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Experimental Study on Downhole Gas-Liquid Separation and Produced Water Reinjection

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Abstract

Gas well fluid accumulation caused by floodout is an important problem to restrict natural gas exploitation. To solve the problem by using dewatering gas production is an effective method. For convention gas well production with water withdrawal technics, accumulated water is lifted to ground, gas-liquid mixture is treated on the surface, and separated water is reinjected back into the formation, which results in many problems, such as more equipment and investment needed, and other environmental pollution issues. For the purpose of clean, low input and high output, a cost-effective and simple downhole gas-liquid separation and water injection system is developed.

A downhole gas-liquid separation and water reinjection process is proposed in this paper. The core components of the system are the improving hollow rotor screw pump and downhole gas-liquid separator. The gas-liquid recovery and impetus providing for the separation and reinjection water pressure are achieved through a hollow screw pump rotor. The separated gas is produced through casing, and isolated from the underground water through hollow screw pump rotor to provide access for reinjection. The system experiments carried out at Shen 14-6 gas well in Shenyang Oil Production Plant, Liaohe Oilfield, China get a satisfactory result.

Introduction

With the gradual reduce of gas reservoir pressure and gas liquidity rate, the produced water of gas reservoir can not be carried out the shaft with the gas flow, so the water accumulates in the shaft and forms a liquid column which can cause the additional hydrostatic pressure to the gas reservoir. Finally it leads to the flushing energy of the gas well drop continually (J.G.Harris, 1999). Accumulating over a long period of time, the fluid column which gathers in the well causes the gas to end up finally and causes the gas well to stop producing, water drainage and gas recovery is an effective way to solve the kind of gas well. At present the conventional gathering gas crafts which have been applied for many years in domestic oilfields include optimal tube column water drainage and gas recovery craft, the froth water drainage and gas recovery craft, machine pulls out water drainage and gas recovery craft, the electronical submersible pump water drainage and gas recovery craft and so on. It has increased the production of the natural gases, and has obtained good economic and social benefit. But for these conventional gas recovery crafts, the accumulated fluid is lifted to the ground, and reinjected into the formation after surface treatment, in which a lot of problems existed, such as many equipment and big investment needed, and other environmental pollution. Therefore a kind of high efficient gas-liquid separation and the reinjection system is proposed, which can realize downhole gas-liquid separation and reinjection of the water.

The downhole gas-liquid separation and produced water reinjection technology was developed earlier in overseas oilfields. C-FER (the Center for Engineering Research Inc, Canada) took the lead to propose the idea of downhole gas-liquid separation, and carried out field test in 1995. They applied the separator downhole and directly discharged the separated water to drainage layer which was chosen well beforehand, and picked the gas with less water. (Qiming Yang, 2001) Generally the high water-cut gas wells with very good water injection under the production formation are selected.

In 1996 American Enviro Tech Tool Company promoted a patent product. This equipment is applied with the oil pump having plunger traveling valve cancelled, fabricated packer at the bottom, the pump tube without standing valve, top hole in vivo loaded with 5 induction valve hood. It applied in 4 states' gas field, realized downhole gas-liquid separation and separated water reinjection with pressure boosting.

American Oxy Corporation also promotes a downhole separation system for applying in the flooding gas well's with by-pass and nipple. This equipment was used together with oil pump, realized water drainage upon liquid gravity, which suits for