

PROGRESS AND PROSPECTS OF SCIENCE AND TECHNOLOGY WORK ON OIL PIPES AND EQUIPMENT MATERIALS

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Abstract: Scientific and technological innovation in oil pipes and equipment materials is of great significance to the construction of a strong manufacturing country and the high-quality development of the petroleum industry. Summarized my country's petroleum pipe and equipment materials science and technology industry The progress made in the work was analyzed, the existing problems and deficiencies in the development of oil pipes and equipment materials were analyzed, and key methods of scientific and technological research were put forward to improve the quality, efficiency and long-term development of the petroleum industry. Towards. In view of the problem that my country's petroleum industry standards and certification system are not yet complete, it is recommended to learn from the successful experience of API and accelerate the formation of group standards and certification systems widely recognized by the industry. Focusing on improving quality and efficiency, it is recommended to build an innovation consortium to carry out targeted research, focusing on solving the deformation and damage of casing in oil and gas fields, leakage in gathering and transportation pipeline networks, corrosion and wear of refining and chemical facilities, and long-distance transportation. Prominent issues include improving the quality of pipeline circumferential welding and localizing offshore oil equipment and materials. Focusing on long-term development, we should accelerate the advancement of intelligent application technology research in the field of oil pipes and equipment, advance the layout of key pipe application technologies in the development of new energy, carry out the research and development and application of new oil pipes and equipment materials, and help promote my country's energy technology transformation and Industrial upgrading.

Keywords: Oil pipe; Petroleum equipment materials; Quality and efficiency improvement; Artificial intelligence; New energy

1 INTRODUCTION

Materials are the foundation and key to manufacturing. Material innovation and development are the key to realizing Necessary conditions for a strong manufacturing country. The Industrial Strengthening Foundation Project (referred to as "Four Foundations") includes core basic components (components), advanced basic processes, key foundations Basic materials and industrial technology foundation are the weak links of my country's manufacturing industry. The National Strategic Advisory Committee for the Construction of a Strong Manufacturing Power clearly pointed out that our country will start from realizing The transformation from a large industrial country to an industrial power requires an urgent need to accelerate the strengthening of the industrial base, thereby improving the overall level of my country's industry and building a manufacturing power [1]. Among them, key basic materials, as the most upstream link in each industrial chain, are known as manufacturing The "chassis" of manufacturing industry is an indispensable material guarantee to support the modern industrial system. and infrastructure [2]; The industrial technology foundation takes standards, metrology, inspection and testing, certification and accreditation as core elements, and runs through the entire process of the development of core basic parts (components), key basic materials and advanced basic processes, and is the key Technical foundation and support. Therefore, it is of great significance to accelerate the development of material standards, certification and accreditation, new product development, testing and evaluation, and industrialization.

Petroleum equipment, including oil pipes, is an indispensable tool for oil and gas exploration, development, storage, transportation and refining. It is an important material guarantee for the petroleum industry [3-4]. The development of oil pipes and equipment materials is an important part of the strategy of building a strong country. content. The Fifth Plenary Session of the 19th CPC Central Committee emphasized that innovation should remain at the core of my country's modernization drive and that scientific and technological self-reliance should be the strategic support for national development. In order to implement the spirit of the Fifth Plenary Session of the 19th CPC Central Committee and accelerate the scientific and technological innovation of oil pipes and equipment materials, on the basis of summarizing the progress of scientific and technological work on oil pipes and equipment materials, we will focus on solving weak links around oil pipes and equipment and supporting and driving the improvement of the petroleum industry.

2 PROGRESS IN SCIENTIFIC AND TECHNOLOGICAL WORK ON OIL PIPES AND EQUIPMENT MATERIALS

After more than 60 years of development, my country's oil pipes and petroleum equipment materials have never been to have, from low-end to high-end, basically forming a complete range of categories, complete industries, and quality a

reliable product system, among which oil well pipes have been exported in large quantities, and high-quality steel The quality and usage of grade 1 conveyor pipes have been at the forefront of the world, providing strong support and ensure the development and growth of my country's petroleum industry [5-6]. China Petroleum Group Tuan Petroleum Pipe Engineering and Technology Research Institute (referred to as "Pipeline Research Institute") is engaged in stone A professional institution that conducts basic and engineering application research on oil pipes and equipment materials, and has played a vital role in promoting the technical progress of my country's oil pipes and equipment materials. important role.

2.1 Develop and Apply New Steel Materials to Promote the Upgrading of Petroleum Equipment

In the 1960s and 1970s, in response to the outstanding problem of my country's petroleum equipment being bulky and bulky, Academician Li Helin led a scientific research team to analyze and study the service conditions and failures of a number of key representative products based on the service conditions of petroleum machinery. According to the criteria, more than 10 new steel materials such as 20SiMn2MoVA have been researched and developed in a targeted manner, and the performance potential of existing materials has been fully utilized, and good results have been achieved by combining saving chromium and nickel with improving the quality and life of petroleum machinery products. The effect has reduced the weight of a large number of petroleum machinery products, extended their lifespan, improved their service performance, reduced their overall costs, and promoted the upgrading of petroleum equipment [7].

2.2 Collaborate with Metallurgical and Pipe-Making Enterprises to Tackle Key Problems to Achieve Large-Scale Local Production of Oil Well Pipes

Before the 1990s, more than 90% of the oil well pipes used in my country's petroleum industry relied on imports, and failure accidents occurred frequently. Starting from the service conditions and through a large number of failure analyses, the team of the Institute of Management Research has researched and constructed an oil well pipe standard system, established a key technology system for oil well pipe material selection evaluation and application; established a comprehensive system that can simulate the complex mechanics and corrosive environmental conditions of oil well pipes. Dimensional simulation test platform and methods; assisting metallurgical and pipe-making enterprises to produce a full range of domestically produced products that are more suitable for my country's oil and gas development conditions, fully replacing imports, and surpassing imports in some products and indicators. product. Promote the localization rate of oil well pipes from 10% before 1990 increased to nearly 100% in 2012, supporting the "three lows" in Changqing and Tarim Key oil and gas fields such as "three supers", "heavy oil" in Xinjiang and "high sulfur content" in southwest China development[8].

2.3 Continue to Promote High-Grade, High-Pressure, and Large-Volume Transportation of Natural Gas Pipelines

Focusing on my country's major natural gas pipeline construction projects, we actively carry out advanced Research and continue to promote long-distance natural gas pipelines to improve transmission pressure and pipeline steel intensity level. Based on the advanced research results of the Institute of Management and facing international management Road construction technology frontier, represented by Academician Li Helin and Professor Huang Zhiqian In 2000, the scientific research team proposed a technical plan and scientific basis for using X70 steel grade and 10MPa transmission pressure for the West-East Gas Pipeline, which was decided by PetroChina. Adopted by the policy leaders, the West-East Gas Pipeline's designed annual transmission volume of 12 billion cubic meters was achieved. (The actual annual transportation volume once reached 17 billion cubic meters), pipeline technology has achieved leapfrog development development, greatly shortening the gap with the international advanced level. Proposed in 2006 The second line adopts X80 steel grade and 12MPa conveying pressure, which is double than the original X70 steel grade. The pipeline plan saves investment of 13 billion yuan and achieves an annual transportation volume of 30 billion cubic meters. It also marks that my country's key pipeline construction technologies have entered the ranks of the frontrunners. 2015 In 2012, the China-Russia East Line started construction, using X80 steel grade, 1422 mm pipe diameter, 12MPa transmission pressure, and the designed annual gas transmission volume reached 38 billion cubic meters. Institute of Management Research and establish high-grade pipeline failure control technology and adapt to actual working conditions The standard system supports the Western First Line, Western Second Line, Western Third Line, and China-Russia Eastern Front. construction and operation safety of major projects such as lines.

2.4 Establish and Improve the Application Technology Support System and Promote the Comprehensive Localization of Pipeline Steel and Steel Pipes

At the end of the last century, with the development of the national economy and the increasing demand for clean energy such as natural gas, With the increasing demand for energy sources, my country's oil and gas pipeline construction has ushered in a period of rapid development. In response to the dilemma of relying entirely on imports of pipeline steel at that time, we established and improved The application technology of "failure analysis-standardization-scientific research-testing and evaluation" technology support system [9]. According to the study of working conditions and environment, X70 and X80 pipes were formulated. The series of standards for wire steel and steel pipes proposes

spiral steel pipes that undergo strict quality control. Submerged arc welded pipes can be used in high-pressure and large-diameter natural gas pipelines, establishing the domestic Spiral submerged arc welded pipe plays an important role in the construction of important large-diameter high-pressure gas transmission pipelines. Build the third facility in the world that can complete natural gas explosion tests. A full-scale gas explosion test site, research and development of a full-scale actual delivery pipe Physical performance testing platform and detection and evaluation technology, united with metallurgical and pipe manufacturing enterprises Collaborative research has promoted the realization of comprehensive national standards for X70 and X80 pipeline steel and steel pipes. On the basis of 50% localization of X70 steel pipes in the West First Line, the West Second Line Comprehensively realize localization, save more than 9 billion yuan in procurement funds, drive and lead It has led to the rapid development of my country's metallurgical and pipe-making technology.

2.5 Carry Out Research on Failure Analysis and Prediction and Prevention Technologies to Provide Technical Support for the Safe Operation of Oil Pipelines and Equipment

Carry out research on failure analysis and prediction and prevention technology, identify failure modes, mechanisms and influencing factors, feed them back to the design, materials, processes, usage and other processes, and take effective measures to prevent recurrence of accidents, which is of great significance to improving the safety and reliability of oil pipelines and equipment. major. The Institute of Management Research has carried out more than 1,600 failure analyzes of oil pipelines and equipment, including two natural gas leaks and explosions in the Guizhou Qinglong section of the China-Myanmar Pipeline, pipeline girth weld leakage in the concentric section of the Second West-East Gas Pipeline, "11·22" The Huangdao oil pipeline leaked and exploded, the Canadian Nexen oil sand pipeline failed, the Keshen 2-1-3 well casing broke, the 76# valve chamber in the eastern section of the West Second Line failed, the Turkmenistan straight seam submerged arc welded pipe leaked and failed, etc. Major failure projects have established the industry's authoritative status in failure analysis and provided technical support for ensuring the safety of the petroleum industry.

3.6 Continue to Carry Out Safety Assessment and Integrity Management to Ensure that Risks in the Entire Life Cycle of Oil and Gas Pipelines and Gas Storage are Controlled

In the 1990s, China took the lead in developing oil and gas pipeline integrity technology. technology research and application, through residual strength evaluation, remaining life prediction, wind Risk assessment, integrity evaluation, repair and reinforcement of composite materials and sleeves, etc. Continue to carry out scientific research and establish oil and gas pipeline integrity technology and management system. The research results are used in the first, second and third lines of the West-East Gas Pipeline and the Shaanxi-Beijing Pipeline The promotion and application of all major pipeline projects and surface pipelines in oil and gas fields have significantly It reduces the failure rate of oil and gas pipelines and ensures national energy security. against me The geological conditions of state-owned gas storages are complex and the risk points are multifaceted and difficult. During the "Eleventh Five-Year Plan" period, we took the lead in researching gas storage risk assessment technology and built a gas storage "geological The three-in-one life risk management and control system of "down - shaft - surface" has Effectively ensures that gas storage operation risks are controlled, ensuring peak supply and storage of natural gas. The large-scale construction of gas reservoirs provides strong technical support.

2.7 Construct a Standard System for Oil Pipes and Lead the Rapid Development of the Industry

Construct and improve the oil pipe standard system, form a standardization working organization covering group standards, industry standards, national standards and international standards at all levels, promote and lead the technological progress of oil pipes and equipment materials. In terms of international standardization, since a paper on drill pipe "Drill pipe failure analysis and the influence of internal thickened transition zone structure on drill pipe service life" was published at the API annual meeting in 1987, "opening the door of API in one fell swoop", the international Standardization work has made great progress. Organized the formulation and revision of 6 international standards, established and undertaken 4 new international standard projects (including 3 product standards), assumed the role of the ISO/TC67/SC2 parallel secretariat and served as vice chairman, and also served as the ISO/TC 67 AHG green manufacturing special As the convener of the working group, he led and promoted the development and application of new pipe products.

In summary, the scientific and technological innovation of oil pipes and equipment materials has made important progress. development, onshore oil pipes have solved the problem through the close integration of innovation chain and industrial chain. Solved a series of stuck problems and achieved self-reliance, support and guarantee The rapid development of my country's petroleum industry. As the petroleum industry continues to deepen With the entry of oil pipes and equipment, the service conditions of oil pipes and equipment are becoming increasingly complex and severe, which has a great impact on oil pipes and equipment. and the quality and performance level of equipment materials have put forward higher requirements, and we We have a low degree of localization in offshore oil and gas equipment materials, and high temperature resistance There is also a big gap between non-metallic materials used in oil fields and foreign countries. At the same time At this time, under the background of the fourth industrial revolution, the world's energy technology innovation has advanced Entering an active period, technologies such as artificial intelligence, new energy, and new materials are gaining momentum. It is expected to have a profound impact on the development pattern

of the petroleum industry. Facing the new situation, it is urgent to further sort out the key directions and development strategies for scientific and technological innovation in oil pipes and equipment materials, so as to form an industry consensus, collaborate to tackle key problems, and achieve key breakthroughs.

3 LEARN FROM API'S SUCCESSFUL EXPERIENCE TO ESTABLISH MY COUNTRY'S PETROLEUM INDUSTRY STANDARDS AND CERTIFICATION SYSTEM

Founded in 1919, the American Petroleum Institute (API) is a non-profit trade association representing the U.S. oil and gas industry. It mainly provides standards, certification and training services. At present, API has established a complete petroleum industry standards and certification system, formulated more than 700 technical standards, and has been recognized and used by more than 100 countries.

In the 1980s, my country began to widely use API standards. Of the 342 national and 1,629 industry standards currently in effect in the petroleum industry, about 50% rely on API standards. API is based on a complete standard system and carries out certification around the world. It has become a passport for petroleum products and services in the international market. A total of more than 1,540 petroleum equipment companies in my country have obtained API certification, involving an annual export volume of more than 70 billion yuan. .

At present, the authoritative group standard in the field of domestic oil pipes and equipment materials Lack of standards and certification makes it difficult to obtain widespread recognition abroad. The Standardization Law revised in 2017 clarified the legal status of group standards. However, the current group standards system lacks top-level design and unified planning. Taiwan's standards are scattered and centralized in more than 20 societies and associations, with overlap and duplication. and disorderly competition, it is difficult to form a model like American API, ASTM, ASME, NACE It is also difficult to develop group standard systems such as those that are widely recognized and implemented by users. Authoritative authentication like API. We should learn from the successful experience of API and work from the following aspects.

3.1 Actively Build a Group Standard System and Form an Authoritative Certification System

Led by the industry leader (PetroChina), with petroleum equipment (pipe materials)

Focusing on the two fields of manufacturing and oil and gas engineering technical services, relying on the most powerful scientific research institutes or technology-based enterprises, and jointly with other petroleum companies and manufacturers in the industry, in the name of the China Petroleum Institute, we can learn from existing relevant and mature Industry or enterprise standards, and supplementary formulation of relevant standards to establish as soon as possible an independent, systematic group standard system for my country's petroleum industry that complies with the laws of market economy. On this basis, the independent group standard system and the certification of products and services should be implemented in petroleum equipment enterprises to continuously enhance the influence and authority of my country's independent petroleum group standards.

3.2 Accelerate the Internationalization Process of Standards and Certification Systems

At present, there are more than 500 teams in my country engaged in oil and gas exploration and development in more than 40 countries. The overseas market potential for drilling equipment and pipe products and engineering technical services is huge. We should rely on the "Belt and Road" construction to carry out extensive cooperation and mutual recognition of CPS standards and certification in countries along the route, and gradually radiate to the world for recognition and recognition; on the other hand, we should actively strive to cooperate with IOGP (International Association of Oil and Gas Producers), Cooperation with organizations such as ISO has brought my country's petroleum industry standards and certifications abroad. Through continuous efforts, China's independent petroleum industry group standards will become internationally influential and authoritative international advanced standards .

3.3 Increase Investment in Standardization and Seize the Commanding Heights of Petroleum Standard Technology

Plan and layout in advance, incorporate independent innovation and standard development in the fields of offshore oil and gas, unconventional oil and gas, smart pipelines, green manufacturing, new energy and energy storage materials into the "14th Five-Year Plan" development plan, invest special funds to support the formation of a number of Authoritative international standards in the field of cutting-edge technologies, and actively seize the commanding heights of standard technology.

4 FOCUSING ON IMPROVING QUALITY AND EFFICIENCY, WE STRIVE TO SOLVE MAJOR TECHNICAL PROBLEMS SUCH AS CASING DEFORMATION AND DAMAGE AND PIPE NETWORK LEAKAGE.

The oil pipes and equipment involved in fields such as oil and gas field development, refining and chemical industry, and pipeline storage and transportation are large in quantity and require a high proportion of investment. Once they fail, they often cause huge economic losses, serious environmental pollution, and even catastrophic casualties.

4.1 Carry out Scientific and Technological Research to Effectively Promote the Prevention and Treatment of Casing Deformation and Damage in Oil and Gas Fields

Casing damage in oil and gas fields seriously affects the development and profitability of oil and gas fields. Casing Deformation is also a major technical bottleneck encountered in the development of shale gas and shale oil. Every year, economic losses caused by casing damage and deformation are huge. In recent years, with the increase in mining intensity and mining difficulty, the casing loss rate has an obvious upward trend. Shown; In 2018, the casing of shale gas wells in some areas of Sichuan during the fracturing process The change ratio is as high as 49%; in addition, the high pressure in Southwest and Tarim oil fields The air tightness of the special threaded connection of the gas well is difficult to guarantee, resulting in an annular zone. Pressure becomes a neck-stuck problem. In the 1980s and 1990s, the Institute of Management Research The casing damage in Daqing Oilfield was investigated and treated, and the casing damage rate was once dropped significantly. Starting from 2018, for the development of shale gas in Changning and Weiyuan blocks The serious cascading problem in According to the test, a field test of the casing degeneration prevention technology has been carried out and the expected results have been achieved. As a result, it is expected to significantly reduce the proportion of casing changes in shale oil and gas development. same At that time, the Institute of Management Research focused on the needs of oil and gas fields to carry out prevention and treatment of casing damage. management work. During the "14th Five-Year Plan" period, domestically produced high-gas sealing special thread connections were launched. The development of connected casing is also imperative.

4.2 Strengthen Research on New Products and New Technologies to Prevent and Control Leakage in Oil and Gas Gathering and Transportation Pipeline Networks

The oilfield gathering and transportation pipeline network is the most extensive linear facility under the earth's surface. The only channel through which air is transported. The gathering and transportation pipeline network has long mileage, large quantity, and divided Widely distributed, leaks often occur due to corrosion, third-party damage, etc. Symptoms happen from time to time. In response to this problem, the Institute of Management Research has carried out metallurgical rehabilitation in recent years. Combined pipes, epoxy sleeves, non-metallic pipe insertions, corrosion inhibitors, and intelligent detection of pipe networks Research on new products and new technologies, and achieved preliminary results. The "14th Five-Year Plan" will further increase the promotion and application of new technologies and new products with the support of superiors and oil and gas field companies such as Changqing, Daqing, and Tarim, and solve the problem of gathering and transportation pipeline problems. Network corrosion, operation monitoring and rapid repair problems, and actively participate in leak-free demonstrations Construction of pilot areas will improve the efficiency of oil and gas fields and avoid environmental accidents.

4.3 Apply Risk-Based Detection and Fault Diagnosis Technology to Solve Corrosion and Wear of Refining Facilities

Refining facilities and pressure vessels are prone to corrosion, erosion and wear, and many critical materials still rely on imports. Organizations are needed to conduct in-depth research on materials for refining and chemical facilities, delay corrosion and wear, and achieve localized substitution. On this basis, we will promote the application of risk-based detection and fault diagnosis technologies, and on the premise of ensuring safety, try to extend the overhaul cycle of facilities and improve the efficiency of the refining business.

4.4 Using Non-Metallic Pipes as a Breakthrough Point to Achieve Integrated Upstream and Downstream Operations

In 2015, the Management Research Institute proposed to strengthen upstream and downstream integrated operations and promote Suggestions on the application of chemical raw materials in oil field gathering and transportation pipeline networks. 2017, mid Petroleum has established a key industrial pilot project "heat-resistant polyethylene pipes for oil fields" "Industrial Testing of New Products in Changqing Oilfield" is undertaken by Changqing Oilfield, Petrochemical Institute, Management Research Institute, Daqing Petrochemical, Jilin Petrochemical and other units. Currently, it has Successfully developed new polyethylene pipe products and laid 12 pipes in Changqing Oilfield pipeline (20. 8 kilometers), the pipe performance is stable and the operation is in good condition. this The work has promoted the oil and gas industry from polyethylene development and production, composite pipe preparation to The entire industrial chain and integrated operation of oilfield applications maximize benefits. The "14th Five-Year Plan" will carry out in-depth research and development of rubber and plastic raw materials and non-metallic pipes. development and evaluation, formulate a scientific and reasonable standard system, expand rubber and plastic The application scope of pipes can be realized in oil and gas mixed transportation, natural gas transportation and well Applications in various fields.

4.5 Research High-Grade Steel Natural Gas Pipeline Welding Technology and Detection Technology to Ensure the Safe Operation of Long-Distance Oil and Gas Pipelines

As of the end of 2019, the total length of domestic oil and gas pipelines reached 13.9 million kilometers [10]. According to the two accidents in the Qinglong section of the China-Myanmar Pipeline and other Judging from the analysis of his pipeline accident results, the quality and technical issues of girth weld welding The problem has become the main issue affecting the safe service of high-grade steel natural gas pipelines. Therefore, we should continue to systematically carry out strength matching for high-grade pipeline girth welds. Design, steel pipe base material, welding materials, welding process, fracture control, defect repair scientific research work in complex and other aspects to overcome the dependence on high-performance welding machines and welding materials Import, unstable process quality, pipeline stress status monitoring, welding defect inspection Measurement and tolerance assessment technical difficulties in the construction and safe operation of high-grade steel pipelines The field continues to form leading scientific and technological achievements of independent innovation to ensure high-grade steel pipes. maintain safe operation and maintain its position as one of the front-runners.

4.6 Organize Key Technology Research and Promote the Localization of Offshore Oil Equipment and Materials

my country's offshore oil equipment has insufficient independent innovation capabilities and key core issues problems such as the lag in research and development of core materials [11]. Underwater wellhead, underwater tree, water Martensitic stainless steel and super austenitic stainless steel are used for key equipment in offshore drilling such as lower valves. Addition of solid stainless steel, super duplex stainless steel, nickel-based and iron-nickel-based alloys, etc. The manufacturing technology is immature and mainly relies on imports. Marine flexible pipes are mainly made of Three companies in France and the United States have a monopoly, and domestic companies have no production capacity. The "14th Five-Year Plan" will draw lessons from the "failure analysis" established by the localization of high-grade steel pipes. - Standardization-scientific research-testing and evaluation" application support model and "product The integrated development mechanism of "learning, research, application and inspection" organizes the inspection and testing of offshore oil equipment and materials. Research on localization to improve the independent guarantee of my country's offshore oil equipment and materials ability and overall level.

5 FOCUS ON THE LONG TERM AND PLAN AHEAD FOR THE DEVELOPMENT OF ARTIFICIAL INTELLIGENCE, NEW ENERGY AND NEW MATERIAL TECHNOLOGIES

Digital technologies with artificial intelligence, big data, cloud computing as the core, as well as new energy, new materials and other technologies continue to penetrate into the oil and gas field. Major oil companies have seized the opportunity to advance in energy technology and seek a new round of scientific and technological revolution and industrial revolution. The commanding heights of competition.

5.1 Build an intelligent Decision-Making Platform to Achieve Failure Control, Health Management and Predictive Maintenance of Oil Pipes And Equipment

In its many years of work, the Management Research Institute has accumulated a large amount of data and information on oil pipes and equipment materials, service environments and failure characteristics. In the 1990s, the results of "Drill String Failure Analysis Case Library and Computer-Assisted Failure Analysis" won the second prize of the Shaanxi Province Science and Technology Progress Award. It was an attempt to use computer technology to improve the level of failure prediction and prevention, and provided artificial intelligence technology in oil pipes and equipment. Application in failure control lays the foundation. Artificial intelligence is applied to the full life cycle health management of oil pipes and equipment to establish a digital twin for real-time diagnosis and intelligent decision-making and a smart platform for failure analysis and prediction and early warning, which can effectively reduce failure accidents and protect oil well pipe strings, drilling and production equipment, and the ground. Safety of pipelines and refining equipment.

5.2 Lay Out Breakthroughs in Key Materials Application Technologies in the Development of New Energy and Create Conditions for the Development of New Energy

Hydrogen has become a consensus as a clean energy source for future development, and the collection and transportation of hydrogen is one of the key bottlenecks. The International Energy Agency predicts that pipeline transportation of hydrogen is an economical choice within a distance of 1,500 kilometers. Therefore, it is particularly urgent to carry out research on the development and application technology of high-pressure hydrogen storage and transportation materials, key technologies for hydrogen pipeline construction and safe operation, and the applicability of mixed hydrogen transportation for in-service natural gas pipelines.

In order to achieve the goal of carbon peaking before 2030 and becoming carbon neutral by 2060, PetroChina is carrying out research and field tests on carbon capture, utilization and storage technology (CCUS) to achieve CO₂ generated from fossil energy. By then, the efficient collection and transportation of CO₂ will form a large-scale industry. CO₂ gathering and transportation involves safety risks such as corrosion, leakage, and explosion. Therefore, focusing on the large-scale application of CO₂, it is necessary to reserve key technologies for safe CO₂ gathering and transportation in advance. This is also the focus of research in the field of oil pipes and equipment materials.

5.3 Carry Out the Research, Development and Application of New Oil Pipes and Equipment Materials to Seize the Technological Commanding Heights

Focusing on "deep, low, offshore and non-sea" oil and gas development, titanium alloys, aluminum alloys, magnesium Alloy and carbon fiber pipes have low density, high specific strength, corrosion resistance and With its advantages such as fatigue resistance, it is expected to become an ideal choice for drilling in ultra-deep wells, horizontal wells, extended reach wells, etc. Sharp tools for development; metallurgical bonded bimetallic composite pipes, medium and low Cr corrosion-resistant alloy pipes, new coated pipes, high temperature resistant (temperature resistant above 80 °C) non-metallic and composite pipes Composite material pipes have both good corrosion resistance and economy. The development of these products Faco can be promoted for application in sour oil and gas fields; 3D printing (additive manufacturing), green The rapid development of remanufacturing, high-performance new structural steel, advanced composite materials and other technologies The development will lay the foundation for lightweight, green and intelligent petroleum equipment.

For the development of natural gas hydrates, we develop and apply titanium alloy pipes and new surface coating materials to solve bottleneck problems such as large dogleg passage and hydrate blockage; for underground coal gasification, we develop and apply flammable casings and 350 °C high temperature corrosion tools. Materials to solve gasifier integrity problems such as casing deformation, corrosion perforation, and annular pressure; in terms of geothermal development, it is necessary to develop and establish high-temperature drilling testing for deep (greater than 5,000 m) and high-temperature (greater than 450 °C) environments. Tools and materials system. These are our research directions and key tasks focusing on future development.

6 CONCLUSION

For many years, the Institute of Management Research has been committed to the research and development of oil pipes and equipment materials. Technological innovation, focusing on solving many commonalities, key points and bottlenecks in the fields of oil and gas field development, refining and chemical industry, pipeline storage and transportation, equipment manufacturing, new energy development and other fields technical challenge. At present, the country is vigorously implementing the innovation-driven development strategy and facing New problems and challenges in the development of my country's oil pipes and equipment materials, oil and gas Scientific research institutions in the field of oil pipes and equipment materials in the industry should strengthen cooperation with domestic Cooperate with foreign metallurgical enterprises, universities and scientific research institutes to actively build Innovation consortium to jointly promote new materials and new technologies in oil and gas field development and management Innovative development in road construction and operation, new energy utilization and other fields will help us The transformation and upgrading of China's energy technology will contribute to the construction of a strong manufacturing country and national energy security. Contribute full scientific and technological strength to realize scientific and technological autonomy in the field of oil pipes and equipment materials Establish self-reliance and independent control of the industrial and supply chains.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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