RESEARCH ARTICLE

Research on the Problems and Countermeasures of Petroleum Environmental Protection Management

Denggao Xiong

China Aviation Fuel Co., Ltd. Wanzhou Supply Station, Chongqing 404100, China

Abstract: The wave of low-carbon economy has swept the world, and countries have begun to develop low-carbon economies and implement energy-saving and emission reduction measures. Developed countries have conducted research on low-carbon economy and energy conservation and emission reduction earlier than China, and have achieved some results. The rapidly developing national economy's increasing demand for oil requires people to accelerate the development of oil. However, most regions of China are located in impoverished areas, and the vast majority of oil production comes from water injection development methods. Oil injection development projects are widely distributed in oilfield production. While obtaining stable and abundant oil resources, oil injection development projects have also brought increasingly serious water environment problems. How to scientifically evaluate the impact of oil injection development projects on the water environment has become an urgent problem that needs to be solved.

This article studies the operation process, application technology, and environmental pollution caused by oil injection development projects; Analyzed the process and results of the impact of oil injection development projects on the water environment; A comprehensive evaluation index system for the impact of oil injection development projects on water environment has been constructed, and a dynamic comprehensive evaluation model for water environment impact has been established; A comprehensive evaluation was conducted on the water environment impact of the project. The comprehensive evaluation index system and dynamic comprehensive evaluation model for the impact of oil injection development projects on water environment can be widely used in the evaluation of the impact of oil development projects on water environment. Based on this theoretical achievement, if corresponding evaluation software can be formed, it will be widely used in the evaluation of oil development projects.

By drawing on the successful experiences of developed countries in developing low-carbon economies and implementing energy conservation and emission reduction, we will conduct in-depth analysis of the severe situation and current status of energy conservation and emission reduction policies faced by China; This study focuses on the energy-saving and emission reduction behavior of Chinese oil companies in the current policy environment, including their corporate characteristics and motivations for implementing energy-saving and emission reduction. The achievements and existing problems of adopting energy-saving and emission reduction measures in recent years; Provide strategic suggestions for the future low-carbon development of petroleum enterprises: technological innovation strategy, environmental protection and safety strategy, human resources strategy, cross-border business strategy, development of new energy and resources strategy, and industrial structure low-carbon strategy.Petroleum enterprises are one of the most important energy enterprises in China, and are typical resource dependent and energy consuming enterprises. Implementing energy conservation and emission reduction is an inevitable choice for sustainable development and enhancing international competitiveness of petroleum enterprises. Improving energy efficiency by oil companies has made a great contribution to China's industrial energy efficiency. Therefore, studying the energy-saving and emission reduction behavior of petroleum enterprises is of great significance for China's low-carbon development.

Keywords: Petroleum enterprises; Policy environment; Energy conservation and emission reduction; Evaluation index system; Oil injection development project

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1 Introduction

1.1 Background and Research Significance

1.1.1 Background

The development and utilization of oil by humans has a long history. 2500 years ago, ancient Persians began drilling and mining in the Arlika area near their capital, Susa. The Chinese people's understanding of oil can be traced back to the Song Dynasty. However, the modern petroleum industry has only a history of over a hundred years. In 1848, the Soviet Union drilled and produced oil along the Black Bubble Coast, and in 1859, the United States also drilled the Shan well in Pennsylvania. China's modern oil development started relatively late, It was not until 1878 that oil was produced in Miaoli, Taiwan, China, using "Dun Zuan" drilling. In 1905, the Qing government approved the establishment of the "Yanchang Petroleum Plant" in Yanchang County, Shaanxi Province "In 1907, it became the first Shantou well in Chinese Mainland. Looking back at the history of more than 100 years of modern oil industry, it is found that oil has not only brought prosperity and civilization to the world, but also brought war and disaster, pollution and destruction. Oil is not only related to resources and economy, but also related to the development of politics and human society.

With the sustained and rapid development of the Chinese economy, the demand for oil has skyrocketed. Almost everything that flies in the sky, runs on the ground, travels in the water, and is used at home is closely related to oil. In 2013, China's oil production reached 207 million tons, a year-on-year increase of 1.9%; The import volume was 282 million tons, a year-on-year increase of 4.03%; The external dependence of oil is 57.67%. It is expected that in 2014, China's oil production will be 210 million tons, and its import volume will be 289 million tons. The dependence on foreign crude oil will reach 58%. As an important strategic resource, oil must stabilize its supply and price, avoid the risks brought by the world oil market, and therefore vigorously develop domestic oil development, innovate oil exploration and development technology, improve oil recovery rate, and strengthen domestic oil supply.

Among the developed oil fields in China, the geological reserves of oil fields with sufficient natural energy are only less than 4% of the exploitable geological reserves in ancient times, while 96% of oil fields with geological reserves lack natural energy and require water injection to supplement energy to maintain high and stable production and high recovery rates. Currently, most of China's oil fields have entered the stage of high water cut development, and the development of low permeability and ultra-low permeability oil fields has entered a critical period. More than 90% of China's oil production comes from thousand water injection development, which is currently the most mature, economical, and common development method in China. The occurrence characteristics of Shanqian oil resources include the enormous amount of water extracted and injected during the water injection development process. Overextraction of groundwater leads to a decrease in groundwater level, which in turn leads to land subsidence. The discharge of produced water directly affects the surface water environment. High pressure injection of water may cause underground oil and water to cross layers and return water outside the casing, and even cause ground deformation. Therefore, the water supply environment of oil injection development has brought huge pollution and damage. Water is the source of human life and the source of ecology. China is a country with a severe shortage of water resources, with per capita freshwater resources being only a quarter of the world average. In arid and semi-arid regions, per capita water resources are even lower. Many oil injection development projects in China are located in areas with fragile ecological environments. The oil injection development projects have caused great damage to the local water environment, resulting in a decrease in available water resources and a decrease in water quality. This has led to conflicts between the oil injection development and the population and social development of the project location, thereby affecting the sustainable and healthy development of the environment and economy. It is of great significance to scientifically and reasonably evaluate the impact of oil injection development projects on the water environment, while ensuring oil production and protecting the water environment. Therefore, this article chooses the evaluation of the impact of oil injection development projects on the water environment as the research topic, and the main issues discussed include: the process and results of the impact of oil injection development projects on the water environment; Index system and model for evaluating the impact of oil injection development projects on water environment; How can oil development enterprises protect the water environment from management and policy aspects during project construction and operation.

In recent years, global warming has caused sea level rise, and extreme weather events have occurred frequently, triggering a series of disasters that have endangered human survival and development. The greenhouse gases such as carbon dioxide emitted by human combustion of fossil fuels are the main cause of climate change, and reducing carbon dioxide emissions is directly related to global environmental security. In order to cope with the severe situation of climate change, the international community strongly demands that countries around the world transform their high carbon emissions way of survival and development, and reduce carbon dioxide emissions. The international community has reached consensus on some major issues regarding how to reduce emissions.

China is a developing country with a large population. As a major developing country, the industrial structure is unreasonable, and the economy is characterized by "high investment, high consumption, high pollution, and low efficiency". With the acceleration of industrialization and urbanization process and the continuous improvement of residents' energy consumption level, the pressure on resources and environment will further increase. In the future, greenhouse gas emissions may further increase with economic growth.

The oil industry is directly responsible for the highest 6% of global carbon dioxide emissions. When end users (transportation, power generation, and heating) increase their carbon dioxide emissions, the oil and natural gas sector accounts for almost half of all global emissions, and can be said to play a central role in carbon dioxide emissions. Therefore, petroleum enterprises are the main resource dependent and high carbon emitting enterprises, and also the main force in the development of low-carbon economy.

There is a gap in energy consumption and utilization efficiency between China's petroleum and petrochemical industry and the advanced level of foreign countries. After introducing a series of energy-saving and emission reduction policies and issuing emission reduction targets, China's petrochemical enterprises are facing severe challenges in competition, survival, and development. The tremendous changes in the survival and development environment have forced Chinese oil companies to make strategic decisions. Therefore, in such an international and policy environment, the energy-saving and emission reduction behavior of petroleum enterprises is an urgent research topic.

1.1.2 Research significance

(1) Theoretical significance

Based on the engineering analysis of oil injection development projects and the summary of the characteristics of oil injection development projects, the process and results of the impact of oil injection development projects on the water environment were analyzed; We have constructed an indicator system for evaluating the impact of oil injection development projects on water environment quality and quantity, and explored and evaluated the evaluation model of the impact of the Shishan injection development project on water environment quality and quantity using the idea of

Analytic Hierarchy Process and linear weighting method; Based on this generation, a comprehensive evaluation index system for the impact of oil injection development projects on the water environment has been established from a macro perspective, and a dynamic comprehensive evaluation model for the impact of oil injection development projects on the water environment has been constructed.

(2) Practical significance

This article is based on the perspective of thousands of petroleum development enterprises. In order to scientifically evaluate the impact of petroleum water injection development projects on the water environment, and in response to the particularity of petroleum water injection development projects, it scientifically evaluates the impact of petroleum water injection development projects on the water environment. It provides process and method guidance for petroleum enterprises to evaluate the impact of project construction and operation on the water environment, and feasible policy suggestions were proposed for the water environment protection of oil injection development projects, which is beneficial for thousands of enterprises to protect the water environment while reasonably developing oil resources, and to coordinate the development of resource development and environmental protection.

1.2 Research Status

Environmental Impact Assessment (EIA) is the process of analyzing and evaluating the impact of human activities on the ecological environment, with the aim of ensuring the sustainable development of the ecological environment and human society. In 1969, the United States first proposed the concept of EIA and established an evaluation system [1]. So far, EIA has been widely applied worldwide, playing a significant role in predicting, evaluating, controlling, and reducing the impact of human activities on the environment [2-5]. With the development of the global economy and society, the degree and frequency of human activities' impact on the environment are constantly increasing. Traditional EIA cannot fully reflect the impact of human activities on the environment, and its drawbacks are constantly exposed: the evaluation scope is limited in time and space, and less consideration is given to the indirect, cumulative, and synergistic effects of human activities on the environment. Moreover, human environmental awareness is constantly improving, and choosing the direction, content, scale, speed, and method of human activities that are consistent with sustainable development has become the focus of environmental assessment.

1.2.1 Current research status abroad

In the 1930s, the United States began using water injection to replace and develop oil, but the environmental impact of water injection development was not very clear. In the late 1940s, the former Soviet Union began to adopt a large-scale development method of water injection to maintain the pressure of the Shantou formation, which caused a significant change in the oil development method. Afterwards, oil water injection development was widely carried out in various countries, and the scale of water injection development became increasingly large. In the 1950s, the amount of oil developed by the United States through water injection accounted for only 12% of the country's total production, and by the 1980s it had reached over 50%. In the late 1960s, the amount of oil produced by the former Soviet Union through water injection technology accounted for 71% of the country's total oil production, and by the 1980s it had reached over 90%. Today, more and more newly developed oil fields are adopting water injection development methods. Foreign countries have conducted in-depth research on the pollution and management of water environment caused by oil injection development projects.

Scholars [7] have studied the impact of oil development projects on river water quality. Oil development has caused changes in the physical and chemical properties of water bodies, eutrophication of water bodies, and damage to ecosystems. They have established an indicator system to evaluate the impact of oil development projects on the river water environment by measuring the pH value of water and sediment, suspended solids, heavy metals, petroleum, and other indicators. The emissions from oil development projects have caused changes in the pollution of microorganisms in water, and the chemical indicators of water bodies, such as biochemical oxygen demand, dissolved oxygen, total hardness, and ammonia nitrogen, have also undergone changes. Moreover, as oil development activities continue, pollutants continue to deposit and the water quality in the project area continues to change. Ostera et al. [9] studied the impact of oil development projects on groundwater environment and explored the changes in groundwater quality in arid areas through specific case studies. Ukpohor [10] first affirmed the environmental damage caused by produced water during the operation of oil development projects, analyzed its impact on microorganisms, water environment, and humans, and finally studied how to solve the environmental impact of produced water through technical means. Alhimenko et al. [11] developed a mathematical model based on laboratory data on the infiltration and diffusion of oil under ice, conducted on-site inspections of the process of oil infiltration and diffusion under ice, and verified laboratory data. Warner et al. established a numerical model using finite difference method to determine the flow status of groundwater in abandoned oil and gas well areas, and analyzed the trend of pollutants flowing into water sources through abandoned wells with certain permeability as pollution pathways.

The global warming caused by greenhouse gas emissions caused by human activities is an undeniable fact, and energy consumption is the main reason for the increase in global carbon dioxide emissions. Public opinion believes that "climate change is the biggest challenge facing humanity in the 21st century" and requires the international community to jointly address it. The United Nations has made climate change one of its top issues, and Secretary General Ban Ki moon believes that the impact of climate change is not limited to wars and conflicts. Climate change has brought serious consequences, and many regions' agricultural production will face reduced production, changing 2 Above, agriculture in almost all regions will reduce production, and the destructive power of floods, droughts, heatwaves, and storms will continue to increase. Diseases sensitive to temperature and humidity, such as cholera and dengue fever, will spread, and rising sea levels will cause huge property losses. Since the signing and entry into force of the United Nations Framework Convention on Climate Change and the Kyoto Protocol, ensuring energy security, promoting sustainable development, and addressing climate change have become inseparable for any country or region.

In 2003, the UK energy white paper 'Our Energy Future: Creating a Low Carbon Economy' first made the world aware of the concept of a low-carbon economy. Currently widely cited is the definition of UK environmental expert Rubinstein: a low-carbon economy is an emerging economic model, whose core is to promote the development and application of energy efficiency, energy conservation, renewable energy, and greenhouse gas emission reduction technologies through the formulation and innovation of institutional frameworks and policy measures based on market mechanisms, promoting the overall socio-economic development towards high energy efficiency and low energy consumption Transformation of low emission and low pollution models.

Although the definition of low-carbon economy in various countries is not completely consistent, it basically represents two core priorities: 1) From the perspective of economic development models, it is believed that the essence of low-carbon economy is to improve energy efficiency and clean energy development, with the core being energy technology innovation and institutional innovation. The goal is to mitigate climate change and promote sustainable human development, that is, to implement an energy revolution, relying on technological innovation and policy measures, Establish an economic development model that reduces greenhouse gas emissions; 2) From the perspective of economic development and transformation, it is believed that a low-carbon economy is an economic model based on low energy consumption, low pollution, and low emissions. It is another significant progress in human society after agricultural and industrial civilization. The low-carbon economy is essentially a profound reflection on the operation of modern economy, a global energy economy revolution involving production patterns, lifestyles, values, and national rights.

Developing a low-carbon economy requires timely transformation of existing traditional energy systems and changes in energy structure. The construction of energy infrastructure requires a large investment and a long cycle, and once completed, it will have a long-term impact on greenhouse gas emissions for a long time in the future. If large-scale energy infrastructure on a global scale only uses current non low-carbon traditional technologies, the harm to the environment is irreversible. However, the conversion of energy systems will involve enormous investment and interest challenges. To convert the world's existing energy systems, it will require a huge amount of funds worth over ten billion US dollars. The already invested huge energy assets will normally have to operate for another decade to recover their investment. So the structural transformation in the energy sector often affects the economic operation in the next decade, and early preparation is needed to avoid causing huge economic losses. The capital deposition in the energy sector is huge, and the interest groups formed here are too powerful and have a large tail, which is also one of the root causes of the poor reform effect in the energy sector of various countries and the serious disconnection between economic and social development.

At present, the low-carbon economy around the world mainly operates through multilateral or joint carbon funds, emission trade, carbon taxes, quota quotas, energy funds, financial subsidies, increased investment in technology research and development, and other means. It also includes implementing strong industrial policies, etc.

1.2.2 Current research status in China

In China, the Laojunmiao oil field began water injection development in 1955, marking the beginning of China's petroleum water injection development. In the late 1950s, Karamay Oilfield began to conduct internal cutting water injection, and in the early 1960s, Daqing Oilfield also determined the policy of early water injection to maintain formation pressure, which greatly promoted the development of China's oil injection development theory and practice. According to statistics, the average comprehensive water content of various oil fields in China has exceeded 85%, of which the water content exceeds 80%. Oil fields that have entered the late stage of high water content and ultra-high water content have recoverable reserves accounting for over 70% of the country. At the same time, the impact of China Petroleum's water injection development projects on the water environment has also attracted widespread attention.

In terms of the impact of oil injection development projects on surface water environment, Jia Bing [13] analyzed the emission characteristics of pollutants from oil injection development projects, combined with the pollution status of surface water, and used a fuzzy comprehensive evaluation method to comprehensively evaluate the quality of surface water environment. Kang Yuan et al. [14] sampled surface water from the upper reaches of the Luo River in northern Shaanxi, tested for hexavalent chloride, sulfate, chemical oxygen demand, volatile phenols, petroleum, etc., and conducted a water environment assessment using the single factor pollution index method. They found that the main causes of water environment pollution in the project area were mining wastewater, landing crude oil and oil sludge, drilling oil pollution, etc. At the same time, they found that the pollution levels of the river were different during the dry and semi dry periods.

In terms of the impact of oil injection development projects on groundwater environment, Li Yang [15] used the Nemero index method, fuzzy comprehensive evaluation method, principal component analysis method, and fully arranged polygon comprehensive index method to evaluate the shallow groundwater quality of oil injection development projects. Zheng Zikuan [16] analyzed the impact of oil injection development projects on groundwater resources and proposed water environment protection measures based on Dong Zhiyuan's current water environment situation. Cao et al. [17] pointed out that the oil injection development project in the Loess Plateau of Longdong poses a direct threat to the drinking water sources of local residents, such as the leakage of drilling mud, causing serious pollution of underground diving; And accidents where oil wells cut off underground runoff, leading to the drying up of motor wells. Ma Ying et al. [18] introduced the damage to the water environment caused by oil injection development projects, and believed that crude oil leakage and the reinjection of produced water were the main reasons for groundwater pollution in the injection development project area.

In terms of the comprehensive impact of oil injection development projects on the water environment, Yu et al. [19] analyzed the pollution characteristics of wastewater in China's mining industry, including the petroleum industry, and proposed relevant measures for wastewater control. Cui Tengke et al. [20] investigated the impact of the oil injection development project in Changqing Oilfield on the water environment of Qingyang City and found that the development of Changqing Oilfield has exacerbated the scarcity of water resources in Qingyang City, caused pollution of surface rivers and shallow groundwater, and had an impact on key drinking water source protection areas. Lu Zaoquan [21] also investigated the current situation of regional water environment pollution caused by the oil water injection development project in Qingyang City in his research, pointing out that the oil water injection development has caused serious pollution to the surface and groundwater environment in Qingyang City, resulting in the decline of groundwater level, the deterioration of water quality, and the direct pollution of surface rivers by the drainage outside Shantou. Zhao Dongfeng et al. [22] conducted quantitative analysis on the diffusion, volatilization, dissolution, decomposition, emulsification, oxidation, biodegradation, sedimentation, adsorption and absorption, distribution and enrichment of petroleum pollutants in the aquatic environment, and obtained the migration and transformation process of petroleum pollutants in rivers, wetlands, and nearshore waters.

Analysis of the Situation of Climate Change and Energy Shortage in China:

(1) Climate change has become a major issue of global environmental security

In recent years, climate change has caused frequent global extreme climate events, causing a series of major disasters and seriously threatening the space for human survival and development. However, the carbon dioxide emissions from burning fossil fuels are the main cause of climate change. In order to promote sustainable development of human society, the world has begun to advocate energy conservation and emission reduction, reducing carbon dioxide emissions to protect the global environment. The international community requires all countries to transform their high carbon emission survival and development methods in order to reduce carbon dioxide emissions.

(2) Under global emission reduction pressure, China cannot stay out of it

China has a large population and a relatively fragile ecological environment, with frequent natural disasters in recent years. China is in the process of industrialization and urbanization, characterized by intensive resource extraction and rapid consumption. Economic growth has a great demand for the heavy chemical industry, and coal is the main energy source in China. This situation has led to high greenhouse gas emissions in China. In 2007, China surpassed the United States as the world's largest emitter of carbon dioxide. In 2010, China surpassed the United States as the largest energy consumer. Since the signing of the Kyoto Protocol, the issue of climate change has risen to the international political level. With the gradual entry of carbon taxes and carbon trading into the international market, climate issues are no longer simple environmental issues, directly related to a country's political and economic lifeline.

However, China has always been in a passive position on climate issues. Although it has not been subject to mandatory emission reduction requirements from developed countries, the top emitter has led some developed countries to take advantage of this opportunity to exaggerate

China's Environmental Threat Theory and China's Security Theory. Nowadays, the concept of "the lowest per capita emissions" is becoming increasingly unconvincing, and it is necessary to accelerate the transformation of an extensive economic development model and implement energy conservation and emission reduction.

(3) The contradiction between China's energy consumption structure and economic development cannot be ignored

In 2010, the global energy consumption composition was 33.6% for crude oil, 23.8% for natural gas, 29.6% for coal, 5.2% for nuclear energy, 6.6% for hydropower, and 1.3% for renewable energy; The composition of China's energy consumption is: crude oil 17.6%, natural gas 4.0%, coal 70.5%, nuclear energy 0.7%, hydropower 6.7%, and renewable energy 0.5%. My coal consumption is the most severe and high, while the proportion of other energy sources is lower than the world average. This is because in terms of energy structure, China's choices are extremely limited, and improving economic competitiveness and promoting economic growth require cheap energy as support. The government's regulation of energy prices is a good example. The resource reserves and price advantages of coal make it the top choice for energy in China, but it also emits the most carbon dioxide, with a unit of electricity generating 1.3 times more carbon dioxide than oil. The energy that emits the most pollutants is consumed the most in China. The contradiction between the limited energy structure and resources, as well as the sustainability of economic growth, is becoming increasingly acute. On the one hand, with the rapid development of the economy, we hope to undertake the industrial transfer from developed countries. The rapid development of the heavy chemical industry requires the support of a large amount of fossil fuels; On the other hand, industries based on fossil fuels inevitably bring high energy consumption, high pollution, and high emissions. In addition to meeting the phased characteristics of our own economic development, China's future economic development will also be constrained by climate change and greenhouse gas emissions reduction. Therefore, developing a low-carbon economy and implementing energy conservation and emission reduction is a necessary path for China's sustainable development.

If China's coal consumption is reduced by one percentage point and replaced by hydropower or nuclear energy, the total greenhouse gas emissions in China will be reduced by 1.14%. Replacing coal with low carbon fossil fuels such as natural gas or oil will reduce carbon emissions by 0.46% and 0.28% for each percentage point reduction in coal consumption.

(4) Unreasonable industrial structure

At present, from the perspective of China's tertiary industrial structure, economic growth is overly dependent on the secondary industry, and the development of the low energy tertiary industry is severely lagging behind and has a low proportion. Taking 2004 as an example, the proportion of added value of the tertiary industry in China's GDP is

40.6%, while the average proportion of OECD countries during the same period was 72.5%, the United States reached 76.5%, and India, which is close to China's development level, also reached 52.3%. The industrial structure of our country is unreasonable and needs to be gradually adjusted, vigorously developing the tertiary industry, and suppressing the unrestrained development of energy intensive industries. However, adjusting the industrial structure is constrained by many factors. Firstly, the industrial structure is adapted to a certain stage of economic and social development. China must fully industrialize before the tertiary industry, represented by the service industry, can lead the national economy.

1.2.3 Problems in the research

With the expansion of the number and scale of oil injection development projects, significant progress has been made in oil injection development technology, and oil injection development has become a research focus today. However, with the increasing attention paid to the water environment, more and more scholars and organizations are paying attention to and studying the impact of oil injection development projects on the water environment. Scholars at home and abroad, such as Zheng Zikuan [16], Cao Tongmin [17], Ma Ying [18], and Cui Tengke [20], have qualitatively analyzed the impact of oil injection development projects on the water environment. They point out that oil injection development projects emit a large amount of pollutants in multiple processes and links such as surface construction, drilling, cementing, water injection and oil recovery, and gathering and transportation. These pollutants change the physical properties of surface and underground water bodies through direct and indirect effects Chemical and biological characteristics affect the quality of the water environment, and based on this, policies and suggestions for water environment protection have been proposed, as well as corresponding technologies and measures for water environment governance. The qualitative analysis of the impact of the Shiyan water injection development project on the water environment provides a research foundation for evaluating the impact of oil water injection development projects on the water environment, clarifies the research content and focus, and also points out the direction for proposing and formulating corresponding water environment protection policies and laws and regulations. However, these qualitative analyses cannot clarify the extent of the impact of oil water injection development projects on the water environment A series of issues such as whether governance measures need to be taken.

Domestic and foreign scholars have established water environment quality evaluation index systems in different regions. Through data collection and organization, the changes in pollutant content in the water environment of oil injection development projects were analyzed, and the process of pollutants affecting the water environment was analyzed. The water environment quality level was evaluated using fuzzy evaluation methods, artificial neural network methods, and other methods. These quantitative analysis and research results have solved the problem of uncertain impact degree in the water environment impact assessment of oil injection development projects, and made significant progress. However, these water environment assessments only reflect changes in water environment quality, and the impact of oil injection development projects on the water environment not only includes quality aspects, but also quantity aspects. These water environment quality assessments cannot fully reflect changes in the water environment. In addition, these water environment quality evaluations are based on static water environment quality monitoring data and cannot reflect the dynamic changes in the water environment.

In addition, there are still the following issues in the evaluation of the impact of oil injection development on the water environment:

(1) Insufficient depth of research

Deep research has been conducted on the sources and processes of the impact of oil injection development on the water environment, and the seriousness of the water pollution problem caused by oil injection development has been recognized. However, the quantitative research on the impact of oil injection development on the water environment is insufficient, only focusing on the quantitative evaluation of the project's impact on the quality of the water environment, without analyzing the impact on water volume and socio-economic factors, There is also no research on the impact of oil injection development projects on the water environment from the perspective of project management.

(2) Time limitations

Previous studies on the impact of oil injection development projects on the water environment were mostly short-term, even at a certain point in time, and continuous long-term studies were not common. The dynamic characteristics of the mountain water environment and the long-term sustainability of oil injection development projects cannot provide a reliable basis for the identification and treatment of water environment problems caused by oil injection development projects, It is even more difficult to study the development and changes in the impact of the Shishan water injection development project on the water environment. In future research, attention should be paid to time scale research, focusing on the dynamic characteristics of the water environment and the timeliness of pollutant emissions from oil injection development projects, and conducting long-term continuous monitoring research on oil injection development projects.

(3) Theory and practice are disconnected

The United States and Canada have conducted long-term research on the impact of oil injection development projects on the water environment, and have entered the cumulative impact assessment stage from the mountain environmental impact assessment stage. The cumulative environmental impact assessment is explicitly stipulated in laws and regulations. However, there are also significant issues in the cumulative assessment of the impact of oil injection development projects on the water environment in the United States and Canada. The complexity of mountain assessment and its involvement in multiple disciplinary fields lag behind theoretical research in practice. Even in theoretical research, there are no universally recognized principles, frameworks, or mature methods. The concept of cumulative impact assessment has been proposed in the guidelines for environmental impact assessment in China, but it is not mandatory to conduct cumulative impact assessment.

Moreover, China has conducted years of research on the impact of oil injection development projects on the water environment, but the pollution caused by oil injection development projects has not significantly improved. This indicates that there is a disconnect between theory and practice in the study of the impact of oil injection development projects on the water environment, and theoretical research has not been valued and applied in practice. Therefore, in the future, when conducting research on the impact of oil injection development projects on the water environment, While conducting theoretical exploration, more emphasis should be placed on the practical testing and application of theory. Accelerate policy and technical research that can effectively address the monitoring and governance of the impact of oil injection development projects on the water environment, and concretize and standardize the evaluation indicators of the impact of oil injection development projects on the water environment, providing theoretical guidance and technical support for the coordinated development of resources and environment. Connect theory with practice, practice under the guidance of theory, and improve theory in the development of practice.

1.2.4 Ways for Energy Conservation and Emission Reduction in Various Countries

From the practice and current research of energy conservation and emission reduction in various countries, the main ways to achieve energy conservation and emission reduction are as follows:

(1) Adjusting industrial structure

Industrial structure refers to the composition of various industries in a country, as well as the connections and proportional relationships between them. Industrial structure adjustment is an important topic for economic development in various countries today. Developed countries have completed industrialization and urbanization, driving economic transformation through accelerated industrial structure upgrading. The proportion of high-energy consuming raw material industries and manufacturing industries in the economy of developed countries has significantly decreased. Low emission industries such as finance, services, and information have rapidly developed, and greenhouse gas emissions per unit of GDP have shown a downward trend. At the same time, the internal structure of the secondary industry in developed countries is also undergoing significant changes. By improving environmental standards and other measures, the development of low-end manufacturing and high energy consuming industries such as metallurgy and chemical industry has stagnated or even shrunk. Developed countries will

Transfer high energy consuming industries to developing countries. For example, in the UK, from 1990 to 2007, the proportion of the secondary industry to GDP

The proportion has decreased from 35% to 23%, and the tertiary industry has increased from 63% to 76%. The upgrading and optimization of industrial structure is an important aspect for developed countries to achieve greenhouse gas emissions reduction. However, in the process of urbanization and industrialization, the phased characteristics of the rising proportion of high-energy consuming manufacturing in the national economy are still difficult to change. However, developing countries still need to incorporate the adjustment of industrial structure into their long-term national planning as an important way to control greenhouse gas emissions and achieve sustainable development.

(2) Strengthen energy conservation and improve energy efficiency

Energy efficiency refers to the efficiency of various processes such as energy development, processing, conversion, and utilization. On the basis of relatively high energy efficiency levels, developed countries are further strengthening energy conservation and improving energy efficiency, suppressing the growth of energy demand, and issuing various policy measures. The European Union has proposed to increase energy efficiency by 20% by 2020, and has issued the "Green Paper on Energy Policy" and the "Action Plan for Improving Energy Efficiency", clarifying 75 specific measures to improve energy efficiency in ten key areas including construction, transportation, and manufacturing. It is estimated that through the above measures, the EU can reduce energy consumption by 400 million tons of standard oil and reduce carbon dioxide emissions by approximately 800 million tons. In the energy consumption of developed countries, industrial energy consumption is mostly less than 30%, while building and transportation energy consumption each account for 30-40%. Therefore, building and transportation have become key areas for energy conservation and improving energy efficiency, and the results are significant. According to statistics from the International Energy Agency, the per capita energy consumption for building heating in developed countries decreased by 19% from 1990 to 2006, while the energy consumption of large household appliances such as refrigerators and washing machines decreased by 24%. The average fuel consumption per 100 kilometers of new cars decreased by 15%. Starting from 2009, EU member states have fully implemented new building energy consumption standards and vigorously promoted ultra low energy new buildings without active heating, which is expected to reduce the total terminal energy consumption of the EU by 11%. Japan has been implementing the "Leader Plan" since the beginning of this century, encouraging energy-saving and improving energy efficiency of energy consuming equipment such as appliances and cars. In 2005, the energy efficiency of R-type lighting increased by 36% compared to 1997 levels, and the fuel economy of passenger cars increased by 23%. In 2009, the United States established new fuel economy standards for automobiles, requiring all cars and light trucks manufactured and sold in the United States to reduce fuel consumption per 100 kilometers by 8% compared to current levels.

(3) Optimize energy structure

What is needed for socio-economic development is energy, not carbon. The amount of carbon contained in different forms of energy or per unit heat value varies greatly. Optimizing the energy structure mainly involves replacing high carbon energy with low-carbon and non carbon energy to achieve greenhouse gas emissions reduction. For example, natural gas replaces coal. Carbon dioxide emissions from the combustion of natural gas with the same calorific value in traditional fossil fuels

The quantity is approximately 25% lower than oil and 40% lower than coal. According to data from the International Energy Agency, developed prisoners from 1990 to 2008

In the overall energy structure of the family, the proportion of oil is relatively stable, while nuclear and renewable energy have slightly increased. The proportion of natural gas in primary energy consumption has increased from 20% to 25%, while the proportion of coal has decreased from 24% to 21%. For example, the UK's use of natural gas as a substitute for coal has achieved significant results. In 1990, the proportion of natural gas in primary energy was 22%, increased to 40% in 2008, and the proportion of coal decreased from 31% to 17%. This alone led to a 7% reduction in carbon dioxide emissions in the UK in 2008 compared to 1990.

(4) Maintaining and increasing forest carbon sinks

Forest carbon sequestration is a carbon dioxide reduction measure proposed in the context of climate change, with the core of increasing the carbon absorption capacity of terrestrial ecosystems. Maintain and increase carbon sinks and absorb carbon dioxide through afforestation and strengthening forest management. It is estimated that about 20% of the carbon dioxide gases that cause global climate change are caused by deforestation. For example, although the United States is a major country in forest products, it attaches great importance to the social and ecological benefits of forests. The federal government adopts the "cost sharing subsidy program" to increase funding subsidies to encourage states and private individuals to cultivate non timber forests. The Clean Energy and Security Act of the United States allows for the use of 1 billion tons of domestic carbon emission offset credits, primarily through increased carbon sequestration through domestic forest management. Japan has a very complete forestry legal and regulatory system, with a forest coverage rate of up to 67%. India encourages tree planting and afforestation, with the forest coverage rate increasing from 19.5% in 1990 to 23% in 2006. It plans to gradually increase the forest coverage rate to 30% through agricultural and natural forest protection. In recent years, China has implemented policy measures and key projects such as afforestation, natural forest resource protection, returning farmland to forests and grasslands, and basic construction of farmland. As a result, the forest coverage rate reached 20% in 2010.

(5) Emphasize the research and development of carbon capture and storage technology (CCS)

Carbon Capture and Storage (CCS) technology refers to the relevant technical system that collects and permanently stores carbon dioxide generated in energy consumption or industrial processes. In special cases, carbon capture and storage can also be directly carried out from the air. This technology is still in the research and development stage, and if a technological breakthrough is achieved, it can significantly reduce costs and energy consumption. CCS technology has great potential for emission reduction in future large-scale commercial applications. According to the International Energy Agency's analysis, to achieve the long-term goal of global emissions reduction, 10% of the required emissions reduction by 2030 will be achieved through carbon capture and storage technology. Developed countries such as Europe and America are actively conducting research and development on carbon capture and storage technologies in order to compete for the dominant position in key low-carbon technologies in the future. Especially in the United States, which has a high proportion of coal-fired power generation, a large amount of research has been conducted on the mechanism, potential, and economic evaluation of this technology. According to Advanced Resources International Corporation of the United States, the global capacity of depleted oil and gas to store carbon dioxide can reach 923 billion tons, which is equivalent to the highest emissions of fossil fuel fired power plants in the world in 125 years. Moreover, the United States has attempted to pass legislation that requires the application of carbon capture and storage technology in new coal-fired power plants built after 2020. In addition, Norwegian National Petroleum Corporation captures and injects 120 tons of carbon dioxide into the salt marshes below the gas field every year; British Petroleum Corporation (BP) has established the world's largest integrated hydrogen power generation and carbon dioxide storage project in Scotland. The project injects and stores approximately 130 tons of carbon dioxide annually into the Miller oilfield, producing approximately 548 tons of oil and extending the oil lifespan by 15-20 years.

1.3 Research Content and Methods

1.3.1 Research content

Based on the analysis of the research background and significance of the impact assessment of oil injection development projects on water environment, this article analyzes the current research status and existing problems of water environment impact assessment for oil injection development project teams. In order to better evaluate the impact of oil injection development projects on the water environment, an engineering analysis of oil injection development projects was conducted in response to their unique characteristics. On the basis of this generation, a detailed qualitative analysis was conducted on the sources, processes, and results of the impact of oil injection development projects on the water environment. Through the idea of solving problems using the Analytic Hierarchy Process, a quantitative evaluation was conducted on the quality, quantity, and socio-economic impact of oil injection development projects on the water environment. The comprehensive impact of oil injection development projects on the water environment was also evaluated, Then, the quantitative evaluation process was empirically applied and tested in a certain oil injection development project. Finally, based on the current situation and evaluation results of the impact of oil injection development projects on the water environment, policy recommendations for water environment protection during the construction and operation of oil injection development projects are proposed.

1.3.2 Research Methods and Technical Route

This article uses the idea of Analytic Hierarchy Process to obtain an indicator system for the impact of oil water injection development projects on water environment quality, quantity, and socio-economic development. An evaluation model is established to conduct a static evaluation of the quality and quantity impact on water environment. On the basis of static evaluation, the impact of oil injection development projects on water environment was evaluated through comparative analysis, and the dynamic impact of oil injection development projects on water environment quality and quantity was evaluated using linear weighting method. Finally, a comprehensive evaluation index system for the impact of oil injection development projects on the water environment was constructed, and a dynamic comprehensive evaluation model for water environment impact was established using a linear weighting method.

Since the 1970s, countries such as the United States and Japan have taken the lead in making energy conservation and emission reduction one of the strategic points for energy development. Major countries have taken various measures to control energy consumption and reduce the impact of the energy crisis on their own economies. The energy supply and demand situation varies greatly among countries around the world, so the focus of energy conservation and emission reduction work varies among them. Ernst Worrell introduced the energy-saving and emission reduction policies and experiences of developed countries, emphasizing the role of the government in market economy conditions [6]. Japan is a country with extremely scarce resources and has always been committed to building an "energy-saving society". Chinese scholar Sun Wanju analyzed the achievements of R Ben's energy strategy from the aspects of energy consumption per unit output value and structural energy conservation. Japan has been formulating correct and effective energy strategies since the 1970s and has successfully implemented them, solving environmental and energy security issues for Japan and breaking free from the constraints of traditional energy policies that rely on oil, building a sustainable economic and social foundation has laid the foundation and made Japan a country with diversified energy sources. Geller Howard et al. provided a detailed introduction to the relevant policies formulated by developing countries such as Brazil and India to encourage energy efficiency improvement and the development of renewable energy.

Based on the research of these scholars on energy strategies and energy-saving and emission reduction policies in various countries, some experiences have been drawn, which can be summarized as follows:

1. Develop laws and regulations related to energy conservation and emission reduction, and manage energy conservation and emission reduction in accordance with the law. Within the existing legal framework, countries around the world have formulated corresponding regulations, rules, and policies in all aspects of energy resources, development, production, and use, and continuously revise and improve them during the use process.

2. Develop relevant tax policies, including incentive and restrictive policies. Incentive policy measures include: promoting energy conservation among enterprises and consumers through different types of taxation, encouraging the development and utilization of renewable energy, and optimizing the energy consumption structure; Promote and popularize high-efficiency products through policies such as energy-saving and emission reduction cash rebate subsidies, tax exemptions, preferential loans, and mortgage loans. Restrictive policies include establishing new taxes on products that consume non renewable energy, such as environmental pollution tax, carbon tax, resource tax, energy consumption tax, etc.

3. Continuously increasing public budget support for energy efficiency management. The focus includes the formulation of laws and regulations, public publicity, information services, education and training, research projects, etc. At the same time, guide enterprises to develop, introduce, and demonstrate key, common, and forward-looking energy-saving and emission reduction technologies, and guide the promotion and application of energy-saving and emission reduction technologies.

4. Develop energy efficiency standards and labeling systems. Many foreign countries usually set a minimum energy efficiency value as a mandatory standard, and products that do not meet the standard are prohibited from entering the market. The current energy efficiency standards mainly target end-use energy products, such as automobiles, household appliances, buildings, etc.

5. Develop energy-saving and emission reduction promotion policies, strengthen consulting services and information dissemination, and enhance public awareness of energy-saving and emission reduction through regular targeted publicity, education, and training. There are many non-profit energy conservation and emission reduction information dissemination and consulting service organizations abroad, generally funded by the government.

6. Conduct extensive international carbon emissions trading activities. After the entry into force of the Kyoto Protocol, developed countries have actively engaged in multinational or regional international cooperation to achieve their emission reduction commitments while tapping into domestic energy conservation and emission reduction potential. Currently, international economic cooperation on carbon dioxide emissions trade is very active, with COM (Clean Development Mechanism) projects being the majority, and most of the projects are industrial energy conservation and emission reduction projects.

Chinese scholars have conducted research on energy development based on the current situation and practical significance of energy conservation and emission reduction in China. On the basis of in-depth analysis of the implementation status and existing problems of China's energy efficiency standards and labeling system, Jin Minghong and others drew on external experience and combined with China's actual situation, proposed countermeasures to improve China's energy efficiency standards or performance standards and labeling system. Famous Chinese energy economist Lin Boqiang pointed out that facing the current macro situation, China's energy strategy must be adjusted. On the one hand, the traditional mode of meeting energy demand only from the energy supply side must be changed, and management should be combined with the energy demand side. By comparing and selecting energy supply investment and energy-saving investment, the cost of meeting energy demand must be minimized; On the other hand, incorporating carbon dioxide emissions into the constraints of meeting energy demand and formulating energy structure strategic planning based on these constraints is not appropriate. Jia Jingquan and others introduced the experience of foreign energy-saving and emission reduction policies, analyzed the various problems in China's energy-saving policies, and proposed suggestions for formulating and improving energy-saving and emission reduction policies. From the experience of developed countries, it can be seen that there must be systematic and strong policy support for energy conservation and emission reduction in the field of market failure.

2 Engineering Analysis of Oil Water Injection Development Projects

In the early stages of development, oil relies on the natural energy of the oil layer to overcome the seepage resistance in the oil layer and flow to the bottom of the well before being lifted to the ground. As the production time increases, the reservoir pressure continues to decrease. If the formation energy is not replenished in a timely manner, at a certain period, the formation will not have enough energy to lift the oil to the surface, leading to the shutdown of the oil well. In China, the vast majority of oil fields lack natural energy, and even if they can rely on natural energy for extraction, there are still many problems: limited natural energy, difficult to control, and short action time; In addition, the utilization of natural energy is unstable, with fast initial and slow later stages, low oil recovery speed, and low recovery efficiency, which cannot achieve stable production; Furthermore, it is difficult to adjust and control oil fields that utilize natural energy for extraction.

In order to maintain or restore reservoir pressure and achieve high and stable production in the oilfield, oil development methods such as water injection and gas injection are needed. Oil injection development is currently the main method of oilfield development both domestically and internationally. Considering the specific sedimentary environment and development stage, over 90% of China's oil fields require or are undergoing injection development. The reason for choosing water injection development is because the oilfield has available water resources and good stability; In addition, water injection is rough and easy, and the equipment is relatively simple; Furthermore, water has a higher sweep ability in oil reservoirs, and it is effective in oil displacement. Water injection can maintain formation pressure, displace oil in pores, and improve oil recovery rate.

Oil injection development has many advantages:

(1) Being able to maintain high production water injection can maintain the energy needs of the formation, and can maintain high pressure differential production, resulting in high production;

(2) High efficiency: Water is relatively easy to enter the formation, and its viscosity is small, making it easy to flow in the formation. High pressure water injection can drive the oil in the reservoir towards the bottom of the production well;

(3) High recovery rate is an effective displacement medium for oil with low to medium density, and water can improve recovery rate. The recovery rate of dissolved gas drive in sandstone oil fields is 15%~31%, while water pressure drive can reach 36%~60%; The average recovery rate of dissolved gas drive in carbonate oil fields is 18%, while the recovery rate of water pressure drive can reach over 44%.

(4) It is easy to control and adjust the process of water injection into the formation. The timing and method of water

injection can be adjusted according to different stages of oilfield development;

(5) Good economic effect, easy access to water, simple injection process, low investment and operating costs, and high efficiency can be achieved at low cost;

However, there are also some shortcomings in oil water injection development, mainly due to the low water recovery rate of oil fields developed by water injection. The water recovery rate during artificial water injection development is usually 5% to 8% of geological reserves, or even lower. The thicker the crude oil, the more severe the heterogeneity of the oil layer, and the thinner the well network, the lower the anhydrous recovery rate. The greater the water injection required to achieve the same recovery level, and the higher the percentage of oil production in the high water cut period to the total production. In addition, oil injection development causes early water breakthrough in the reservoir and increases production costs.

2.1 Petroleum Water Injection Development Project

The oil water injection development project is widely distributed in Daqing Oilfield, Zhongyuan Oilfield, Dagang Oilfield, Shengli Oilfield, Changqing Oilfield, Liaohe Oilfield, and other fields. Taking the newly developed Daizhikui Oilfield by PetroChina Longdong Oilfield Company in 2001 as an example, this oilfield is a low permeability oilfield that is developed using water injection methods. By the end of 2008, a total of 4026 oil and water wells were drilled in the oilfield, including 3023 oil production wells and 993 water injection wells. However, as of now, major oil companies such as PetroChina and Sinopec, as well as authoritative departments in China, have not yet released authoritative statistics and survey data on China's oil injection development areas. There is no comprehensive information on the area of oil injection development areas, the number of producing and producing wells, the number of abandoned wells, and the number of water injection wells.

2.1.1 Meaning of Oil Water Injection Development Project

Petroleum water injection development projects are a type of project, more precisely a type of construction engineering project, so the definitions of projects and construction engineering projects are also applicable to petroleum water injection development projects.

A project is a one-time task undertaken to achieve a specific goal under certain constraints such as time, cost, and environment. Construction projects refer to the construction projects of various buildings and engineering facilities that provide material and technological foundations for human life and production, including oil and gas engineering projects. The definition of oil and gas development and construction projects in the "Technical Guidelines for Environmental Impact Assessment - Land Petroleum and Gas Development and Construction Projects" includes construction projects related to oil and gas exploration, development, surface industrial infrastructure construction, and related gathering, storage, transportation, roads, and oil and gas processing processes. The oil injection development project provides petroleum energy for human production and life, and is a type of oil and gas engineering project.

According to the definition of projects and construction engineering projects, it is believed that oil water injection development projects refer to projects that occur in a certain geological area, within a certain period of time, under certain resource and environmental constraints, and use relevant technologies and methods of water injection to extract, produce, and collect petroleum.

2.1.2 Characteristics of Oil Water Injection Development Projects

As a type of project, oil injection development projects have unique characteristics, as well as some special characteristics of oil development.

(1) Characteristics of oil water injection development

projects

Knock once. Oil injection development projects have a clear starting and ending time, but the one-time duration of oil injection development projects is not related to the duration of the project. No matter how long the project lasts, the project has a beginning and an end.

Uniqueness. The project has never happened before and will not happen again under the same conditions in the future. Although the oil extracted from different oil injection development projects may exhibit some common characteristics, this does not change the uniqueness of the project.

Goal clarity. Every oil injection development project has a clear goal, which is the expected goal to be achieved under certain constraints. In fact, all the work during the implementation of oil water injection development projects is carried out to achieve the predetermined goals of the project.

Risk. The risk of oil water injection development projects refers to the possibility of unexpected losses or benefits caused by the development and changes of various conditions and environments, as well as the limited understanding of people.

Resource constraints. Oil injection development projects are to some extent constrained by the objective environment and various resources in which the project is located, including the human, material, financial, time, technology, and information resources required for the project.

Life cycle. Oil injection development projects have a unique lifecycle mechanism, with clear start and end dates and a defined duration. According to the development process of the petroleum industry, the life cycle of petroleum water injection development projects can be intuitively divided into seven stages: planning, construction, production, reaching production, stable production, decline, and closure. The limited reserves of petroleum resources determine the total length of the life cycle of petroleum water injection development projects. In addition, national strategic planning, energy demand, petroleum development technology, and enterprise production plans also affect the life cycle of the project and the length of each stage within the life cycle.

(2) Special characteristics of oil water injection development projects

Integrity. Oil water injection development projects should be based on geological exploration data, reasonably design well locations, strive to extract the maximum amount of oil resources, and use the most economical methods and well location design to consider the oil reservoir as a whole. In addition, there is a strong mutual influence between oil and water wells, and the oil field must be viewed as a system.

Broadness. Oil injection development projects are distributed over a wide geographical area.

Dispersion. According to the distribution pattern and economy of oil reservoirs, the distance between each oil production well is far and the location is scattered.

Irreversibility. The oil water injection development project is carried out according to a certain procedure, and the process and results are irreversible.

Long implementation time. The oil water injection development project takes more than ten years or even longer from geological exploration, planning and design, to completion and production, and to abandonment and well sealing.

The product location is fixed. According to its migration law, the geographical location of the oil reservoir is fixed in the short term. Once the oil well is completed and put into operation, it cannot be moved and can only be driven to the bottom of the well using water injection development or other driving methods.

2.2 Engineering Technology for Oil Water Injection Development Projects

Although water injection development is the most widely used oil development method in the world, due to its wide source of water, easy engineering construction, good water flooding effect, and easy flow, not all oil fields are suitable for water injection, which depends on the permeability of oil reservoirs, oil-bearing rocks, and the physical properties of the oil itself. Before water injection development, it is necessary to first understand the natural energy status of the reservoir, in order to determine whether water injection is necessary, when water injection is needed, and what water injection method to choose. In addition, for the Qianyou Water Injection Development Project, there is a strong mutual influence between oil wells, water injection wells, and water injection wells. Therefore, a single well cannot be studied separately. Instead, the oil injection development project must be viewed as a whole, and all interconnected oil and water wells on the project must be considered as a interconnected and mutually constrained development system, Conduct comprehensive research, design, and adjustment of the entire development area.

2.2.1 Theoretical Basis of Oil Water Injection Development

Oil and water are two immiscible liquids. Water is injected into the reservoir, enters the pores, and displaces the crude oil where it flows, but water cannot wash all the crude oil where it passes. The leading edge of oil and water moves towards the direction of oil production over time, meaning that the two-phase flow zone continues to expand and the pure oil zone continues to shrink. When water is seen at the oil production end, only the two-phase flow zone remains in the oil layer. Under water flooding conditions, the water saturation at each point in the oil layer continuously increases over time. At the same time, the saturation at different points within the oil layer also varies. As the leading edge advances, the water resistance inside the oil layer constantly changes, so the production and pressure also change, so the water drive oil process is unstable.

The oil layer is a highly dispersed system, and the rock of the oil layer is a complex space composed of mineral particles with extremely different geometric shapes and sizes, and the composition of mineral particles is also extremely different. These factors determine that the micro geometric structure and surface properties of the pore medium are extremely uneven, and the heterogeneity of the oil layer properties increases the complexity of water flooding.

From a macro perspective, the area of the reservoir that can be contacted by injected water also affects the process of water flooding, which is related to factors such as the properties of the injected fluid, the properties of the driven fluid, the geological characteristics of the reservoir rocks, and the layout of injection wells and production wells. The geological characteristics such as rock composition and pore structure, as objective existence, cannot be changed, and the water injection time, water injection method, and water injection speed can be adjusted to affect the water flooding process. [23]

(1) Water injection time

In terms of water injection time, from the perspective of development trends, there are more advocates for early injection than late injection, and two factors are mainly considered in the specific boundary of water injection: pressure factor, reservoir permeability, and geometric shape. For different types of oil fields, water injection at different stages of oilfield development has different impacts on the development process, and its development effects also vary greatly. From the perspective of water injection time, it can be roughly divided into three types.

Early water injection refers to injecting water in a timely manner before the formation pressure drops to saturation pressure, so that the formation pressure remains above saturation pressure or near the reservoir pressure. This water injection method can always maintain the formation pressure above the saturation pressure, allowing the oil well to have a higher production capacity, which is conducive to long-term self injection production, and has a large margin for adjusting the production pressure difference, which is beneficial for maintaining a higher oil recovery rate and achieving long-term stable production.

Medium term water injection refers to the initial stage of production that relies on natural energy extraction. After the local formation pressure drops to a low saturation pressure, water injection is carried out before the gas oil ratio reaches its maximum value. Its characteristic is to transform the two-phase flow of oil and gas in the oil reservoir into a three-phase flow of oil, gas, and water. With the recovery of water injection pressure, there can be two situations: firstly, under stable formation pressure conditions, a water drive mixed gas drive mode is formed; The second method is to dissolve the released free gas back into the crude oil through water injection. Under high formation pressure and saturation pressure conditions, the bottom hole flow is reduced to saturation pressure. Although the oil recovery index is low, the production pressure difference of the oil well is significantly increased, which may also result in higher oil production and a longer stable production period.

Late stage water injection is actually a secondary oil recovery method, which refers to water injection after dissolved gas drive. In the early stages of development, relying on natural energy extraction, without energy supply, the formation pressure will gradually decrease below saturation pressure, and dissolved gas will precipitate from the oil. The reservoir driving method will be changed to dissolved gas drive. When continuing this mining method is no longer economical or unable to maintain a certain oil recovery rate, artificial water injection development is carried out to improve the oil recovery rate of the reservoir.

(2) Water injection method

The water injection method refers to the location of the water injection well in the reservoir and the arrangement relationship between the water injection well and the production well. Choosing different water injection methods for different oilfield geological conditions, especially the properties and structural conditions of oil layers, is the main geological factor in determining the water injection method. At present, there are four main types of water injection methods used in domestic and foreign oil fields: edge water injection, cutting water injection, area water injection, and point water injection.

Edge water injection refers to a type of well arrangement in which water injection wells are distributed near the oil-water boundary according to certain rules for water injection. Edge water injection requires the drainage of injection wells and production wells to be parallel to the oil bearing edge, in order to facilitate uniform advancement of the oil and water edge and achieve high recovery efficiency. According to the relative position of the water injection well at the oil-water interface, edge water injection can be further divided into: outer edge water injection

The water injection method of arranging the water injection well in the pure water area on the outer edge of the oil-water boundary The water injection method of arranging the water injection well on the oil-water transition zone through edge water injection Edge water injection is a water injection method that directly arranges water injection wells within the inner edge of the reservoir.

Cutting water injection refers to the use of water injection wells to cut a reservoir into several blocks, treating each block as an independent development unit, and conducting development and adjustment in different zones. The methods of cutting and water injection can be divided into horizontal cutting, vertical cutting, circular cutting, zone cutting, etc. Cutting the water injection well network requires determining factors such as cutting distance, number of production well rows, rejection, and well spacing to achieve cutting the water injection line formed on the water injection well row. In order to leverage the advantages of cutting water injection, it is necessary to better select a reasonable cutting width, determine the optimal cutting well row position, supplemented by point shaped water injection, and enhance the cutting water injection system to increase the pressure difference between the water injection line and the bottom of the production well (or oil production area).

Area water injection refers to a method of arranging water injection wells and production wells evenly across the entire development area according to a certain geometric shape and density. This water injection method essentially divides the oil layer into many smaller injection production units (also known as injection production well groups). A water injection well controls one of them to simultaneously affect several oil wells, and each oil well is simultaneously affected by the water injection well in several directions. According to the different locations and well network shapes of oil wells and water injection wells, area water injection can be divided into four point area water injection, five point area water injection, seven point area water injection, nine point area water injection, inverse seven point area water injection, inverse nine point area water injection, linear row water injection, and staggered row water injection.

After determining the water injection method based on the nature of the reservoir, it is necessary to consider the deployment of the well network and determine the density of the well network. The main purpose of water injection for thousand cutting is to determine the density of the well pattern, reasonable cutting distance, and rejection; The main purpose of an area water injection well network is to select a reasonable well density and determine a reasonable injection production well ratio. The development stage of an oil field varies, and the density of its well network also changes. Factors that affect the density of the well network include the physical properties and heterogeneity of the formation; Crude oil viscosity; Mining and water injection methods; Burial depth of oil layers; Other geological factors, such as the fractures and direction of the oil layer, the fracture pressure of the oil layer, bedding, and the required oil production, all have an impact.

The reasonable density and deployment of production wells have a significant impact on the initiative and flexibility of the entire oil development process. The more wells drilled and the denser the well network in an oil development project, the higher the degree of control of the well network over the oil layer, which is more conducive to achieving high and stable production and improving oil recovery. An increase in well spacing density will lead to varying degrees of increase in oil recovery, and the smaller the flow coefficient, the greater the impact of well spacing density. This is because the smaller the water injection well spacing, the better the continuity of each small layer, and the higher the water flooding coefficient, the higher the oil recovery rate. However, after the density of the well network increases to a certain extent, when the well network is encrypted, there will be no significant increase in the control of the oil layer, and there will be inter well interference, resulting in a decrease in single well production, poor economic results, and a significant increase in oil and water well management and repair work.

(3) Water injection pressure

Before the reservoir is opened, there exists a primitive pressure field, where the fluid inside the reservoir is in a state of equilibrium and no flow occurs. With the drilling of oil wells into the reservoir for oil production and water injection, the static pressure balance inside the reservoir is disrupted. A new pressure field is established from the bottom of each injection well to the bottom of each production well, which we call the "pressure system" of the reservoir. A reasonable pressure system is a reasonable coordination of the matching relationship between the bottom hole pressure, formation pressure, and production well flow pressure of water injection wells, in order to achieve the goal of rational utilization of energy, economically and effectively exerting the production capacity of oil reservoirs, and improving oil recovery.

In the actual production process, the pressure system inside the oil reservoir is in a complex dynamic change process. From the perspective of the entire process of oilfield development, mountain water flooding oil itself is an unstable seepage process, so it is always in a cycle of changes where the old balance is constantly broken and the new balance is constantly established. In this process of change, there is a complex relationship between the bottom hole pressure of the injection well, the formation pressure, and the flow pressure of the production well that affects and depends on each other.

The level of water injection pressure is first measured by the water injection intensity required to achieve the oilfield. Water injection intensity refers to the daily water injection rate per unit thickness of an oil layer, which to some extent reflects the possible range of oil recovery rate for a certain well network. In theory, increasing water injection intensity has certain significance in improving oil displacement efficiency. However, due to the heterogeneity of the Shanqian oil layer and various contradictions, there is even a certain range of water injection intensity. So in the process of oilfield development, to maintain the water injection intensity within a reasonable range, it is necessary to select a reasonable water injection pressure to ensure the rationality of the water injection intensity.

2.2.2 Petroleum Water Injection Development Engineering Technology

(1) Periodic water injection

Cyclic water injection is a water injection method that began to be implemented in the late 1950s and early 1960s in the former Soviet Union and the United States. From the 1970s to the 1980s, the former Soviet Union had already used this water injection method as the main method to improve the development effect of some water injection oil fields, and it was implemented on a large scale, mainly in about 80 layers of 22 oil fields in the West Siberia, Gubishev, and Boothu oil regions. In the 1980s, China began to carry out cyclic water injection experiments in Fuyu, Putaohua, Karamay and other oilfields, and achieved certain results.

Cyclic water injection is a water injection method that improves crude oil recovery. Its mechanism of action is not completely the same as ordinary water flooding. It mainly utilizes the different transmission rates of pressure waves in different media with different filtration characteristics. By periodically increasing and reducing the water injection rate, unstable pressure fields are generated inside the oil reservoir and corresponding unstable liquid infiltration flow is generated between small layers with different permeability.

During the half cycle of boosting pressure, the injection pressure increases. On the one hand, some of the injected water directly enters the low permeability and high permeability zones, displacing the remaining oil that cannot be driven away during conventional water injection, and improving the absorption profile; On the other hand, as the injection volume of Shanqian increases, some of the water flowing in the large pores overcomes the capillary force to obtain more interfaces along the high and low permeability sections and enter the low permeability section, causing some of the oil in the low permeability section to be displaced; Furthermore, the increase in water injection pressure results in more elastic energy being obtained in low-permeability intervals, so the larger the water volume, the stronger the various activities of the fluid in the reservoir during the half cycle of pressure rise. When entering the half cycle of pressure reduction, the pressure conduction velocity in the high and low permeability sections is different. The pressure in the high permeability section decreases quickly, while the pressure in the low permeability section decreases slowly. This forms a reverse pressure gradient between the high and low permeability sections, and at the same time, the capillary force and elastic force of the mountain lead to the slow flow of some water and oil in the low permeability section towards the perforated channel of the high permeability section at the interface of the two sections, And under the action of production pressure difference, it flows along with the subsequent displacement water flow towards the production well. Therefore, the smaller the water volume, the faster the energy decrease in the high permeability section, which is more advantageous for the early utilization of its reserve energy in the low permeability section. In the high permeability section, the fluid in the low permeability section enters the high permeability section along the interface between the high and low permeability sections under the action of elastic energy and capillary force, and the earlier the timing, the more fluid there is.

(2) Subdivision water injection technology

Subdivision water injection technology is to try to place oil layers with similar properties into a single interval for water injection. Its function is to reduce interlayer interference between oil layers with different properties, improve the utilization degree of various oil layers, unleash the potential of all oil layers, and control the increase in water content and decrease in oil production. It is one of the effective measures to improve the water injection development effect during the high water content period, especially in the later stage of high water content.

Subdivision water injection is an effective measure to reduce interference between small layers within the development layer system. By adjusting the water outlet of the well, the high permeability layer that interferes with other small layers can be blocked out and appropriately restricted; At the same time, water injection can be strengthened in small layers with low permeability and low water content to reduce interlayer interference. However, the high permeability layer is not only the source of interference with other layers, but also the main oil producing layer before it is completely flooded. Practical experience has shown that, Unable to take action The approach of "negative balance" limits the water injection intensity of high permeability layers to the same level as that of low permeability layers. Otherwise, excessively strict water injection restrictions on high permeability layers will inevitably lead to a significant reduction in production of surrounding oil wells. Therefore, the correct approach should be to appropriately limit the water injection intensity of the high permeability main reservoir while fully tapping into its production potential, and at the same time, take various injection and production increase measures such as unblocking and fracturing to maximize production as much as possible The water injection intensity and production rate of low permeability layers can only achieve the effect of reducing interlayer interference while maintaining stable and even increasing oil well production.

Subdivisional water injection is also an important means of regulating the advancement of injected water on the plane. When an oil well is connected to multiple water injection wells and the water content of the oil well increases, it is necessary to strengthen water injection in the non main direction based on the analysis of the water production layer and water inflow direction, and appropriately control the water injection in the main direction. If necessary, the water injection in that direction can even be stopped. When a water injection well and multiple oil wells are in circulation, it is necessary to comprehensively consider the water injection requirements of each oil well direction within the well group, weigh the priorities, and focus on the water injection requirements in the most favorable direction. [24]

(3) Horizontal well water injection development technology

Horizontal well water injection technology was proposed in the 1990s and is an emerging technology. With the development of low-permeability reservoirs, Shanqian low-permeability oil fields have the characteristics of high water injection pressure, insufficient formation pressure, weak water absorption capacity, and insufficient natural capacity. Moreover, with the prolongation of water injection time during the production process, water injection becomes increasingly difficult, and in the end, water cannot be injected. In this situation, although the recovery rate can be improved by increasing the density of the well network, the cost of the Shanqian high-density well network is relatively high, and for the Qianlow permeability oilfield, its production capacity is low, and the economic benefits are not very optimistic. However, the cost of injecting water through horizontal wells is relatively low, making it possible to develop low permeability thin layers.

Compared to vertical wells, horizontal well water injection has many advantages, and the biggest success of horizontal well water injection technology is the control of thermal fractures. Because it can generate different types of cracks. Different types of cracks can generate different relatively small interferences through the rock pressure field, which can relatively reduce the closure of cracks; Horizontal water injection wells have relatively long horizontal intervals in thin oil layers, which can indirectly expand the injection area and effectively maintain formation pressure; Injecting water into Shanqian horizontal wells can generate abundant thermal fractures and relatively long horizontal sections in oil layers, which can be driven by water front approximately equilinear and have good stability.

Horizontal well water injection technology can maximize the development effect of low permeability oil fields. It has unique advantages. Currently, with the continuous development and maturity of horizontal well water injection technology, it has quickly formed a remarkable technology in the field of oil and gas field development. It is widely used in the development of low permeability reservoirs, thin layer reservoirs, fractured reservoirs, and depleted oil fields [25]. Some petroleum experts have proposed two modes through indoor experiments: vertical well injection horizontal well production and horizontal well injection horizontal well production.

2.3 Pollution caused by oil injection development projects

The environmental pollution caused by oil injection development projects has been long-standing. During the construction, extraction, and storage and transportation of oil injection projects, formation damage, reinjection of water, and landing of crude oil can all affect the environment, resulting in loss of environmental and resource value. According to statistics from the US Environmental Protection Agency, in the past decade, the cost of cleaning up soil and aquifer pollution caused by oil spills alone has reached 160 billion US dollars, and the cost of pollution control has reached as high as 750 billion US dollars [26]. Moreover, the prevention and control of oil pollution has always been a challenge internationally. In order to coordinate the contradiction between oil injection development and the environment, in-depth research and exploration have been conducted abroad for a long time,

Some countries prioritize the control of petroleum pollutants as toxic pollutants in the environment and have developed corresponding prevention and control measures [27-31]. In China, Zhang Yafei [32], Ran Xinqing [33], Yi Li [34], Wang Yun [35], Pei Qungao [36], and Hui Juehe [37]

Many scholars have analyzed the impact of the entire process of construction, extraction, gathering and transportation, storage and transportation during the construction and operation periods of oil water injection development projects on the water environment, soil environment, grassland environment, atmospheric environment, etc. They believe that oil water injection development projects have a significant impact on the ecological environment.

(1) Pollution caused by oil injection development projects

The main sources of pollutants in oil injection development projects are wastewater, exhaust gas, and waste discharged during the construction and development of oil injection projects. These pollutants enter the ecosystem through different channels, causing ecological pollution and damage. The construction and operation process of oil water injection development projects includes surface construction, drilling, oil production, and gathering and transportation.

During the ground construction process, the construction of stations, roads, and pipelines will generate dust and solid waste, damaging soil and vegetation. During the drilling process, land will be occupied, vegetation will be destroyed, and pollutants such as wastewater, waste liquid, rock debris, oily mud, and solid waste will be discharged. Wastewater, waste, activation fluid, etc. are discharged during the logging process. During underground operations, landing crude oil, flushing water, oily wastewater, acidizing fluid, fracturing fluid, etc. will be generated. Produced wastewater, landing crude oil, oil sludge, fuel waste gas, and process waste gas during the oil extraction process. After oil is extracted from underground, it first enters various oil depots for storage through the gathering and transportation system. A certain amount of wastewater and solid waste will also be generated during the collection and storage process to pollute the environment near the irrigation area.

In addition, sudden accidents during the construction and operation of the project can also lead to crude oil leakage, sewage discharge, etc. When oil wells enter a decline period, water and oil leakage accidents will also occur in the water injection pipeline network and oil transmission pipeline, polluting the environment.

(2) Pollution characteristics of oil injection development projects

Multiple pollution links and strong mobility: Petroleum water injection development projects have multiple types of construction, large differences in processes, complex processes, and multiple pollution links. Moreover, Shanqian implements small team mobile operations, which has strong mobility of pollution sources, increasing the difficulty of environmental management and pollution control work.

Scattered pollution sources and irregular discharge: The distribution of oil and water wells in the project development zone is very scattered, forming highly dispersed point pollution. The discharge of pollutants has no fixed discharge outlet, is discontinuous in time, and the discharge amount is uncertain, with characteristics of randomness, temporary, and suddenness.

There are many types of pollutants and complex components: various construction types such as drilling, oil testing, oil production, well repair, fracturing, acidification, gathering and transportation, storage, etc. may form pollution. There are many types of pollutants, and the components are complex, with great harm.

Large pollution range and wide coverage: Oil development operations have scattered pollution sources and a wide range of pollution discharge. It is likely that some pollution sources are located in environmentally sensitive areas such as nature reserves, aquaculture areas, and farmland, and involve multiple units. Management is difficult, and once large-scale pollution occurs, the consequences will be serious.

Long pollution incubation period and difficult recovery: During the process of water injection and oil extraction, petroleum water injection development projects discharge a large amount of pollutants into water bodies, soil, and air. Some pollutants have a long incubation period and form indirect impacts through the biological chain. Once pollutants enter the ecological environment such as water and soil, it is difficult to control and costly.

3 Analysis of the Impact of Oil Water Injection Development Projects on the Water Environment

During the construction and operation of oil injection development projects, a large amount of pollutants are discharged, which has a great impact on the surface water and groundwater in the project area. The degradation of these pollutants in the water environment takes a certain amount of time, and different pollutants also interact with each other. Therefore, in the short term, the continuous discharge of pollutants will accumulate pollutants, exacerbating the impact of oil injection development projects on the water environment. Moreover, the dynamic characteristics of the water environment will further expand the geographical scope of the impact of oil injection development projects on the water environment. Even if the abandoned well is improperly sealed or the casing is corroded, it will continue to affect the groundwater environment for several years after abandonment.

3.1 Impact sources and pollutants of oil injection development projects on water environment

The impact of oil water injection development projects on the water environment mainly comes from wastewater, waste liquid, and landed crude oil discharged during drilling, water injection and oil recovery, and gathering and transportation processes. The impact of sudden oilfield water pollution accidents such as crude oil leakage and sewage leakage caused by natural or human factors on the water environment cannot be underestimated.

3.1.1 Drilling process and its impact on water environment

The main pollutants in the water environment during the drilling process are wastewater, waste liquid, crude oil, and circulating mud.

During the drilling process, a large amount of water is required to flush the drilling tools and equipment, resulting in a large amount of sewage. During drilling construction, the drilling wastewater is discharged into the sewage storage pit and is completely consumed by natural evaporation. These oily wastewater can contaminate groundwater through leakage. During evaporation storage, in case of rainstorm, flood and other natural factors, sewage from evaporation pool and drilling well pad will overflow and pollute the water body.

Drilling wastewater is generally a colloidal solution containing multiple components such as clay, rock debris, petroleum, and chemical treatment agents. Different drilling fluid treatment agents are used according to different geological properties, and there are various types of Shanqian chemical treatment agents, resulting in a variety and high content of pollutants in drilling wastewater, making treatment difficult. During the drilling construction process, drilling waste liquid is mainly discharged into the mud pool. After the drilling construction is completed, the mud containing the waste liquid is treated harmless and then buried.

During the drilling process, a large amount of water is required for mud preparation, cooling of mud pumps, and flushing of the bottom of the well, resulting in a large amount of diluted drilling mud containing a large amount of rock debris and oil, which is discharged into the mud pool during the drilling construction process. The amount of waste mud generated by China Petroleum's water injection development drilling at a depth of 10000 meters is 634 tons/10000 meters [38].

The main pollutants in drilling wastewater, waste liquid, and circulating mud are petroleum, solid suspended solids, heavy metals, and various drilling fluid additives. These pollutants enter the aquifer of the aeration zone driven by atmospheric precipitation and self leakage, polluting groundwater. The toxicity of oil is harmful to human body through inhalation, skin contact and ingestion, which will cause a high incidence rate of cancer, and this harm is mainly from thousands of fresh oil. Once toxic compounds in petroleum, especially benzene and toluene, enter the food chain, from lower algae to higher mammals, they will not be spared, and the influence of toxins will also be passed on to the offspring of several species of organisms. The organic components in additives can increase the chemical oxygen demand (COD) and biochemical oxygen demand (BOD) of the water environment, affecting the growth and reproduction of aquatic organisms. Saline alkali substances such as NaOH, CaC03, KOH, and NaCl can alter the pH value of the water environment.

3.1.2 Water injection and oil recovery process and its impact on water environment

The pollutants in the water environment during water injection and oil recovery are mainly oily wastewater, additives, and landing crude oil.

The oil-water mixture extracted from oil wells through sedimentation and chemical dehydration processes is called oil production wastewater, which contains crude oil, solid suspended solids, and a large amount of organic matter, and has high mineralization. After treatment, most of the oil production wastewater is reinjected into the formation, but due to geological conditions, water injection capacity, or accidents, there is still a portion of the oil production wastewater that needs to be discharged into the environment. At the same time, in order to facilitate the separation of oil and water, prevent pipeline corrosion or scaling, a large amount of chemicals are added to make the composition of oil extraction wastewater more complex. The composition of oil extraction wastewater is closely related to factors such as original oil properties, oil reservoir properties, and water injection materials, and belongs to a complex multiphase system of solid impurities, liquid impurities, dissolved gases, and dissolved salts. [39]

In addition, high salinity oil extraction wastewater has a high conductivity, which accelerates electrochemical reactions and accelerates the corrosion rate of pipelines and equipment. The combined action of organic matter in oil extraction wastewater and appropriate water temperature increases the proliferation of bacteria, mainly including sulfate reducing bacteria (SRB) and saprophytic bacteria (TGB), which can also easily cause pipeline corrosion. High salinity and high bacterial content oil extraction wastewater can pollute the water body after being discharged, and the frequency of pollution accidents caused by pipeline and equipment corrosion increases. These accidents increase the frequency of sewage and crude oil polluting the water environment. A large amount of treated wastewater is partially reinjected underground, which contains organic matter and bacteria. In addition, in order to better displace oil, a large number of additives such as flocculants, fungicides, and scale inhibitors are added. Reinjected water has potential pollution effects on groundwater.

The main sources of landed crude oil in oil production are a large amount of landed crude oil produced by perforation and replacement before the production of a thousand self flowing wells, as well as a large amount of landed crude oil produced during production accidents such as blowout, pipeline leakage, and valve failure during the production process. These crude oils enter the water bearing layer under the action of precipitation and leakage.

3.1.3 Gathering and transportation process and its impact on water environment

The pollutants in the water environment during the gathering and transportation process mainly include crude oil and wastewater that runs, drips, and leaks.

The oil-water mixture extracted from the oil extraction well passes through a partial gathering and transportation system and enters the sedimentation and chemical dehydration device for oil-water separation. The separated crude oil enters various oil depots for storage through the gathering and transportation system, and the wastewater returns to the water treatment station through pipelines. Once pipelines or storage devices leak during this process, wastewater and oil will directly leak to the surface, polluting the surface water environment of pipelines and storage irrigation areas.

3.1.4 Water environment impact caused by accidents

Sudden accidents include blowout, pipeline leakage, and drilling accidents. A large amount of mud and oil spewed out during a blowout, affecting surface water; The pipeline leakage caused a large amount of oil spill, which has an impact on groundwater. The main impact on groundwater is the oil water breakthrough accident in drilling accidents, where a large amount of oil, mud, reinjection water, etc. will directly enter the groundwater layer.

Human accidents mainly refer to the leakage of oil, sewage, and other oilfield pollutants caused by theft and destruction, which directly pollutes the surface water environment and pollutes shallow groundwater under the action of precipitation and infiltration.When oil wells enter a decline period, water and oil leakage accidents will also occur in the water injection pipeline network and oil

3.2 Impact pathways of oil injection development projects on water environment

For every new well or group of wells added in a petroleum water injection development project, a new water environment impact source needs to be added. The pollution emissions and water injection and usage of each impact source are influenced by various factors such as geological conditions, reservoir types, well depths, and process technology, and there will be significant differences. The water environment of each impact source varies in different seasons and eras, and the discharge of pollutants also has uncertainty. Some pollutants will degrade within a certain period of time, while others will degrade for a long time and accumulate continuously. Various pollutants combined with different hydrogeological environments will also undergo complex interactions. In addition, the interactions between oil fields, production wells, injection wells, and different processes of each well or well group in oil water injection development projects also make the impact of oil water injection development projects on the water environment more complex.

3.2.1 Direct impact

Direct impact refers to the direct impact of pollutants generated during the construction and operation of oil injection development projects on surface water and groundwater.

Some oil extraction wastewater, after treatment, meets the discharge water quality standards and is directly discharged into surface water bodies. These wastewater that meet the discharge standards still contain pollutants such as solid suspended solids, petroleum, COD, bacteria, etc. These pollutants will directly affect surface water and cause pollutants to enter a larger range of water through surface runoff. In addition, accidents caused by natural or human factors during the construction and operation of the project, such as oil, sewage, or mud pools leaking or overflowing, can also directly bring pollutants into surface water bodies. Oil floating on the water surface will isolate the air and reduce the dissolved oxygen in the water.

After treatment, the oil extraction wastewater meets the injection water quality standards, but it still contains some solid suspended solids, heavy metals, petroleum, COD, acid-base substances, bacteria and other pollutants. In addition, in order to better displace crude oil, a large number of additives are added. These pollutants and additives enter the oil bearing layer and also cause oil water to cross layer through geological processes, entering the water bearing layer. If there is a rupture or perforation of the injection well pipe during the reinjection process, the reinjection water containing pollutants can easily enter the aquifer and pollute the groundwater under enormous reinjection pressure. [40] The ground fissures caused by the excessive exploitation of confined water by Shan Qian cause the confined aquifer to lose its protection. During the rainy season, polluted surface water flows into the underground confined aquifer through the ground fissures.

Pollutants can also produce other substances through complex physical, chemical, and biological changes, and affect the aquatic environment. For example, highly mineralized water contains a large amount of Cr3+, Ba2+, Mg2+, Ca2+, Fe2+, Sr2+ ions. When the water temperature, water pressure, or pH value changes, it is easy to generate carbonate precipitation. When produced water containing Ca2+, Cr3+, and Ba2+ ions is mixed with ions, Sulfate precipitation can also occur.

3.2.2 Indirect Impact

Indirect impact refers to the indirect entry of pollutants generated by oil injection development projects into surface and underground water bodies through precipitation, surface runoff, and infiltration after polluting soil, vegetation, air, etc. The large amount of solid waste, circulating mud, wastewater and waste liquid generated during drilling and water injection mining processes, which contain a large amount of petroleum, solid suspended solids, heavy metals, acid-base substances, and additives, are stored in fixed locations and devices. Once leakage and overflow occur, pollutants from the solid waste will be brought into the surface water and soil. When the local surface water replenishes groundwater, pollution will enter the groundwater environment; In addition, when the soil pores are large, the surface runoff formed by mountain rainfall infiltrates pollutants and contaminated soil into the deep soil layer, permeating into the groundwater system, causing groundwater pollution. During long-term storage, circulating mud and wastewater will flow into surface groundwater through leaching and leakage, causing pollution.

The organic and inorganic substances such as ammonia and phosphorus in the sewage of oil injection development projects are nutrient rich substances for bacteria in the water, resulting in the deterioration of the slowly flowing water quality, blackening and odor. The oil deposited at the bottom of the water will undergo anaerobic decomposition to produce highly toxic hydrogen sulfide.

In the wastewater of oil injection development projects, there are various microorganisms such as sulfate reducing bacteria (SRB), saprophytic bacteria (TGB), and iron bacteria OB. These bacteria increase the content of suspended particles, increase particle diameter, and increase total iron content. Dissolved oxygen oxidation water injection facilities generate Fe (OH) 3 precipitation, which is beneficial for the proliferation and growth of aerobic bacteria, thereby generating a large amount of sediment. The water system of oil injection development projects also contains other pollutants. Although some sewage is discharged or reinjected underground after treatment, there are also some sewage that leaks to the surface or permeates to the underground. The discharged, reinjected, and leaked sewage undergoes complex physical, chemical, and biological changes with surface and underground water bodies due to temperature, pressure, pH value, etc., generating a large amount of other pollutants, The large amount of organic and inorganic substances in artificial additives makes these physical, chemical, and biological changes more complex.

3.2.3 Collaborative Impact

Collaborative impact refers to the direct and indirect effects of pollutants generated during the construction and operation of oil injection development projects on the water environment. Each sub project of the oil water injection development project generates and discharges a large number of different types of pollutants, some of which directly affect the water environment, while others affect environmental factors such as soil, vegetation, atmosphere, and indirectly affect the water environment through precipitation and surface water erosion and infiltration. Some links and sub projects are sequentially carried out, but most projects are running simultaneously, such as water injection engineering, oil production engineering, and gathering and transportation engineering. Although there is a certain sequential relationship between them, they are all running simultaneously. This leads to both direct and indirect effects of oil injection development projects on the water environment, and simultaneously affects the water environment. The existence of the synergistic effect between mountains and thousands of factors has resulted in a significant synergistic impact of oil injection development projects on the water environment, both directly and indirectly.

3.2.4 Accumulated impact

The impact of oil injection development projects on the water environment will always accompany the construction and operation of the project, and even after the project is completed, abandoned wells will still affect the water environment due to the quality of well sealing and geological processes. In addition, the project is distributed in a wide geographical area, consisting of multiple scattered oil and water injection wells in the mountains. The engineering construction, water injection and oil recovery, and gathering and transportation processes are complex and have numerous links. The pollution sources of the project are scattered, the emissions are irregular, and the types of pollutants emitted are numerous, the components are complex, and the pollution incubation period is long. Therefore, the impact of oil injection development projects on the water environment is significant in both time and space.

The pollutants generated in multiple stages of oil water injection development projects will accumulate through addition, subtraction, and interaction during project operation. Some pollutants have a long incubation period, and the pollution of the water environment, especially the groundwater environment, is not easily detected, making the impact of oil water injection development projects on the water environment not immediately apparent. After a period of time, the pollutants accumulate to a certain extent before they first appear. In addition, the dynamic characteristics of the water environment cause changes in the detection and control data of water quality and quantity in different seasons and years. For example, there are significant differences in pollutant concentrations between dry and wet seasons, and there may be significant differences in the average quantity of water environment in different years, resulting in significant changes in the monitoring results of water environment quality over time. However, the impact of oil injection development projects on the water environment continues to accumulate and gradually erode the water environment.

3.3 Results of the impact of oil injection development projects on the water environment

The oil injection development project affects the water environment directly, indirectly, and accumulatively, causing changes in the quality and quantity of the water environment, ultimately affecting the socio-economic environment, constraining the sustainable development of the economy and society, and affecting human production, life, and development.

3.3.1 Water quality impact

The main pollution sources that affect the water environment quality of oil injection development projects are oily wastewater, landing crude oil, waste mud, and various waste liquids generated during the millennium construction and operation process. These pollutants include petroleum, COD, suspended solids, heavy metals, volatile phenols, acid-base substances, bacteria, etc. These pollutants affect the quality of the water environment through direct, indirect, and cumulative effects, causing significant changes in the content of pollutants in the water environment and the water environment quality before the construction and operation of oil injection development projects.

Before the construction of the oil injection development project, the surface and groundwater environmental quality of the project site was only affected by the existing industrial and agricultural production and living conditions in the local area. After the project started construction and operation, it broke the existing water environment quality status in the local area, and new pollution sources discharged a large amount of new pollutants into the water environment. The significant increase in new pollutants and their physical, chemical, and biological interactions with the pollutants discharged from industrial, agricultural, and domestic production continue to enter the water environment, resulting in an increase in the number and content of pollutants in the water environment. Compared with the statistical indicators of groundwater environmental quality before project construction, the statistical indicators of groundwater environmental quality have increased and the statistical values of the indicators have also changed.

3.3.2 Quantity impact

There is a huge demand for water in the construction and production operation of oil injection development projects, which comes from thousands of surface water or groundwater sources. The project exploits and uses surface water or groundwater according to project requirements based on factors such as the distribution of water environment, water quality requirements, and economic efficiency in the area. Although most of the produced water in the project is reinjected underground after treatment, the demand for water environment quantity in the project is still significant.

The oil injection development project uses a large amount of surface water, which reduces the available amount of surface water and reduces the downstream water volume of the basin. The development stage, types of oil reservoirs, and mismatch between oil reservoirs and water environment of China Petroleum's water injection development projects result in a generally high demand for water, especially a higher dependence on groundwater. Overextraction of groundwater, especially under conditions where there is no replenishment or excessive replenishment, results in a decrease in static groundwater reserves and a significant decrease in water levels. The decrease in groundwater level leads to a decrease in static water pressure and a thinning of the aquifer, which changes the groundwater pressure and stress conditions in the upper and lower stagnant layers of the aquifer, forming a large-scale regional groundwater depression funnel. The drilling of motor wells has become increasingly deep, making it increasingly difficult to obtain water. The water inflow of a single well has generally decreased, and even there have been phenomena such as lifting pumps and scrapping wells, which has increased project expenses and affected the normal production activities.

Furthermore, the impact of oil injection development projects on water environment quality has severely polluted the water environment in some areas where the projects are located, resulting in a decrease in the number of available water environments that meet water quality requirements.

4 Model Construction of Impact Assessment on Water Environment of Oil Water Injection Development Projects

Each sub project and link of the oil injection development project releases a large amount of pollutants into the water environment, which affect the quality and quantity of the water environment through direct, indirect, synergistic, and cumulative effects. The impact of oil water injection development projects on the development of oil resources and the water environment will ultimately have an impact on the human economy and society, affecting the sustainable development of the human economy and society.

The primary purpose of planning, construction, and operation management of oil development projects by oil development enterprises is to develop oil resources in the most economical and scientific way according to the national strategic needs and energy needs for economic development. The process of water injection development is bound to have an impact on the water environment, or even damage it. The deterioration of water environment quality leads to a decrease in the number of available water resources that meet water environment quality standards, which increases the operating cost of oil injection development projects and subsequently affects the efficiency and social responsibility of enterprises. Oil injection development projects will also compete with other human life and production for limited water resources. Water is the source of life and the most important resource for human survival and development. The impact and destruction of oil injection development projects on the water environment have a profound impact on the development of human society.

Entering the 21st century, China is increasingly emphasizing the sustainable and harmonious development of its economy, society, resources, and environment. It is also paying more and more attention to environmental protection in the process of resource development, especially water environment protection. Therefore, the country has promulgated the "Water and Soil Conservation Law of the People's Republic of China", and various provinces have successively introduced the "Water and Soil Conservation Regulations" on this basis. This also forces oil development enterprises to pay more attention to water environment protection during the construction and management of oil injection development projects.

Whether it is the subjective protection of water environment by oil development enterprises or the objective requirements of national and social water environment protection, it is required that oil development enterprises continue to pay attention to changes in the water environment during the construction and operation management of oil injection development projects, evaluate the impact of oil injection development projects on the water environment, take reasonable measures to reduce the impact of projects on the water environment, and take timely and scientific measures to protect the water environment, Avoiding the old path of pollution before treatment has also increased the social responsibility awareness of oil development enterprises.

Therefore, scientific evaluation of the impact of oil injection development projects on the water environment has become a top priority in current scientific research. This article proposes an evaluation method for the impact of oil injection development projects on the quality and quantity of water environment, and based on this generation, evaluates the comprehensive impact of oil injection development projects on the water environment. It is hoped to provide reference for oil development enterprises to evaluate the impact of oil injection development projects on the water environment.

4.1 Principles for constructing indicator system

The establishment of an indicator system for evaluating the impact of oil injection development projects on water environment quality should follow certain principles, including:

Systemic principle: The indicator system must be able to reflect various aspects of the impact of oil injection development projects on water environment quality;

Dynamic principle: The indicator system should reflect the dynamic behavior and development trend of the impact of oil injection development projects on water environment quality;

The principle of scientificity: the physical meaning of indicators is clear, measurement methods are standardized, and statistical calculation methods are standardized;

The principle of operability should take into account the quantification of indicators, the difficulty and reliability of data collection, and make the best use of existing statistical data and normative standards related to economic development and environmental conditions;

Regional principle: The indicator system should reflect the characteristics and stages of the relationship between the construction and operation of petroleum water injection development projects in the geographical area and the water environment.

4.2 Establishment of indicator system

There are many pollution links and sources in oil water injection development, and corresponding regulations have been made both domestically and internationally for the environmental impact assessment of oil water injection development. China's "Technical Guidelines for Environmental Impact Assessment" (hereinafter referred to as the guidelines) recommend the use of water quality evaluation parameters for oil development projects in surface water environments, including pH value, COD, five day biochemical oxygen demand (BODs into dissolved oxygen (DO), suspended solids, sulfides, water temperature, volatile phenols, hazardous substances, petroleum, benzene, polycyclic aromatic hydrocarbons, and stipulate that appropriate selection can be made based on project characteristics, water area types, and evaluation levels. Additionally, it is stipulated that the number of pollutant types? 3. Or the number of water quality parameters that only contain two types of pollutants but require prediction of their concentration? 10; The number of pollutant types=2, and the number of water quality parameters for predicting concentration is less than 10. The "Guidelines" also provide detailed provisions for the selection of water quality evaluation parameters such as the complexity of project sewage quality and the size of water bodies. The Guidelines also have similar provisions in the groundwater environment, but do not provide detailed evaluation parameters for groundwater quality. In the "Guidelines" for onshore oil and gas development and construction projects, it is stipulated that groundwater monitoring factors include pH value, total hardness, total dissolved solids, COD, high salt index, petroleum, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, volatile phenols, and appropriate supplementation of iron ions, chloride ions, sulfur ions, etc. based on the characteristics of the oil reservoir.

The impact indicators of petroleum annotation development projects on water environment are very complex. Among the selected indicators, indicators with similar properties are classified into one category. On the basis of previous research and guidelines, following the principle of constructing an indicator system, establish an evaluation indicator system for the impact of oil injection development projects on water environment quality. This indicator system divides the impact of oil injection development projects on water environment quality into surface water environment quality and groundwater environment quality. In surface water environment quality, it includes petroleum, suspended solids, water body indicators (COD, BODs, pH, DO, water temperature, etc.), volatile powder, salt alkali (sulfides, sulfides, native chemicals, chemicals, etc.), benzene, polycyclic aromatic light Metal (lead, cobalt, pickaxe, iron, etc.) and bacterial (SRB, TGB); In the environmental quality of groundwater, it includes petroleum, dissolved total solids, water indicators (pH value, total hardness, COD, etc.), volatile powder, ammonia nitrogen, saline alkali (high acid salts, sulfates, nitrites, etc.), benzene, polycyclic aromatic light, ionic (sulfur ions, sulfur ions, iron ions, strong ions, etc.), and bacterial (SRB, TGB).

5 Improvement and Improvement of the Legal Risk Management System for Environmental Pollution in Petroleum Enterprises

The legal risks of environmental pollution borne by petroleum enterprises include both administrative and civil legal risks, as well as criminal legal risks faced by the increasingly stringent national legal environment. At the same time, the author analyzes the causes of these risks from a practical perspective, and how to avoid risks. Under existing risk management models, further improvement and improvement are needed, Establishing a more targeted environmental pollution risk management mechanism to enable petroleum enterprises to embark on the path of "green operation" requires further efforts, not only in the construction of peripheral mechanisms, but also in the establishment of a new production and operation concept by all levels of petroleum enterprises.

The establishment of modern enterprise systems is a process of balancing and choosing between opportunities and risks. Opportunities can bring profits and development prospects to enterprises, but risks always accompany them. Therefore, enterprises must incorporate risks into a manageable and controllable range in order to ensure their sustainable development. Enterprise legal risk management is one of the core contents of modern enterprise management system. Although it has only been developed for more than a decade in China, its crucial role in enterprise operation has attracted sufficient attention. Legal risks have various manifestations, and according to statistics, there are over 2000 types of legal risks faced by enterprises, covering various fields from company preparation, establishment, to bankruptcy liquidation.

In recent years, with the gradual infiltration of high-quality foreign enterprises, it has had a huge impact on China's extensive management of enterprises. Especially with the increasingly strict environmental protection laws, enterprises are facing increasing environmental pollution risks. If scientific environmental pollution legal risk management is not implemented, for enterprises, when risks arise, it will not only damage their reputation and finances, but also lead to a dismal outcome of being eliminated from the market. Legal risk is one of the important incentives for enterprises to fall into operational difficulties. Oil companies are a typical industry with high environmental pollution risks, as evidenced by recent events such as the Gulf of Mexico oil spill From the perspective of environmental pollution infringement incidents caused by improper operation and production of oil companies such as the "Bohai Bay Oil Spill Accident", a series of unresolved problems such as huge compensation and litigation have brought immeasurable losses to oil companies, and have also caused great pressure on subsequent operations. China's oil industry is a monopoly operated by thousands of countries. With the development of network technology and the expansion of information disclosure, many previously unknown pollution incidents have surfaced Large oil companies are facing strict public opinion supervision, whether it is pollution incidents that have occurred or potential pollution risks, forcing them to face a severe situation. Therefore, strengthening the legal risk management of environmental pollution in oil companies is an important component of risk avoidance for oil companies and an important way for them to maintain sustainable development. Starting from the urgent need for environmental protection and corporate social responsibility to achieve sustainable development in China, this article explores the legal risks of environmental pollution in petroleum enterprises and corresponding risk management mechanisms.

At present, the internationally representative energy consumption evaluation indicator systems mainly include: the UK energy industry indicator system; IAEA (International Atomic Energy Agency) Sustainable Development Energy Indicator System; EU (European Union) Energy Efficiency Indicator System; WEC (World Energy Council) energy efficiency, etc.

The UK energy industry indicator system is designed in a top-down hierarchical manner, divided into three levels: the first level is the main indicators, including reliability, competitiveness, fuel poverty, and low-carbon indicators, which correspond to the four major energy development goals proposed in the 2003 UK government's energy white paper; The second layer is the supporting indicators, which are used to specify the four main indicators mentioned above; The third layer is the background indicators, divided into 12 items, and each item has a thousand indicators to refine and supplement the supporting indicators of the previous layer.

The framework of the EU energy efficiency indicator system is designed for classification, including six macro level energy efficiency indicators to evaluate the energy efficiency of a country or industry. These six types of indicators are: energy intensity, unit energy consumption, energy efficiency index, adjustment index, diffusion index, and target index.

The WEC energy efficiency indicator system is designed as a single layer, which includes 23 indicators. According to the nature of indicators, they are divided into two categories - economic indicators that measure energy efficiency at the entire economy or industry level; The other type is technical and economic indicators, which are used to measure the energy efficiency of individual industries and end use energy systems.

The IA EA Sustainable Development Energy Indicator System is also a single-layer design, with the main idea of identifying the main issues and parameters related to sustainable energy development; Determine the internal causal relationship between various important parameters related to energy and develop a set of indicators to measure the changes in parameters related to the energy sector. IAE A has finally identified 41 indicators.

5.1 Establishment of Environmental Pollution Legal Risk Management System

With the continuous deepening of the market economy, modern enterprise systems have gradually been improved and developed in various industries. The risk factors faced by enterprises in the process of operation and development are becoming increasingly complex, including not only commercial risks but also legal risks. To achieve long-term and stable development, enterprises must effectively control the occurrence of these two types of risks. Business risk refers to the risk caused by the actions of counterparties in the business process of an enterprise. Compared to commercial risks, legal risks are more controllable, and the legal compliance department can minimize the potential legal risks faced by enterprises in the business process by developing comprehensive risk control mechanisms. There are various forms of legal risk in enterprises, including default risk, violation risk, and infringement risk. In the production and operation process, if improperly handled, the occurrence of legal risk will not only lead to huge economic losses for the enterprise, but also the administrative and even criminal responsibilities that the enterprise should bear, and ultimately may lead to the brink of bankruptcy. Therefore, legal risk is one of the important incentives for enterprises to fall into operational difficulties. Oil companies are a typical high-risk industry for environmental pollution. In recent years, environmental pollution infringement incidents caused by improper operation and production of oil companies such as the "Gulf of Mexico crude oil spill" and the "Bohai Gulf oil spill accident", as well as a series of unresolved problems such as huge compensation and litigation, have brought immeasurable losses to oil companies and put great pressure on subsequent operations.

Since the reform and opening up, China's social and economic development has always been at a stage of rapid development. Through decades of efforts, the total economic output has now ranked second in the world, reaching an unprecedented height. While achieving brilliant achievements, looking back on the past, the shocking scenes have always lingered in the minds of the Chinese people, lingering like nightmares, accompanied by environmental pollution caused by high-speed development, The sword of Damocles, which has become the wheel of restraining the economy from further advancing, has been counted by relevant institutions as a significant environmental pollution event that has had a significant impact in China in recent years, with an average of three incidents per year. The Songhua River major pollution event in 2005, the Zijin Mining copper acid water leakage accident in 2010, the Dalian Xingang crude oil spill accident in the same year, and the Bohai Penglai Oilfield oil spill accident in 2011, The 2012 Longjiang River Pick Pollution Incident in Guangxi, a typical and major environmental pollution accident, is a well-known case that can be traced back to petrochemical enterprises.

As an important component of China's modern industry, petrochemical enterprises play a crucial role in the national economy and social development. However, the current development trend shows that the petrochemical industry has entered a high-risk period of environmental pollution, exhibiting characteristics such as wide impact range, serious damage consequences, and diverse types of pollution. As one of the driving forces for the development of basic industries and other industries, We do not have the determination and conditions to "tear down Ma Su", but we will not allow it to develop and expand freely and without restraint. How will it develop in the future? Corporate social responsibility: During the production and operation process, oil companies inevitably face potential or existing environmental pollution infringement risks and accidents. The sources of infringement are also diverse, such as environmental pollution infringement accidents caused by improper management during the exploration, development, and transportation of oil and natural gas, and third-party infringement caused by negligent damage to oil and gas facilities and equipment by criminals, These all fall within the scope of risk management by the legal/compliance department of petroleum enterprises. Therefore, in the context of the frequent occurrence of environmental pollution accidents in petroleum enterprises, it is particularly urgent and important to conduct in-depth research on the operational mechanism of their legal risk management.

When formulating a risk prevention and control system, enterprises should consider the risks identified in the risk tree as a whole, and develop a risk prevention and control system for each risk to form an institutional system. This article focuses on establishing a three-dimensional framework for legal risk management of petroleum environmental pollution based on the three dimensions of risk management: objectives, elements, and management levels.

5.1.1 First Dimension - Legal Risk Management Objectives

The goal of legal risk management in terms of development is to ensure that the risk returns of oilfield enterprises are compatible with sustainable and healthy development. In the process of advancing towards the goal of "building world-class and achieving leading development", we actively play a role in ensuring and promoting legal affairs work.

The goal of legal risk management in the market is to ensure that the legal review rate of important contracts and major business decisions of oilfield enterprises reaches 100%, major legal disputes left over from history are basically resolved, and behaviors that infringe on the interests of enterprises can be promptly and effectively responded to, achieving the maximization of legal rights and interests of enterprises and minimizing transaction risk losses.

The goal of legal risk management in terms of operations is to ensure that all operational and management activities of the oilfield comply with national laws, regulations, and policy requirements. Major legal disputes arising from illegal operations are basically eliminated, and a long-term mechanism for enterprise legal risk management with a focus on systems and processes is formed, achieving standardized, systematic, and procedural legal risk prevention and control.

The goal of legal risk management in terms of reform is to ensure that relevant legal risks are controlled within the target range, that various reform measures of the enterprise are legal, effective, and can be implemented, and that the internal control management system is continuously enriched and improved, providing protection for scientific decision-making and lawful operation of oilfield enterprises.

5.1.2 Second Dimension - Elements of Legal Risk Management

(1) Environmental pollution legal risk management process

Legal environment investigation. Mainly collecting domestic and foreign legal risk cases and risk information related to oilfield enterprises, including political, economic, and regional environmental changes; New laws, regulations and normative documents; Industry and industrial policies; Financial and tax policies; Important contract agreements and major dispute cases of oilfield enterprises; Internal and external legal risk environmental information such as intellectual property rights of competitors, and tracking and monitoring important information.

Legal risk identification. When identifying the legal risks of environmental pollution, various methods can be comprehensively applied, such as sorting out past dispute cases of the enterprise or the industry, organizing relevant laws, regulations or policies that may be involved in the production and operation process of the enterprise, and sorting out the production and operation business processes of the enterprise. The legal risks and risk behaviors involved in the enterprise can be listed as completely as possible without omission, and logically independent of each other Completely exhaust, accurately reflect the connotation and extension of environmental pollution legal risks in terms of expression, and create a concise and easy to understand list.

Legal risk assessment. Determine the risk level and predict the likelihood of risk. The probability of risk refers to the frequency of risk occurrence within a certain period of time, which can be evaluated from aspects such as external regulatory enforcement, improvement and implementation of internal control systems, legal quality of relevant personnel, comprehensive situation of stakeholders, and frequency of work involved; Risk loss degree refers to the degree of loss that a risk may cause to the enterprise once it occurs, We mainly consider the types of consequences, including property losses and non property losses, as well as the severity of the consequences, including the size of property losses, the scope of non property losses, and the reactions of stakeholders. The expected value of risk losses (risk level) It is to comprehensively consider the possibility of environmental pollution risk occurrence and the degree of risk loss, and then judge and analyze whether the risk has reached the severity level, specifically manifested as the product of risk likelihood and risk loss degree.

Develop corporate legal risk management strategies. The following four risk management strategies can be used separately or in combination for different types and levels of legal risks:

One is to avoid risks. It refers to the active exercise of legal or contractual rights by enterprises, or the full and complete fulfillment of legal or contractual obligations, in order to avoid the possibility of risk occurrence, thereby eliminating legal risks or reducing their losses. This method is mainly applicable to risk prevention. There are two situations, one is to avoid violating prohibited provisions of the law and eliminate the illegality of business operations. The second is to effectively avoid risks in contractual behavior by clarifying the rights and obligations of both parties and setting up "risk prevention clauses".

The second is to reduce risks. A strategy to reduce risks that are unwilling to give up or transfer, by controlling risk factors, reducing the likelihood of loss occurrence, reducing the degree of loss, and achieving the goal of reducing risks. Risk reduction is a proactive risk management measure that involves using pre established policies and procedures to prevent and manage risks. Specifically, there are two ways: firstly, by controlling the risk factors that affect the outcome of legal risk damage, the outcome or probability of legal risk damage can be reduced; The second is to take other proactive actions to reduce the degree of legal risk damage and achieve control over legal risks.

The third is to transfer risks. When legal risks cannot be reduced through risk reduction strategies to reduce the likelihood of occurrence and the amount of losses, enterprises can consider measures to transfer risks. Risk transfer refers to the transfer of financial burden and legal responsibility for losses by enterprises to others through contracts, economic, financial instruments, and other forms, in order to reduce the likelihood of risk occurrence and reduce the amount of losses.

The fourth is to retain risks. At the current level of legal risk, the strategy of not taking any measures to reduce the likelihood and impact of legal risk, and allowing the enterprise to take the initiative to bear legal risks on its own. When other legal risk resolution strategies are unable to effectively resolve specific legal risks, or the cost of resolving legal risks is too high for enterprises to accept, retaining legal risks becomes the last choice. This strategy is mainly applicable to the cost of handling legal risks for enterprises, as well as the cost of bearing legal risks; Estimate that the enterprise itself has the ability to bear the maximum loss that may occur due to certain legal risks; And the legal risks that the enterprise cannot transfer to others.

Legal risk management control. From the specific practice of enterprises, the measures to address legal risks mainly include: setting up personnel and institutions specifically responsible for environmental pollution legal risk management, and developing corresponding systems and procedures; Develop risk management guidelines or training materials, conduct specialized training, and strictly conduct performance evaluations.

(2) Enterprise legal risk management information system

In response to the current legal risk management document gap in oilfield enterprises and the lack of precedent and data support in analyzing legal risks, the legal department should focus on strengthening two aspects of work:

Firstly, in terms of basic document construction, form texts such as legal risk management documents are established as working papers for the legal risk management system documents, specifically used to record the basic situations faced by the group company, such as legal risks, risk sources, evaluation information, and prevention and control measures. The legal risk management document is presented in the form of an Excel table, embedded with a series of interdependent and logically arranged concepts.

The second is in terms of information platform construction, with contract management information as the focus, through the "5+l" model, which integrates five systems: ERP system, fund settlement system, supplier (customer) database, contract management system, and standard contract text library. On this basis, with the help of advanced modern scientific and technological methods and information management methods, existing resources are sorted and integrated, and a unified legal risk information and knowledge management platform is gradually established. Through this system, the main tasks of legal risk identification, analysis, control implementation evaluation, etc. are completed, achieving online query, retrieval, and maintenance of legal risk databases, And the communication and interaction of legal risk management work between the oilfield and various secondary units.

(3) Corporate legal risk management culture

One is to educate and guide leaders and managers at all levels to firmly establish a legal concept.

The second is to integrate the cultivation and shaping of legal risk management culture into the entire process of corporate culture construction. Starting from the actual situation of the enterprise, scientifically define the core concepts such as the connotation and extension of the legal risk management culture of oilfield enterprises.

The third is to focus on enhancing the awareness of legal risk management among all employees, fully utilizing various activity carriers, interpreting risk management concepts to employees through different ways and channels, guiding employees to clarify their ideological misconceptions, stimulating their enthusiasm for proposing strategies to promote the construction of corporate legal risk management culture, transforming risk management awareness into common understanding and conscious action among employees, and forming a situation where all employees participate.

5.1.3 Third Dimension - Legal Risk Management Hierarchy

According to the current organizational structure of legal affairs in the oilfield and the principles for setting up risk management functions, a legal risk management organizational system is established under the unified leadership of the oilfield decision-making level, with the general legal advisor system as the core and the joint participation of the legal affairs department and business departments.

The organizational structure of this organization is actually based on the existing legal affairs management organizational system of the oilfield. Under the oilfield and the second level decision-making level, legal risk management committees are respectively established, and legal risk monitoring teams or risk monitors are respectively established in the oilfield agency business department and the second level agency business department. At the oilfield level, the Legal Risk Management Committee is mainly composed of oilfield leaders and relevant business department heads. The main leader serves as the chairman of the committee, while the general legal advisor and other leaders serve as deputy directors. The Legal Affairs Office exercises the corresponding functions of the committee office. In the design of this organizational system, there is a regulatory constraint relationship of "subordinates are responsible to superiors, and superiors are responsible for subordinates", as well as a guidance and assistance relationship of "division of labor and cooperation" between business departments and legal affairs departments at the same level, as well as a supervision and guidance relationship of "hierarchical responsibility and centralized control" between legal affairs departments at different levels.

The Oilfield Legal Risk Management Committee is responsible for coordinating and managing the legal risk of the entire oilfield, and is accountable to the decision-making level of the oilfield. As the overall person in charge of oilfield legal affairs, the chief controller of legal risks, and the convener of the legal risk management committee, the general legal advisor of the oilfield directly participates in major decisions of the oilfield, is fully responsible for the operation of oilfield legal risk management work, and is directly responsible to the decision-making level. The Oilfield Legal Affairs Office studies and proposes the annual work report on oilfield legal risk management, as well as the judgment standards or mechanisms for major decisions, risks, events, and important business processes across functional departments; Guide and supervise relevant functional departments and secondary units of the oilfield to carry out legal risk management work and other responsibilities. Other functional departments and secondary units shall comply with The principle of "who is in charge, who is responsible" follows and follows the unified arrangement of the Oilfield Legal Risk Management Committee, and conscientiously fulfills risk management responsibilities. Functional departments can establish a legal risk monitoring team or legal risk monitoring officer, establish a joint mechanism with the legal affairs department to prevent and control legal risks, in order to timely receive guidance and guidance from the legal affairs department before legal risk hazards evolve into legal risk events Assist in achieving legal risk prevention and control by moving forward and preventing in advance; The secondary units should strictly implement the legal risk prevention and control process and legal affairs management system under the supervision and guidance of the Oilfield Legal Affairs Department, and establish a legal risk management system that is suitable for their own characteristics and can effectively play a role.

5.2 Legal Risk System Layout

At present, research on the legal risk management of environmental pollution by thousands of oil enterprises in China is still in its infancy, and there is no systematic theory or mature operational process in both theoretical and practical fields. However, it cannot be denied that the legal risk management of environmental pollution is of great significance to enterprises, especially oil enterprises, by enhancing their "soft power" to enhance their value. Undoubtedly, the Bohai Bay oil spill incident has had a negative impact on CNOOC's corporate image. As the incident gradually ferments, both national ministries and the oil industry have begun to re-examine the importance of risk management. As a high-risk and highly polluting industry, there must be a strict constraint mechanism in the production and operation process of oil, which is within the framework of the rule of law Risk management mechanism under public supervision environment. It can be expected that China's research on legal risk management of environmental pollution will gradually deepen, becoming an important guarantee for the sustainable development of oil enterprises.

The characteristics of high-risk and high pollution industries determine that oil field exploration and development activities inevitably affect and damage the ecological environment while developing and utilizing natural resources. Therefore, oil companies may bear environmental pollution infringement liability. This article focuses on the legal risks of environmental pollution infringement by petroleum enterprises, and takes the Bohai Bay oil spill accident and SL oilfield oil spill accident as cases to elaborate and analyze. Compared with the actual operation situation of the unit I work for, starting from the infringement issues that occur in oil exploration and development, this article analyzes the legal risks of environmental infringement, and seeks quick and effective solutions to disputes from the legal perspective, The ultimate goal is to build a legal risk prevention and control system for oil exploration and development infringement disputes, prevent potential legal risks of infringement disputes, and provide reference for properly handling existing disputes, in order to achieve the "green" and harmonious development of oil enterprises. The establishment of a legal risk management system for environmental pollution infringement in petroleum enterprises is not something that can be completed overnight, nor can it be solved by a single legal department or a set of legal systems. It relies on a long-term process of improvement.

Establishing and improving the legal risk prevention system for enterprises as soon as possible is the basic guarantee for preventing legal risks. " Based on the high-risk attribute of high pollution in the production and exploration process of petroleum enterprises, in order to prevent the occurrence and expansion of risk accidents, it is necessary to adhere to the synchronization of safety production and emergency management, and strictly control all links to achieve healthy and orderly development of the enterprise.

5.2.1 Prevention and Control of Legal Risks in Environmental Pollution in the Early Stage

The source and prevention of legal risks fundamentally need to be implemented in daily business processes, which requires the company's business management personnel to put great effort into the design of business processes and the standardization of business operations

Due to the possibility of legal issues arising from environmental pollution occurring in different environments of oil production, targeted measures and methods should be taken in accordance with laws and regulations as well as local government rules and regulations.

Firstly, an environmental risk assessment must be conducted during the application and approval stages of the construction project. Construction operations can only be carried out after the official environmental assessment report from the local environmental protection department is approved.

Secondly, for projects under construction and in the construction phase, a regular notification and review system should be implemented. It is strictly prohibited to carry out operations without the permission of the environmental protection department or superiors, and the "three simultaneities" of environmental protection should be strictly followed. Once the regulations are violated, the main person in charge should accept punishment, reduce the performance evaluation score, and order rectification within a specified period of time. Thirdly, construction projects that may cause environmental pollution should be reported in a timely manner and corresponding measures should be taken immediately

Implement prevention and control measures. For example, in the Sinopec SL oilfield oil spill accident After the incident, the competent department should immediately formulate a contingency plan and promptly notify the environmental protection department to obtain government technical support. At the same time, in accordance with the provisions of emergency management, immediate rescue should be carried out to control the expansion of the accident and strive to reduce casualties and property losses. When dealing with public opinion, an honest attitude should be maintained and relevant information should be disclosed in a timely manner. For illegal and criminal activities of third parties, timely reporting should be made and evidence should be collected and preserved .

5.2.2 Remedies after Environmental Accidents

In the case of unavoidable environmental legal risks, in order to minimize the adverse effects and maximize the rights granted by law, the construction unit should timely initiate relevant legal relief procedures.

It is a dispute over compensation for environmental pollution damage, which should be based on whether there are legal exemptions,

Take different measures. Compensation for pollution damage caused by one's own fault, The legal department of the construction unit should try to minimize litigation burden as much as possible Starting from here, resolve the dispute through reconciliation or administrative mediation. If there is no consensus with the infringed party, sufficient preparation should be made to respond to the lawsuit. For pollution compensation disputes that have exemption reasons such as force majeure or third-party fault, the legal department should collect evidence together with relevant departments and actively negotiate with the victim to reach a settlement agreement. If consultation fails, the legal department should bear the defense of exemption or take legal action To seek compensation from a third party through other means. For those who claim compensation through illegal means such as obstructing oil field production, they can report the case to the public security organs and request them to punish the interference with oil field producers in accordance with the "Regulations on Public Security Management Penalties"; You can also bring a lawsuit to the people's court to stop the illegal behavior of the claimant in accordance with the relevant provisions of the Civil Procedure Law, and at the same time demand civil compensation for the losses caused to the enterprise by the illegal behavior.

Secondly, after receiving notification from the administrative authorities of the administrative penalty behavior, the legal department of the construction unit should first collect evidence in a timely manner in conjunction with other relevant departments, fully utilize the procedural rights granted by law, actively state and defend, and request the administrative authorities to provide the facts, reasons, and basis of the administrative penalty, in order to strive for the initiative of the administrative penalty case; Secondly, the laws and regulations on which administrative penalties are based should be carefully studied. Confirm whether the application of laws in administrative penalty cases is correct; Thirdly, it should be confirmed whether the illegal act has passed the statute of limitations for punishment; Fourthly, it is necessary to carefully study the legal responsibilities of relevant administrative organs to determine whether the administrative subject is qualified and has corresponding punishment powers. On the basis of clarifying the above situation, objectively evaluate the degree of impact of relevant administrative actions on the enterprise, and then decide whether to seek relief by applying for a hearing, administrative reconsideration, or filing an administrative lawsuit.

Thirdly, in the event of a major environmental pollution accident that requires criminal responsibility, the legal department should work with professional lawyers to study whether there are legal circumstances for reducing criminal responsibility in production operations, and cooperate with lawyers to collect relevant evidence and prepare for litigation.

5.3.1 Diversified risk transfer channels

From the perspective of ensuring the sound and rapid development of petroleum enterprises, it is necessary to attach great importance to the prevention and control of environmental pollution during the exploration and development process of oil fields, while also taking precautions and actively exploring ways and methods to transfer and share environmental pollution risks. Through market-oriented risk management and economic compensation measures, petroleum enterprises should enhance their ability to respond to pollution accidents and reduce business risks.

5.3 Actively purchase environmental pollution liability insurance

At the end of 2007, the former State Environmental Protection Administration, in collaboration with the Insurance Regulatory Commission, issued guidance on environmental pollution liability insurance and carried out pilot projects in some provinces and cities across the country. In 2010, the State Council issued a notice on further increasing efforts to ensure the achievement of the "Eleventh Five Year Plan" energy-saving and emission reduction goals, which clearly stated the requirement of "carrying out environmental pollution liability insurance". Domestic insurance companies also launched some service projects accordingly, and the comprehensive implementation of the environmental pollution liability insurance system has become a trend. Insurance can also promote enterprises to improve their production methods. Insurance companies regularly visit policyholders, which is also beneficial for reducing the possibility of environmental risks. This is where the Youqian government rescue fund is located. Currently, some regions in China have already carried out compulsory insurance for environmental pollution liability insurance, such as Shanxi, Jiangsu, and other regions, which have achieved certain results. However, overall, the progress of this work is not smooth, and even has been successful It is difficult to make progress, especially in the face of large state-owned enterprises such as oil companies, which have a strong voice. The determination of insurance premiums and other issues is also a major challenge, therefore, further promotion is needed from functional departments.

5.3.2 Establish and improve an environmental pollution risk compensation fund

After the oil spill accident in Bohai Bay, the call for establishing a risk compensation fund in the oil industry has become increasingly popular, and relevant departments such as the Ministry of Environmental Protection have also made positive statements regarding this. In a broad sense, the concept of a fund mainly refers to a certain amount of funds established for a certain purpose, and risk compensation funds (or safety production fees) are funds that are concentrated by transferring risks. At present, China's risk compensation funds are mainly implemented in high-risk industries such as coal mines. In 2006, the Ministry of Finance and the State Administration of Work Safety issued the "Interim Measures for the Financial Management of Safety Production Expenses of Enterprises in High Risk Industries", requiring coal and non coal mining enterprises to pay safety production expenses, which are kept and distributed through specialized institutions.

In the energy industry, the establishment of funds or the purchase of insurance have the function of transferring risks. Compared to Qianinsurance, the use of funds has the characteristic of flexibility and a wider range of functions. They can not only be used for the maintenance of daily equipment, but also solve the business pressure caused by huge losses after accidents through compensation methods. The disadvantage of funds lies in the large amount of payment. According to the Interim Measures for the Financial Management of Safety Production Expenses of Enterprises in High Risk Industries, the proportion of funds withdrawn from high-risk industries is 2% or even higher of operating income (or engineering costs), while the premiums paid for purchasing insurance are much lower than those of funds. At present, relevant departments in China have proposed to establish a risk compensation fund within the oil industry to supplement

The economic compensation for victims after pollution accidents, as an oligopoly oil enterprise, should actively cooperate with the establishment and improvement of the fund, combining the pursuit of the company's economic, social, and ecological interests, combining the company's immediate and long-term interests, and pursuing the coordination and maximization of human, natural, and social interests as the goal, to promote the implementation of sustainable development strategies.

Green culture, as a brand new concept of modern enterprises, is gradually being valued and promoted in China's petroleum enterprises, and has accumulated certain experience through years of practice. However, overall, the concept of green culture has not formed a systematic and comprehensive institutional system. Corporate culture is the soul of enterprise development and progress. CNOOC has a vision of "contributing inexhaustible clean energy and creating a better life". Sinopec has described the company's development blueprint with the goal of "building a world-class energy and chemical company". In terms of corporate culture terminology, CNOOC has a more green cultural connotation, while Sinopec has shown people an ambitious desire, However, slogans and slogans are not systematic systems and do not serve as "soft constraints" for enterprises. The disconnect between ideals and practice, and the inadequate implementation of concepts are important obstacles to the sustainable development of China's oil enterprises.

China is currently in a period of rapid development and energy shortage, making the country's demand for oil very urgent

Seizing time and competing for speed, insufficient development preparation, coupled with inadequate ideological awareness among management at all levels, many enterprises have non-standard or serious mistakes in legal behavior during the oil development process, resulting in many legal risks in the exploitation of onshore and offshore oil fields. The lack of human understanding of nature, that is, the erroneous guidance of low-level ideological understanding, has led to non-standard behavior of oil development enterprises, which has buried many legal risks in oil development behavior. A few years ago, due to some leaders' weak awareness of petroleum engineering risks, environmental protection, and high investment and high risk in petroleum development, some petroleum engineering problems that now seem absolutely impossible to solve still exist.

As an experienced employee who has worked in an oil company for over a decade, whether I am the author or others, when it comes to corporate culture construction, the first thing that comes to mind is ideological and political activities such as singing, dancing, reading newspapers, or literary and sports activities. However, I have little knowledge of what green culture is, and my understanding of its form often remains in seminars jointly reported by scholars or in internal meetings, It does not receive enough attention. At the same time, like most people, in their understanding of green culture, they generally focus on the protection of the environment by enterprises. In fact, this kind of action is only a superficial understanding, and the true implementation of green culture needs to be implemented within the oil industry, which is a deeply rooted influence. Posting slogans, posting bulletin boards, shouting slogans, and other forms have no substantive significance. Leaders do not attach enough importance, employees go through motions, and the construction of green culture concepts cannot be implemented. In the long run, it will inevitably restrict the sustainable development of oil enterprises.

6 Suggestions on Water Environment Protection Policies for Oil Water Injection Development Projects

Petroleum enterprises are one of the most important energy enterprises, and are typical resource dependent and energy consuming enterprises. Implementing energy conservation and emission reduction is an inevitable choice for sustainable development and enhancing international competitiveness of petroleum enterprises. Improving energy efficiency by oil companies has made a great contribution to China's industrial energy efficiency. Therefore, studying the energy-saving and emission reduction behavior of petroleum enterprises is of great significance for the development of low-carbon.

With the continuous development and utilization of petroleum resources, the technology of oil water injection development has achieved tremendous development and significant progress. Oil water injection development projects have been widely carried out in major oil fields in China, and unprecedented results have been achieved in ecological environment protection such as water environment. However, in the process of socio-economic development, the coordinated development of oilfield ecological environment and resource development also faces very serious challenges. Petroleum development enterprises must pay attention to the quantitative evaluation of the impact of oil injection development projects on water environment quality, quantity, and comprehensive impact, and at the same time, reasonably and timely regulate the technologies, methods, and measures for water environment protection based on the results of the quantitative evaluation. At the same time, based on quantitative evaluation and prediction trends, correctly adjust the research and development direction of future water environment protection technologies and methods. In addition, oil development enterprises should also strengthen the water environment protection mechanism in terms of policies and systems, strictly protect the water environment from their own perspective, establish a water environment supervision and management system, achieve coordination between oil development and environmental protection, and increase efforts to optimize the industrial system, achieve clean production and circular production, and actively promote the construction of the rule of law system.

6.1 Water Environment Supervision and Management System for Petroleum Development Enterprises

(1) Improve the management system and carry out in-depth goal management by the team

Aiming at the international advanced level of oil injection development, improving the benchmarking system, and benchmarking with the world's high-level in technology, management, environmental protection, etc., to find gaps and improve space. Clarify the goal of taking the lead in development, and strive to make petroleum development, petroleum engineering, environmental protection engineering, and other businesses world-class.

Effectively promote procedural and institutionalized management

Adhere to the standardization of water environment management mechanisms, management systems, management methods, and management platform informatization, standardize relevant business processes, establish a standardized system for water environment management and evaluation, and carry out full lifecycle management and evaluation of projects. Establish and improve a business process system with clear hierarchical responsibilities and effective process management, and achieve standardization and informatization of rules and regulations for oil water injection development projects.

Adjust and improve the assessment and incentive mechanism

We will adopt incentive mechanisms to encourage the development of oil injection development projects, coordinate the overall development of the oil region, focus on increasing rewards for stable production and increase production, environmental protection, and technological innovation, and continuously strengthen assessment efforts.

Establish a water environment monitoring system

Highlighting key links, implementing "pre in process post" full process supervision, promoting real-time and synchronous water environment protection and impact assessment, integrating water environment supervision into every link and step of oil injection development, is the institutionalization of water environment impact assessment, ensuring synchronous improvement of oil resource development and water environment, and achieving coordinated development of resources and environment.

(3) Improve operational management mechanism

Gradually improve the emergency plans and prevention and control measures for water environment protection and water pollution emergencies, actively carry out the preparation and improvement of emergency plans for water environment accidents, standardize emergency plans at all levels and on-site emergency response procedures, strengthen the training and practical exercises for safety production and green production management of oil injection development projects, and improve the emergency management and prevention capabilities of all employees.

(4) Information disclosure mechanism

The information disclosure system mainly refers to the disclosure of water environment information among oil development enterprises, the public, and government departments. Based on the premise of information disclosure, promote public participation in water environment management, supervision, and evaluation, and continuously improve the transparency of water environment monitoring and management work, ensuring the coordinated development of oil resource development and utilization and water environment through information disclosure.

The oil field information disclosure mechanism mainly considers two aspects: firstly, oil development enterprises should bear the social responsibility of information disclosure. In the development and utilization activities of oil resources, the impact assessment information on the water environment and other ecological environments, including various evaluation indicators and data, should be truthfully provided to government functional departments and stakeholders, so that government departments and the public can be aware of it. Secondly, oil development enterprises should use convenient means to publicly disclose water environment information related to public interests, encourage public participation, and listen to public suggestions and opinions to safeguard the overall interests of the social system.

(5) Strengthen investment in environmental protection technology

Oil development enterprises must increase their research and development efforts in environmental protection technology, strengthen investment in environmental protection technology funds and manpower, and continuously develop more environmentally friendly oil injection development technology and pollutant recovery and treatment technology while improving oil recovery rate and high and stable production technology. At the same time, we will strengthen technical training for oil injection operation sites, enhance the technical level of on-site operators, and reduce uncontrollable pollution emissions.

6.2 Coordination between oil development and environmental protection

The large-scale and disorderly development and utilization of petroleum resources is the main factor causing environmental pollution and damage in oil development project areas. How to coordinate oil development activities and environmental protection is related to the optimization of oilfield resource allocation and the improvement of economic efficiency, and is the key to achieving sustainable social and economic development in oil development areas.

(1) Implement closed management and strengthen environmental management

In the process of oil development, we adhere to the principle of "protecting while developing, developing while protecting", implement closed management for oil development, and effectively reduce negative impacts on the water environment and other ecological environments. The main measures to adopt closed management for oil water injection development projects include: strengthening publicity and education on the important value and significance of protected objects Governance of the water environment in oil development areas, effective cultivation of natural aquatic animals and plants, regulation of the quality and quantity of regional water bodies, strengthening the resilience of the water environment system, and improving the self recovery ability of the water environment Centralized recovery, placement, and treatment of pollutants throughout the entire process of oil water injection development projects, strengthening the clean and harmless treatment, recycling, and reuse of pollutants Establish pollutant treatment and emission standards for oil water injection development projects, and strictly control emissions that meet standards.

(2) Improve the economic compensation system for water environment and resources

At present, in addition to imposing general taxes such as resource tax and value-added tax on oil resource development enterprises, China also imposes various ecological and environmental compensation taxes such as pollution discharge fees, soil and water resource compensation fees, and mining area use fees on oil production enterprises. In addition to paying the above-mentioned taxes and fees in full and on time, enterprises should also establish and improve an economic compensation system for oil resource development and ecological environment that conforms to the characteristics of oil water injection development projects, based on the current situation of domestic oil fields and the compensation mechanism for China's ecological environment, and learn from the advanced practices of some foreign oil development enterprises.

6.3 Industrial System Construction

The pollutants discharged from various stages of oil water injection development may have adverse effects on human beings, animals and plants, and also affect the ecological environment such as water and soil, posing a huge threat to the ecological environment. The water environment issues in the Qianyou Water Injection Development Project area are not only related to the safety of the water environment in the area, but also include various issues regarding whether the area can develop and the direction of development.

(1) Establish a circular industry system

In the past, Shan Qian's oil production practice only focused on the transformation and control of natural resources, while neglecting the unity of human and nature. From the development history of the world petroleum industry, it can be seen that some oil fields did not pay attention to environmental protection during the development process, resulting in prominent environmental problems and a sharp decline in production. The same problem has also occurred in the development process of Chinese oil development enterprises. To achieve sustainable development of oil development enterprises, environmental protection should be taken as the foundation, technological innovation should be carried out, resources in the oil development project area should be fully utilized, and scientific coordination between resource development and environmental protection should be achieved to achieve a circular industrial system composed of clean production.

In order to further optimize the industrial structure, oil development enterprises should promote clean production, Its main idea is the "zero emission" of pollutants We are committed to controlling pollution emissions. We apply the concept of overall pollution prevention throughout the entire process of oil water injection development, and introduce the concept of clean production into the economic and industrial system. At the same time, in accordance with the principles of reduction, reuse, and resource utilization, we promote the mode of circular production, achieve centralized production, pollution control, and intensive development, build an ecological and environmental protection industry chain, strengthen research and transformation of recyclable technologies, and form a clean production and A circular economy that integrates the comprehensive utilization of waste. Actively promote new technologies in construction, drilling, operations, oil extraction, gathering and transportation, and environmental protection, starting from the source, controlling the entire process, minimizing pollutant emissions, and striving to achieve clean production and build ecological oil fields. From the perspective of fully utilizing resources and controlling environmental pollution, with clean production as the core, plan and design major circular economy projects. Fully implement energy-saving and emission reduction projects, comprehensively promote clean production in every link of the oil resource development process, implement full process detection and control of pollution, and actively encourage and guide enterprises to engage in clean and sustainable production.

(2) Building an efficient ecological industry system for resource conservation and rational utilization

The extensive development, utilization, and consumption of China's petroleum resources not only result in waste of resources, but also cause environmental pollution and destruction. After decades of development in the oil field, various problems such as resource shortage, energy shortage, and environmental degradation have emerged, bringing enormous pressure to resources and the environment. In order to ensure the sustainable development of resources and the environment, we will comprehensively promote environmentally friendly and energy-saving economic development methods, promote the conservation of water resources and energy, and effectively utilize resources comprehensively, Strive to build an efficient ecological industrial system with low consumption and efficient utilization.

In order to promote the rational and efficient utilization of water resources, we actively explore effective ways of resource intensification, conservation, and efficient and sustainable utilization. Enterprises must continuously improve the efficiency of intensive utilization of water resources, vigorously support the transformation of water-saving technologies, strictly prohibit the introduction of new high water consumption projects, accelerate the transformation of water supply pipelines, and strive to reduce the leakage rate of pipelines; Promote the utilization of sewage resources and improve the paid use system of water resources.

6.4 Actively Promoting the Construction of Legal System

The development and utilization of petroleum resources have achieved enormous economic benefits, but at the same time, they have also paid a painful price for environmental pollution. In order to maintain the coordinated and sustainable development of oil resource development and environmental protection in the future of oil development areas, oil development enterprises should actively promote the establishment of a sound legal system for the coordinated development of resource development and environment, while considering their long-term goals and regulating market operations.

With the further development of oil development and utilization, the amount of oil development and demand continue to increase, coupled with the differences in the ecological environment of oil regions, the impact on the environment is also intensifying. In order to ensure the authority of laws and regulations related to petroleum development, and effectively guide the coordinated development of the oil region environment and the development and utilization of petroleum resources, petroleum development enterprises should actively promote the formulation of unified petroleum development and utilization and ecological environmental protection regulations under the premise of feasible national laws, and centralize and unify the management of enterprises in the petroleum development area, Effectively guide the ecological environment protection work during the development and utilization of oil resources in oilfields, and ensure the implementation of the overall strategic management plan of oil development enterprises.

(1) Adjusting industrial structure

Industrial structure refers to the composition of various industries in a country, as well as the connections and proportional relationships between them. Industrial structure adjustment is an important topic for economic development in various countries today. Developed countries have completed industrialization and urbanization, driving economic transformation through accelerated industrial structure upgrading. The proportion of high-energy consuming raw material industries and manufacturing industries in the economy of developed countries has significantly decreased. Low emission industries such as finance, services, and information have rapidly developed, and greenhouse gas emissions per unit of GDP have shown a downward trend. At the same time, the internal structure of the secondary industry in developed countries is also undergoing significant changes. By improving environmental standards and other measures, the development of low-end manufacturing and high energy consuming industries such as metallurgy and chemical industry has stagnated or even shrunk. Developed countries will

Transfer high energy consuming industries to developing countries. For example, in the UK, from 1990 to 2007, the proportion of the secondary industry to GDP

The proportion has decreased from 35% to 23%, and the tertiary industry has increased from 63% to 76%. The upgrading and optimization of industrial structure is an important aspect for developed countries to achieve greenhouse gas emissions reduction. However, in the process of urbanization and industrialization, the phased characteristics of the rising proportion of high-energy consuming manufacturing in the national economy are still difficult to change. However, developing countries still need to incorporate the adjustment of industrial structure into their long-term national planning as an important way to control greenhouse gas emissions and achieve sustainable development.

(2) Strengthen energy conservation and improve energy efficiency

Energy efficiency refers to the efficiency of various processes such as energy development, processing, conversion, and utilization. On the basis of relatively high energy efficiency levels, developed countries are further strengthening energy conservation and improving energy efficiency, suppressing the growth of energy demand, and issuing various policy measures. The European Union has proposed to increase energy efficiency by 20% by 2020, and has issued the "Green Paper on Energy Policy" and the "Action Plan for Improving Energy Efficiency", clarifying 75 specific measures to improve energy efficiency in ten key areas including construction, transportation, and manufacturing. It is estimated that through the above measures, the EU can reduce energy consumption by 400 million tons of standard oil and reduce carbon dioxide emissions by approximately 800 million tons. In the energy consumption of developed countries, industrial energy consumption is mostly less than 30%, while building and transportation energy consumption each account for 30-40%. Therefore, building and transportation have become key areas for energy conservation and improving energy efficiency, and the results are significant. According to statistics from the International Energy Agency, the per capita energy consumption for building heating in developed countries decreased by 19% from 1990 to 2006, while the energy consumption of large household appliances such as refrigerators and washing machines decreased by 24%. The average fuel consumption per 100 kilometers of new cars decreased by 15%. Starting from 2009, EU member states have fully implemented new building energy consumption standards and vigorously promoted ultra low energy new buildings without active heating, which is expected to reduce the total terminal energy consumption of the EU by 11%. Japan has been implementing the "Leader Plan" since the beginning of this century, encouraging energy-saving and improving energy efficiency of energy consuming equipment such as appliances and cars. In 2005, the energy efficiency of R-type lighting increased by 36% compared to 1997 levels, and the fuel economy of passenger cars increased by 23%. In 2009, the United States established new fuel economy standards for automobiles, requiring all cars and light trucks manufactured and sold in the United States to reduce fuel consumption per 100 kilometers by 8% compared to current levels.

(3) Optimize energy structure

What is needed for socio-economic development is energy, not carbon. The amount of carbon contained in different forms of energy or per unit heat value varies greatly. Optimizing the energy structure mainly involves replacing high carbon energy with low-carbon and non carbon energy to achieve greenhouse gas emissions reduction. For example, natural gas replaces coal. In traditional fossil fuels, the carbon dioxide emissions from burning natural gas with the same calorific value are approximately 25% lower than oil and 40% lower than coal. According to data from the International Energy Agency, from 1990 to 2008, the proportion of oil in the overall energy structure of developed countries remained relatively stable, with nuclear and renewable energy slightly increasing. The proportion of natural gas in primary energy consumption increased from 20% to 25%, while the proportion of coal decreased from 24% to 21%. For example, the UK's use of natural gas as a substitute for coal has achieved significant results.

In 1990, the proportion of natural gas in primary energy was 22%, increased to 40% in 2008, and the proportion of coal decreased from 31% to 17%. This alone led to a 7% reduction in carbon dioxide emissions in the UK in 2008 compared to 1990.

(4) Maintaining and increasing forest carbon sinks

Forest carbon sequestration is a carbon dioxide reduction measure proposed in the context of climate change, with the core of increasing the carbon absorption capacity of terrestrial ecosystems. Maintain and increase carbon sinks and absorb carbon dioxide through afforestation and strengthening forest management. It is estimated that about 20% of the carbon dioxide gases that cause global climate change are caused by deforestation. For example, although the United States is a major country in forest products, it attaches great importance to the social and ecological benefits of forests. The federal government adopts the "cost sharing subsidy program" to increase funding subsidies to encourage states and private individuals to cultivate non timber forests. The Clean Energy and Security Act of the United States allows for the use of 1 billion tons of domestic carbon emission offset credits, primarily through increased carbon sequestration through domestic forest management. Japan has a very complete forestry legal and regulatory system, with a forest coverage rate of up to 67%. India encourages tree planting and afforestation, with the forest coverage rate increasing from 19.5% in 1990 to 23% in 2006. It plans to gradually increase the forest coverage rate to 30% through agricultural and natural forest protection.

7 Conclusion and Outlook

7.1 Main research conclusions

(1) Petroleum water injection development projects discharge a large amount of pollutants such as petroleum, salt alkali, heavy metals, ammonia nitrogen, etc. during the drilling and cementing process, water injection and oil recovery process, gathering and transportation process, as well as accidents. These pollutants directly, indirectly, synergistically, and cumulatively affect the quality and quantity of the water environment, and ultimately pass on to the human economy and society, affecting the development mode and direction of human society.

(2) Established an indicator system for evaluating the impact of oil injection development projects on water environment quality and quantity, and explored the evaluation methods and models for the impact of oil injection development projects on water environment quality, quantity, and socio-economic aspects; On the basis of this generation, a comprehensive evaluation index system for the impact of oil injection development projects on the water environment has been constructed, and a dynamic comprehensive evaluation model for the impact of oil injection development projects on the water environment based on the generation thousand index system has been constructed. Empirical application shows that the evaluation system and model proposed in this article can effectively comprehensively evaluate the water environment impact of oil injection development projects, and its research results make up for the shortcomings of the water environment impact of oil development projects. The indicator system and evaluation model for evaluating the impact of oil injection development projects on water environment can be widely used in the evaluation of the impact of oil development projects on water environment.

(3) In the process of project construction and operation, oil development enterprises must establish a water environment supervision and management system, improve the corresponding economic compensation system, implement fully closed management of oil water injection development projects, and promote the construction of industrial and legal systems. Only through a multi-pronged approach in terms of system, management, law, and industrial construction can we better protect the water environment while developing petroleum resources, and achieve the healthy development of petroleum resources and water environment.

7.2 Shortcomings and Prospects

The water environment system is a multivariable open system with high complexity and time-varying characteristics. The impact of oil injection development projects on the water environment has numerous sources and complex processes. The impact results not only affect the quality and quantity changes of the water environment, but also transmit these changes to the economic and social system, affecting the sustainable development of the economic and social system. Oil injection development projects not only have a temporal impact on the water environment, but also have complex interactions between multiple oil wells and water wells in oil injection development projects. There are also cross-border interactions between different oil injection development projects within the scope of oil field development, which means there will also be interactions in space.

In future research, it is hoped that corresponding spatial impact assessments can be conducted to comprehensively study the comprehensive impact of oil injection development projects on the water environment in time and space, further expanding the research scope, content, and depth, and conducting practical tests on these research results to strengthen their application.

In addition, the evaluation of the impact of oil injection development projects on the water environment involves numerous evaluation indicators, and data monitoring and collection need to be carried out over a long period of time. In the era of oilfield informatization, large-scale data monitoring and collection is no longer a problem. If corresponding evaluation software can be formed based on the theoretical research in this article and a database of large-scale evaluation data can be established, these evaluation software and databases will be widely used in the evaluation of oil development projects, providing scientific and reliable data support for the water environment impact assessment of oil development projects, It also provides a reasonable basis for scientific decision-making and protection of the water environment for oil development enterprises.

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