

Estimation of Carbon Dioxide Emission from Shale Gas Exploration and Development and Research on the Way to Reduce Carbon Emission

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Abstract: The research situation of developing shale gas SCCO₂ in recent years is summarized. The stripping mechanism of CO₂ in nanopores was analyzed. This paper discusses the positive and negative effects of CO₂ Geological burial from the process of organic matter extraction, element movement, adsorption and expansion. The macro micro control mechanism and permeability increasing mechanism which influence the reservoir reconstitution are emphasized. The advantages and disadvantages of the mechanism are compared with the hydraulic crushing technology, and the future research direction is summarized.

1. Introduction

Shale gas reservoir has the characteristics of self generation and self storage, no gas water interface, large area continuous storage, low porosity, low permeability and high adsorption. In order to realize the commercial development of shale gas, advanced development technology must be adopted. At present, shale gas extraction technology is mainly horizontal guard multi-stage crushing, but there are the following main problems in this technology[1]. The lack of water resources will severely limit the industrial utilization of shale gas in hilly mountains and northern arid and semi-arid areas. Secondly, shale gas reservoirs in China have high porosity, clay content, deep burial, uneven pressure distribution and traditional excavation. Fluid and broken fluid cause great damage to the reservoir, the amount of hydraulic fracturing is small, the reconstruction effect is poor, the production efficiency and recovery factors are low, and the production drops rapidly. Considering that most of the shale gas exploration areas in China are in the main water shortage areas of the country or adjacent areas, the shale gas development in China cannot simply follow the existing technology. We should pay attention to the protection and utilization of water resources, the protection of ecological environment, and the protection of development and ecological environment. a new theory and method for effective development of shale gas suitable for China's geological conditions are proposed. The research team of 973 project "supercritical carbon dioxide promotes shale gas development foundation" aims to provide new academic ideas and scientific basis for efficient shale gas development in China. It will contribute to the research of large-scale underground storage theory of carbon dioxide and provide references for the effective development of other unconventional oil and gas resources.

2. Progress of SccO₂ Technology

According to the previous theory, domestic scholars discussed more about the change of organic matter and minerals during the period of confirming the possibility of increasing the production capacity of CO₂. Wang Haizhu and others proposed to introduce this technology into shale gas field,

and believed that the development of SCCO₂ shale gas technology would become a new theory leading shale gas production in the future[2]. Li Wenhua and other experiments confirmed the possibility of adsorbing CO₂ montmorillonite. The best CO₂ injection amount is 0.2 times of the pore volume. In order to promote the recovery of SCCO₂, milkshake has used the domestic research which is not mature yet, and the current situation at home and abroad. Considering the effectiveness, economy and safety of shale gas recovery to promote the injection of O₂, it has become the climax of the technology. However, most of the past studies are limited to the theoretical introduction of shale gas generation under a single theory. Few scholars have combined the model of reservoir energy experiment to simulate the whole displacement process. In order to solve the scientific problems in the above direction, Langmuir equation suitable for CO₂ adsorption process in shale was adopted by isothermal adsorption curve, and it was found that the adsorption / desorption process of CO₂ was similar to that of CH₄. In addition to the difference in the maximum adsorption capacity, the characteristics of CO₂ adsorbed by shale with a Langmuir model of more than 6 PA is that if it can not be compared with the research of SCCO₂ adsorption density index of rajeeb sakurovs, based on Wang Xiaoqi's Monte, the adsorption process of CO₂ / C in C Arlo shale 64 is selected to simulate the layered porous model. According to the parameters of temperature and pressure, the coefficient of choice of cozfch 4 is calculated. When the pressure is less than or equal to 2.5 PA, the selection coefficient of CH₄ is negatively correlated with the temperature. In the 25 ~ 35 MPa stage, the effect of temperature on the selectivity coefficient is not obvious, and the effect of temperature above 3 PA can be ignored. At the same time, if the temperature and pressure are increased, the Brownian motion of the molecule will be enhanced, which is not conducive to the adsorption of CO₂.

3. Macro Micro Geological Control Factors of Scc0 Adsorption Desorption

3.1. Micro Control Mechanism and Model Establishment of Scc02 Displacement Shale Gas Process

The fine pore types of shale reservoir include organic pore, succinic mineral granular pore, pyrite intergranular pore and some post dissolution pore. The hole shape has a tubular hole with opening at both ends, a slit hole with parallel wall, a sharp wedge-shaped hole, a tubular hole partially tapered or multi-faceted tapered, and a few ink bottle shaped holes[3]. The results show that the molecular diameters of CH₄ (0.444 nm in diameter) and CO₂(0.33 nm in diameter) are only different in several atomic holes and split holes, especially in the type of ink bottle, so the pressure can be reduced directly if several micro holes (especially the narrow neck hole of the tube hole) are used. The molecules adsorbed on the pore wall near the pore wall block the movement of the internal molecules, so the oligo brightness of the ink bottle pore. When a certain pressure difference is reached, the transfer speed increases, and the drainage and extraction cycle becomes longer. When CO₂ enters the supercritical shale reservoir, SCCO₂ fluid reacts with the organic matters and some minerals in the pore wall, releasing the pore trough. On the other hand, the entrance and exit of CO₂ are relatively easy. Therefore, the natural gas adsorbed on the outlet can be exchanged rapidly, thus shortening the drainage time.

3.2. Negative Effect of Adsorption Expansion and Elastic Self-Regulation Effect of Microcracks

Considering the negative effect of carbon dioxide adsorption process, HLR compares the adsorption process of shale and pure mineral. In order to characterize the adsorption capacity, the expansion capacity is used and compared with the adsorption volume endowed by pore pressure. However, during the experiment, the adsorption capacity of succinic acid minerals measured is greater than that calculated theoretically. According to the analysis, during the drying process of the samples in the drying room, the water vapor adsorbed on the surface of Mongolian soil particles, the pores were developed, and the amount of CO₂ adsorbed increased, which provided experience and lessons for the calculation and determination of the amount of adsorption. In order to quantitatively

characterize the adsorption expansion phenomenon of longmamo formation, shale adsorption expansion curve is given. Comparing the two types of curves, it is found that shale expansion is larger than the bed direction perpendicular to the bed side. According to the curve shape, the constraint pressure in the platform is relatively large, and the matrix volume shrinkage is relatively short. In the middle stage, when CO₂ gradually adsorbs into the pores, the gap pressure increases, and the shale matrix expands and deforms gradually. This stage accounts for most of the time[4]. In the later stage, CO₂ is close to the maximum adsorption capacity. The pressure environment has entered the stage of basic balance and stability.

4. Further Discussion on the Mechanism of "Increasing Storage and Permeability"

4.1. Organic Matter Extraction and Mineral Migration

The response process of organic compounds in SCCO₂ fluid is an important mechanism to control the physical and chemical reaction process after injection. Different physical and chemical characteristics have different control effects on the reservoir reconstruction process. In terms of solubility, SCCO₂, lipid and volatility, as non-polar Ficus agent, and several organic compounds with small molecular weight ratio, can be extracted. In terms of chemical properties, the reduction process of injected SCCO₂ (c + C 2.2co) can be realized. According to the regulation of temperature, pressure and time in low stress environment, the solubility of SCCO₂ fluid becomes weak due to temperature, but solubility in high stress environment It changes with the pressure. In addition, the size of matrix particles also affects the reaction speed[5]. The ideal particle size range is 1-10 mm. Therefore, different kinds of organics have different indications for the transformation degree of organics. The pores with high TOC content are more clear before and after metamorphosis, and the secondary fine structure is developed according to the reaction. Different places of lipid also indicate different degrees of change.

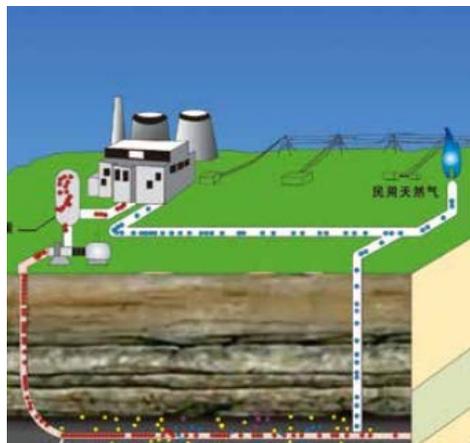


Figure 1 Academic conception of efficient shale gas development with carbon dioxide

4.2. Compared with Hydraulic Fracturing scc02 Fracturing, it is More Suitable for Shale Reservoir

So far, hydraulic fracturing is a traditional partial pressure method, but it has many negative effects. In the process of hydraulic fracturing, the huge pressure difference inside and outside the reservoir often causes destructive damage and damages the reservoir. At the same time, it will inevitably pollute the formed water and cause secondary salinization. In the process of crushing, the mineral expansion of Mongolian soil prevents the damage caused by water expansion, which is not conducive to the permeability of shale gas[6]. In some water shortage areas, this measure is not ideal. The fracture of hydraulic fracture is relatively curved, and water is easy to attach to the fracture surface under tension. The "stagnant zone" which destroys the rotary cutting point forms the "stagnant zone" which is used to block the throat, and has no contribution to improving the water permeability[7]. There are two types of bifurcation methods. The decomposition of

SCCO₂ and soil minerals in Mongolia under high pressure can effectively promote the structure of shale before it can be destroyed. In addition, the increase of decomposition reaction speed for temperature rise is beneficial to a large number of debris from the reservoir. It is said that the mechanical self material treatment process is carried out from the reservoir. Through a large jet pressure, a small amount of the effective holes in the reservoir are formed. Because of the continuous attenuation of the pressure and the volume expansion, the damage of the micro holes will eventually expand[8]. In addition, scc-02 cataclastic shale can significantly increase the countercurrent rate and countercurrent speed of cataclastic fluid, shorten the mining time, and have a certain degree of continental shale gas with high soil content in the deposit.



Figure 2 Field test of supercritical carbon dioxide fracturing of continental shale gas

5. Conclusion

There are many nanopores in shale reservoir. Therefore, the adsorption gas of micropore filling method accounts for the majority. According to the filling theory and model analysis, according to the different molecular diameters of C_2H_6 and CO_2 , and according to the development of the main pores with wide pore size, the reservoir has a good displacement effect. As a kind of geological body with large elastic energy, the matrix expands and deforms during the adsorption of CO_2 in shale. According to the change of expansion curve and permeability of reservoir, it can be considered that there are three stages of CH_4 generation rate in the development of SCCO₂ shale gas[9]. That is, short-term growth phase, acceleration deceleration phase and stable deceleration phase. By analyzing the data of atomic content test and scanning electron microscope, the color change in the picture is mainly caused by the concentration and distribution of two minerals feldspar and montmorillonite. And specific surface area. Although arabite minerals have a great influence, it has a certain significance to optimize shale interval which is conducive to measurement. Recently, the new energy structure advocated by environmental protection has some environmental significance, but there are many problems to be solved. Correct measurement of the expansion in adsorption expansion process: some theories must be studied, such as the spatial overlap and evolution characteristics of pores before and after the transformation of organic mineral complex[10]. There is a need to reduce the delivery and injection of CO_2 and the technology is not enough.

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