilitated industrial upgrade and led to new breakthroughs in major projects; cutting-edge and disruptive technologies helped give the company a head start and technology leadership in the industry; concrete outcomes from the key areas of R&D reform released the vitality of technological innovation. All this contributed to a stronger role of innovation in bolstering the company's business growth.

Construction of Technological Innovation System

The reform of R&D system continues to move forward. The company set up a technical expert committee to oversee R&D programs, streamline the R&D management system, optimize resource allocation and promote information sharing. The company also introduced a fund in support of basic research and strategic research on emerging technologies, improved the policy on R&D incentives and introduced incentive measures for value-creating from R&D results, in an effort to provide a more open and inspiring environment throughout the company for our technical research people.

The company's R&D infrastructure was further reinforced. The existing R&D platforms were further improved, including the national engineering laboratory for exploration and development of low-permeability oil and gas reservoirs. The platform for research of information technology and soft science is under construction. And a number of research platforms such as the nanochemistry laboratory were rated as top level globally.

As the end of 2017, the company has 84 research facilities, 47 key laboratories and testing centers, and more than 33,000 scientists and researchers.

Progress of R&D Achievements

In 2017, the company boosted technological R&D and made significant progress in increasing hydrocarbon discovery rate, enhancing producible rate of reserves and ultimate recovery, and promoting localization of sophisticated equipment, as well as in tackling technological challenges in crude oil processing, cost reduction of chemical raw materials and clean energy production.

Exploration and Development

Challenges were addressed in glutenite exploration, resulting in a major discovery at the Mahu Sag in Xinjiang, with newly added 3P reserves of 1 billion tons. Horizontal well drilling was going smoothly, enabling large-scale production and opening up a new strategic reserve-replacement area.

The evaluation techniques for structural traps in the foreland thrust belts have solved technical problems such as anisotropic pre-stack depth migration and overthrust and superimposed structural belt modeling, resulting in a remarkable improvement in the quality of salt/subsalt imaging and leading to a breakthrough in exploration activities in the Tarim Basin of Xinjiang.

In view of the world-class problems such as micro- and nano-pore throat gas-water seepage in ultra-low permeability-tight sandstone gas reservoirs, a large physical simulation experiment system has been developed for improving productivity and recovery rate. As the state-of-the-art physical simulation system in terms of performance indicators and modeling system, it will greatly facilitate China's theoretical and experimental research in complex gas reservoirs.

Key technologies in residual oil simulation, profile control by polymer microspheres and lateral broadband fracturing were developed for waterflooding of low permeability and ultra-low permeability reservoirs, enhancing the recovery rate by 6-8 percent at two blocks in Changqing Oilfield.

Innovative exploration and development techniques for shale gas have contributed to a significant drop in the overall costs per well and an accelerated pace of shale gas development, with the yearly output soaring up from 200 million cubic meters to 3 billion cubic meters.

Refining and Petrochemical

Clean gasoline tests under the National VI Standards have proved successful and clean diesel production experiments have seen major progress, promoting a new round of fuel quality improvement.

Catalysts with high gasoline yields and low carbon emissions have been successfully developed and widely used to enable a decrease in the company's diesel-gasoline ratio.

Leveraging major progress in high-value production of polyolefin products, the company has launched 20 polyolefin brands and developed all-round R&D capability for catalysts, comonomers and polymers.

A new phosphorus-free polymerization process for SBR production has been developed. Mass production was realized for nine synthetic rubber brands including e-SBR, EPR and Nd-BR.

Oilfield Services

Geophysical prospecting: GeoEast-Diva, a proprietary velocity modeling solution, is developed to tackle a range of seismic exploration issues in relation to the complex surface conditions in domestic exploration areas, marking a leading position in velocity modeling for onshore complex surfaces and formations. The innovative method for controlled induction of strong perturbation has contributed to the development of the EV56 high-precision broadband vibroseis, which is put into use at Xinjiang, Qinghai and Liaohe oilfields to enable the shift from more stable low-frequency to broadband.

Well logging: An innovative azimuthal acoustic reflection imaging logging tool has been developed to support the acquisition of geological data and the discovery of complex reservoirs. Meanwhile, it provides technical parameters for oriented perforating, directional sidetracking and acid fracturing, playing an important role in stratigraphic evaluation.

Drilling: To address the potentially dangerous problem of sustained casing pressure and gas blow-by, a new set of cementing techniques focused on high-strength, low-elastic modulus cement and well integrity have been developed to facilitate the exploration and development of deep and unconventional natural gas reservoirs in a safe and efficient manner. A range of techniques for treatment and recycling of drilling wastes and fracturing fluids, including fine sorting, centrifugal separation and electrosorption, were used, increasing the recovery rate and reducing the costs significantly. Drilling and completion techniques for 5-1/2" sidetracks are used to reduce the average construction period from 100 days to 40 days, with the length of the horizontal section increased from 600 meters to 900 meters and the daily output increased from 5,000 cubic meters to 59,000 cubic meters per well.

Offshore engineering: China's first offshore gas hydrate production project has been successfully implemented, making breakthroughs in connection with silty reservoirs, shallow burial depths, low temperatures under deepwater, formation sand flows and hydrate formation, etc. to maximize the duration of gas production and output and solve flow assurance, environmental safety issues.



Storage and Transportation

The third-generation, large-capacity natural gas pipeline technology has taken shape. The SCADA system for long-distance pipeline transportation has been tested successfully in the Dagang-Ji'nan-Zaozhuang Refined Product Pipeline and the Jining (Hebei-Jiangsu) Natural Gas Pipeline and will be used in the Eastern Route of Russia-China Natural Gas Pipeline.

Frontier Research

In view of the world's growing demand for energy, fundamental research and technology pipeline in the frontier areas has been a priority for the company. In 2017, a series of research efforts in relation to recovery rates, refining processes and engineering techniques recorded positive results.

The reservoir-forming theories and evaluation technologies for ancient hydrocarbon system supported the strategic breakthroughs in Proterozoic exploration. The first-generation nano-displacement agent and heavy oil in-site upgrading catalyzer revealed a bright prospective for EOR in mature field and heavy oil production. New types of catalytic material and new catalytic cracking catalysts are going to widely applied in deep processing of inferior heavy oil. A preliminary solution has been found to reduce coking at high temperatures during the anaerobic process for producing olefins and aromatics from methane. The super-efficient techniques for acquiring and processing overlapping vibroseis data have been commercially used, greatly enhancing operation efficiency. The azimuthal electromagnetic wave resistivity LWD tool was proved effective in improving the recovery rate of subtle reservoirs. High-speed data transmission technology is expected to lead to a reform in measurement and control while drilling.

Technological Cooperation

The company continues to deepen scientific and technological exchanges and cooperation with international oil companies, national oil companies, leading manufacturers, international academic organizations and domestic research institutes to promote the construction and development of high-end alliance of the company. By the end of 2017, the company has partnered with 17 companies and institutions at home and abroad, with important advances in international R&D activities: the pilot tests using new technologies for oily sludge treatment and recycling have shown positive outcomes and some of these technologies will be gradually deployed; a high-temperature, high-voltage azimuthal electromagnetic imaging logging tool has been developed, with state-of-the-art imaging capability and industry-leading detection depth, temperature and pressure indicators. The company is playing an increasingly important role as a powerhouse of international oil and gas cooperation, which in turn provides strong support to its exploration and development efforts in the Middle East and North Africa.

S&T Awards and Intellectual Property Rights

In 2017, the company's five major S&T achievements won national awards. In particular, four research achievements won the second prize of the State Scientific and Technological Progress Award, i.e., "Commercial use of ASP flooding in boosting oil recovery", "Commercial use of FCC catalysts with high gasoline yields and low carbon emissions", "Key technologies for designing and manufacturing lightweight, heavy-duty pressure vessels" and "Key technologies and testing equipment for dynamic evaluation of coalbed methane reservoirs", and the "EOR technologies for diversion and multi-crack fracturing based on targeted temporary plugging in deep reservoirs" received the second prize of the State Technological Invention Award.

In 2017, the company submitted 5,050 patents applications at home and abroad, including 2,850 applications for invention patents, and won 4,879 patents, including 1,225 invention patents.



Patents applied

5,050



Patents granted

4,879