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# Analysis and Management of the Casing Damage of the Weak Base ASP Flooding Test Area in an Oilfield

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**Abstract**. Based onthe present condition of casing damage in the weak base asp flooding test area, combined with the analysis of the geological and engineering factors, it is concluded that the main causes of casing damage in the test area, including that the variation of ground stress caused by water absorption of the shale creepand dilation ofmud shale of old well area interferences to the new well, fault block, the interlayer or planarity pressure difference, the cementing quality and so on. According to the above-mentioned reasons, this article accordingly puts forward theprevention and treatment measures.

## 1. Introduction

Put into developmenttest area at the end of 2011, during the period of production, due to well mineral aging in theold well area, cementing quality of new well, production process, well spacing in different stages of development, the difference and complication of well pattern, the interlayer or planarity pressure differenceand fault,the situation that the interlayer pressure difference of injection well and injection-production pressure imbalance causingthat some casing damage wells are in the test area.

## 2. Overview of casing damage in the test area

There are 192 oil and water wells in the test areaat present. From 2012 to the present, in the process of ASP flooding, there were 27 casing damage Wells (24 injection Wells, 3 production), and 17 Wells were deformed (one hole was leaking, one was ruptured), 5 Wells were faulted, 2 Wells were not pulled, and 3 Wells were in other cases. The deformation and fault wells account for 81.48% of the total well number of the casing damage, so deformation and fault are the main types of casing damage in the test area.

**Table 1.** Damage location and corresponding well number

| Damaged | well number (mouth) |
|---|---|
| Oil layer | 5 |
| Standard layer of | 20 |
| Bottom hole sand | 2 |

## 3. The main damage cause of the test area

### *3.1. Fault barrier and variation of ground stress*

When flooding, the injected fluid flows into the sandstone layer and the fluid is seeped through the cracks, which has no effect on the fouling of the rock, and the action of ground stress remains unchanged. However, when the fluid enters the mudstone, the mudstone will absorb water and soften, and its cementing force will gradually decrease until the plastic and creep rate is accelerated, and the ground stress around the borehole is heterogeneous.

The force of the creep in various directions near the casing is different, and the force is the largest in the direction of the maximum ground stress, which is the smallest in the direction of minimum ground stress. The second standard layer is faulted, broken and leaking, and injected water flows into the second standard layer. A injectionwell faults at 858.07m (the second nun standard layer). In the process of the overhaul the casing collar was finding at 858m, which thread is clear, so it can confirm that injected water along the casing collar entered the second standard of soft layer because of casing thread being lax, and then some wells in the area become casing damage. The total number of damaged wells in the test area was 27, and the number of damaged wells in the second nun standard layer was 20, which accounted for 70.07% of the total number of the casing damaged wells.

On October 10, 2012, the injection well B was found casing damaged in the process of oil operations at 903.5 m (standard), is 114.6 m apart from the objective layer (1018.1 m), and the minimum diameter of Lead film is 112 mm, and there are fault marks. This well is located in 86 # near the fault. In addition, injection well B is an edge well of the test area, and there are three injection wells around it. Among the rest well C injected difficultly in a long time; well D confirms thatis changed at 990.1mwhen it is stratified in general on August 24, 2014. The damage point of the well is located in the non-perforated layer, and the damage point is S2, and the depth is 978.5 m, and it is 54 meters from the top of the perforation layer a, and it is eliminated by injection of the injection wellsurrounding. There is a fault in the vicinity of the well, which is affected by the stress change of the fault. The pressure imbalance between the two blocks leads to the breaking slip and the break of the damage point.

### *3.2. Pressure difference between plane and layer*

The stratification pressure of different permeability of reservoirs is analyzed, and the medium reservoir pressure is lower than that of low permeability reservoir. According to the stratified data of 13 injection Wells, the water injection intensity of the medium permeable layer is 6.44m3/d• m, and the formation pressure is 10.91 MPa. The water Low permeability injection intensity is 6.39m3/d• m, and the formation pressure is 12.54 MPa.

In 2013, the pressure test of 16 injector Wells was carried out, and the measured layer was divided into upper and lower layers, the upper segment was a and the lower segment was b, and the pressure difference between the layers was greater. The pressure of the upper layer a is 11.97, and the the pressure coefficient is 1.19, which is normal well area. The layer b formation pressure is 10.11 MPa, the pressure coefficient is 1.01, which is normal well area. According to the distribution of the pressure plane, the internal pressure distribution is unbalanced. The upper layer pressure is higher, the lower layer pressure is lower, the pressure from the north 3-3# to the north 2-4# is balanced relatively and the high pressure zone is smaller. From the longitudinal pressure of the upper layer, the pressure difference between the upper and lower strata of the northern 3-36# is large, and the maximum pressure difference between the high and low pressure is 5.95mpa, and the inter-layer conflict is large and heterogeneous. The imbalance of pressure distribution can cause casing damage to some extent.

### *3.3. Cementing quality*

Injection well perforation interval a ～ f E, on November 15, 2012,in the pilot flood ptactice the standard layer (859.58 m) was wrong, is apart from the objective layer (1012.32 m) 152.52 m, the Wells were near 3# fault,On December 29, 2012, we found leakage, the well was in good condition, after well opening the pressure was 1.16 MPa.On January 24, 2013, we used isotope logging and water to find leakage, and we found that there was leakage point in the casing about 904.2 ~ 1000.88 m area (more than S). On November 17, 2012, when the gun was fired, it was found that the casing was changed, and the surrounding four Wells were normally produced. When the problem well was re-

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matched on December 9, 2015, it was found that 848.21m was wrongly broken and the minimum diameter was 97mm. The well casing is the standard layer, not the destination level.

From the point of acoustic variable density logging curve, the 890 m and 910 m, 950 m, 970 ～ 980 m,the cementing quality is poor, from the range of 300 m of the well,there were 9 injection wells in the horizon of the cementing quality is poor, the injecting fluid was into the mudstone layer, causing pressure-out and leading to deformation, and leading to a soft layer section of casing deformation or disconnected.

**Table 2.** Isotope log data table

| interval | Depth (m) | Absolute injection volume (m3) | Relative water absorption (%) |
|---|---|---|---|
| x | 935.04～938.21 | 14.1 | 41.46 |
| s | 954.53～956.83 | 5 | 14.71 |
| a | | 14.9 | 43.83 |

### *3.4. Perforating causes and casing corrosion*

Perforating may cause of casing damage from four aspects, one is more charge in a flash explosion at the same time, will produce enormous shock waves, and the casing will be suddenly swell, it will appear serious deformation between the middle of the perforation and adjacent non-perforation location. The second is that the cement sheath may crack, and the casing burst in serious condition. The third is that perforating depth error is too large or accidentally shot, it will open the mud shale in the thin layer,and the injected water or groundwater will erode it, and mud shale expand water expansion, and result in changes of ground stress, and ultimately cause casing damage. Fourth, the density selection of perforation is unsuitable, affecting the strength of the casing.

It offen appears casing leakage when casing cement is back to high interface. After a previous analysis summary, the factors of casing corrosion caused by chemical corrosion, chemical corrosion and electrochemical corrosion, etc. [1], chemical corrosion in test area, through the analysis of the test for injection water combined with the index of water quality monitoring results found that the main factor causing corrosion where oxygen corrosion, sulfate reducing bacteria and high salinity, etc. Generally, the oil jacket ring space is in closed state for long time and easy to be corroded.

## 4. methods of damage control

### *4.1. Injection well control injection near fault*

Test Wells located at the 30 team, the team well drill in the breakpoint 77, more stratigraphic breakpoints than in N2 parts, and the N2 drills in the breakpoint 34.From October, 2012 ,it appeared 27 wells in different degree off casing damage, casing damage Wells are mainly concentrated in the vicinity of 86 # fault, to avoid of the in-situ stress changes caused by the fault causing the second nun period of new and old Wells to be damage formation waters.At the beginning in 2013, the experimental area actively cooperate with the superior departments to control of casing damage zone injection well, ther have bten 44 wells by controlling the water injection since 2013,and the controlled volume has ken 12909 $m^3$.

### *4.2. Ease the difference in plane pressure*

Rock shear force is associated with the effect of casing damage, formation pressure imbalance is also one of the reasons causing rock shear deformation, therefore ease the casing damage of injection-production imbalance caused by ground stress changes. Accurate understanding of high and low pressure strata, timely equilibrium formation pressure, and maintain the balance of injection can also contribute to the prevention of casing damage. At the same time, reasonable water injection pressure and oil production pressure can effectively prevent the formation of sand [1].

For example, the analysis found that the injection quantity of three adjacent injection Wells was not high, with an average of 40m3, with high injection pressure, with an average of 12.61 MPa. However three injection Wells in reservoir fine description on the plane and vertical reservoir development are good, with a effective thickness of 3.5 m, and injection-production well connected, through the pressure and in 2013, we understanded the pressure of each interval.

Pressure of the typical injection well E in this area to understanding the regional formation pressure situation, according to data shows, the shaft of a and c interval formation pressure were 13.86 MPa and 10.53 MPa, respectively, the pressure coefficient were 1.36, 1.04, so the wellbore formation pressure has a big differences. To balance formation pressure, and keep the injection-production balance, on November 5, 2015, Fracture E well that connect the well the yield of fluid well before fracturing was 43t a day,the yeild of oil was 2.7t a day, water 93.62%, after fracturing fluid was 84 t, the oil was 5.6 t, the water was 93.33%, flowing pressure was 5.76 MPa, compared with before, the growing liquid 41t a day, the growing oil was 2.9t a day and water cut down by 0.29%. In January 2013,adjust the parameter of the connecting prodution F and G wells.Turn up the times of stroke from 3 times/min to 6 times/min.And

G well turn up the times from 3 times/min to 5 times/min, and after the increasing participation, 2 Wells daily fluid increased from 231 t to 280 t, nissan oil increased from 7.5 t to 9.6 t, water cut from 96.75% to 96.57%, and effect was better. The pressure coefficients of each layer in the E well were 1.19 and 1.10 respectively, and the difference of the plane and longitudinal pressure was relieved.It played a role that failure of measures to maintain injection-production pressure balance in the region, and connected to a certain extent, reduce the well failure caused by the unbalance of injection-production pressure that cause of casing damage occurred.

### *4.3. Reduce the pressure difference between layers*

The injection well H a, b and c layers development difference is bigger, the effwctive thickness in each layer were 0.8 m, 4.5 m, 3.0 m, and the permeability is respectively 124 x 386 x 10-10-3 mu m2, 3, 325 ($10^{-3}$ mu $m^2$, channel connected at a rate of 0%, 78.9%, 38.3%, on February 17, 2013 ,we layered pressure, for H formation pressure is 12.54 MP a a layer, the pressure coefficient is 1.25, belong to high pressure interval, and b layer formation pressure is 10.21 MPa, the pressure coefficient is 1.02, c interval formation pressure is 11.74 MPa, the pressure coefficient is 1.17, b and c zone belongs to the normal interval. In order to alleviate the suction strength, high and low permeable reservoirs for balance formation pressure and improve interlayer contradictions, reduce the impact of injection on the casing pressure after the injection, we adjust the high permeable interval and then adjust the low permeable interval after injectionpressure dropped of 1.9 MPa, the coefficient of pressure by 1.27 to 1.08, the interval pressure returned to normal and stable condition. The timely injection quantity adjustment, which can control the high pressure layer, also avoids the occurrence of the damage caused by the large pressure difference between the layers.

### *4.4. Improve the quality of cementing and construction quality*

In the process of cementing, it is recommended to protect the casing from three aspects: first, the casing centralizer is used to ensure that the casing is located in the middle of the expected track. Secondly, improve the strength of cement ring. Thirdly, the cement return can be as high as possible, which can help to delay the corrosion.Forthly, improve cementing quality and avoid leakage and formation pressure leakage [2]. When working in the downhole, avoid the oil pipe to cause the casing abrasion. Falling object salvage, wellbore descaling when work over.To avoid the casing wear or corrosion more or less, so as not to reduce the strength of the casing, avoid potential factors that lead to casing deformation later[1, 3].

To ensure the quality of the pilot production, test area since its discovery in 2012 of casing damage,timely investigate the casing damage wells around,and repair operations promptly when found that the casing damage,and to a great extent, improve the quality of the construction work. At present, there are 27 successful cases in the test area, which are all normal production and stable production.

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## 5. Cognition

(1) By means of science and technology, test of injection well layer pressure differences by reforming production measures, such as ease of reservoir plane pressure difference, by adjusting injection well project, ease the interlayer pressure difference and reduce the casing damage occurred.

(2) The casing damage of the old well has been damaged, and the casing damage of the surrounding well has been timely carried out, which effectively inhibits the expansion of the standard layer of submerged water area.

(3) Strengthen the quality supervision of the work, and prevent the casing from being damaged due to unqualified quality.

(4) After the standard layer is damaged, the porforating depth in the fornula is feplace by the N2 chdex bed, that is to soy, it can be reduced the risk of casing damage by decrensong the depth of calculation and lowering the alloweble injectionpressure.

The increase of the number of damaged Wells in the test area seriously affects the development effect. The key of reducing the casing damage well is to prevent and extend the casing service life as far as possible. The most effective measure to turn passive management into active prevention is the optimization of cementing technology, with cathodic protection, chemical antisepsis technology, and selection of reasonable and effective technology to delay the damage. Technology and management should be combined with different measures, and a setting of monitoring and tracking procedures should be established, and further study the mechanism of damage and promote the virtuous cycle of production [1, 3].

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## References

[1] Wang dongying et al. Causes of damage and prevention and control measures [J]. Internal river science and technology, 2013,05:33+143.

[2] Sun shouli. The process technology for the extension of the oil well of minqiao oilfield [J]. Internal river science and technology, 2010, 02: 71+108.

[3] Qu guiliang. Analysis on the damage analysis and treatment of oil Wells in linnan oilfield [J]. Fault block oil and gas field, 2004, 06: 73-75+94.