Knowledge of oil level recovery method based on Measure oil stabilization time

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Abstract. In reservoir dynamic analysis, oil well production volume and level data are important indicators for quantitative evaluation of oil well production status. Under the existing technical conditions, the liquid production volume of oil well can be calculated by using the recovery value of the liquid level after the well is stopped, and its size is the comprehensive reaction of the oil well's fluid production status. At present, there are 386 annular flow Wells in our mine. All are measured in this way. At present, the main problem is that the oil level recovery method varies greatly, and the daily measurement is different. Therefore, under the current situation that the number of total ore ring Wells increases, the problem of oil quantity accuracy is the key to the formulation of oilfield development plan and dynamic analysis, which must be solved.

Key words: Produced fluid volume; Liquid level recovery; Measure oil stabilization time.

1. Introduction
According to darcy's law, oil well production is determined by production pressure difference, formation physical property and formation fluid property. It is difficult to establish the quantitative relationship of a well's fluid output in a mine because of the influence of multilayer coalesce, the multiphase of formation fluid, the permeability of formation and some parameters are not easy to calculate accurately. However, at present, due to the process transformation, there are more ring Wells in the whole mine, and the oil volume is measured by the liquid level recovery method. However, the oil volume results often fluctuate greatly, resulting in inaccurate or even wrong analysis results of the measure effect and production performance of the oil well.

A normally producing oil well has a relatively stable dynamic fluid level (H0) and fluid yield (Q0) during the production process. This means that the fluid volume flowing into the wellbore from the formation is equal to the fluid volume produced from the surface. Due to the differences in physical properties, pressure and water flooding conditions of each well, the continuous liquid output after the production stop also varies greatly, resulting in different shapes of the liquid level recovery curve. Liquid level recovery curve has three types: type 1, poor (Ⅰ) production layer seepage ability is poor, low degree of use; Type (Ⅱ), very good type (Ⅲ) production layer seepage ability is good, has strong water flooded layer or big hole. For most of the oil well liquid level recovery curve type is commonly Ⅱ type. The heterogeneous water flooding oilfield enters the late stage of outbound development, and the recovery curves of the three types of liquid level can be seen (see figure 1).
2. Comparison and understanding of the output of the two methods of oil measurement

In order to solve the problem of large fluctuation of oil level recovery method, from February 2013, we selected 730 units of puonan I fault block to make a production comparison. Because the well here can be measured in a glass tube, it is easy to compare the amount of oil with the level recovery method to find out the reason for the large fluctuation in production. The oil gauge adopted is gold hour 3 type. The following is the statistics of the actual amount of oil on site:

The following is the amount of oil in Wells 194-138, Portugal. The glass tube of this well was able to measure oil for 3 times after water mixing for 1 hour, and the partial pressure was controlled at 0.35mpa. During the process of oil measurement, the liquid level rose steadily, and the average daily liquid volume was 4.9 tons. After measuring the oil, stop the well to measure the oil by the liquid level recovery method. After measuring the moving liquid level according to the instructions of the oil meter, measure the static liquid level continuously for at least 4 times (at most 10 times) to calculate the daily production of oil well.

Table 1. Field oil flow table of well 194-138, Portugal

| Serial number | Time | Cumulative time (min) | The depth of the liquid level (m) | Level appreciation (m) | Appreciation at the accumulative level | Daily fluid (t) |
|---------------|------|-----------------------|---------------------------------|-----------------------|----------------------------------------|----------------|
| 1             | Interval 15 minutes | 15 | 1034.87 | 7.87 | 7.87 | 5.5 |
From the actual measurement of this well, the oil level recovery method is not more accurate with the increase of oil quantity. The daily output of oil is closely related to the recovery rate of liquid level. After measuring the moving liquid level according to the instructions of the oil meter, measure the static liquid level continuously for at least 4 times to calculate the daily production of oil well. If the hydrostatic level is measured 10 times, the well's output is 4.0t, and if rounded, the well's output fluctuates by 1.0t.

Figure 2. Curve of the relationship between level recovery and production in Portuguese well 194-138

Figure 3. Curve of the relationship between level recovery and production in Portuguese well 190-140

Figure 4. Curve of the relationship between level recovery and production in Portuguese well 176-130
Figure 5. Curve of the relationship between level recovery and production in Portuguese well 176-126

With the prolongation of oil flow time, the liquid level recovery method calculates that the liquid production gradually decreases, which is because the liquid level rises after stopping the well. As the flow pressure at the bottom of the well rises, the formation liquid output decreases and the liquid level recovery slows down. Therefore, the calculated amount of oil well production decreases with the increase of oil metering time and times.

In our daily verification work, through repeated oil measurement and observation (as seen from the above oil volume curve of each well), we have a common feature that the liquid production is stable and the closest to the glass quantitative oil is the liquid production calculated at the points where the liquid level is stabilized after shut-in and continuously close to each other. When the flow pressure at the bottom of the well rises, the flow from the formation decreases, and the recovery rate of the liquid level slows down, the calculated daily fluid flow and the actual oil flow are greatly different. In this way, if we find that the recovery rate of liquid level is slowed down in the oil measurement, we can stop the oil measurement, and calculate the production of the well with the hydrostatic point before this point, which is the real production of the well. In this way, we compare the production of Wells at different production levels, and the oil volume results are basically consistent (see table 2).

| Well | The glass tube measures oil production fluid | The level recovery method produces liquid | Measure oil stabilization time | Well | The glass tube measures oil production fluid | The level recovery method produces liquid | Measure oil stabilization time |
|------|-----------------------------------------------|------------------------------------------|---------------------------------|------|-----------------------------------------------|------------------------------------------|---------------------------------|
| 172- | 20.2                                          | 19.9                                     | -0.3                            | 182- | 12.1                                          | 10.6                                     | 1.5                             |
| 188- | 18.1                                          | 19.2                                     | 1.1                             | 40   | 40                                            | 40                                       | 60                              |
| 212- | 19.8                                          | 18.5                                     | -1.3                            | 40   | 50                                            | 40                                       | -9.9                            |
| 176- | 17.4                                          | 18.1                                     | 0.7                             | 174- | 5.2                                           | 4.5                                     | -0.7                            |
| 192- | 17.5                                          | 18.5                                     | 1.0                             | 176- | 1.0                                           | 1.2                                     | 0.2                             |
| 190- | 18.1                                          | 17.0                                     | -1.1                            | 178- | 2.0                                           | 2.1                                     | 0.1                             |
| 22   | 12.0                                          | 11.7                                     | -0.3                            | 60   | 1.8                                           | 1.5                                     | -0.3                            |

3. Determination of oil stabilization time
According to the above well curve, it can be seen that the well with high fluid volume has a tendency of short oil flow time (less oil flow times) and long oil flow time in low fluid volume Wells. We use oil stabilization time and daily fluid volume to make scatter diagram.
Figure 6. The scatter diagram of daily fluid flow and oil flow time

It can be seen from the scatter diagram that the daily fluid production is inversely proportional to the oil measurement time and has a linear trend. The following empirical formula can be obtained by linear regression with the above data.

The correlation coefficient \( r = 0.9591 \)

\[
S = 98.97 - 2.93Q
\]

In the formula:
- \( S \) --- Measure oil stabilization time
- \( Q \) --- The known production

Then, the daily output of oil in the well is known before the oil measurement, the time of oil measurement stability can be calculated, and the lost land can be discharged to measure the oil, instead of observing the recovery of the liquid level every time the hydrostatic level is measured, so as to reduce the working intensity.

4. Conclusions and Cognition

1) In the process of oil measurement, the recovery of oil well's liquid level should be timely observed. The oil measurement can be stopped at the point where the recovery of liquid level slows down. The calculation algorithm can be used to encrypt the observation when the oil volume is close to the stable time, so the measured liquid production is the real reaction of the daily fluid production of the well.

2) In the process of measurement, for intermittent oil Wells, often appear the dynamic liquid level measurement stop well during the recovery level, drawdown of (the) lower than in the working fluid level, the oil well to add a lot of time, when calculating the yield to remove the unreasonable points, so as to calculate the oil well production, otherwise, calculate the production of negative.

3) In the process of oil measurement, the interval of hydrostatic level measurement after shut-in is generally 10 minutes for Wells with an interval of more than 5 tons, and 15 or 20 minutes for Wells with less than 5 tons. Time must be measured accurately, otherwise it is difficult to see the situation of the slowdown of the recovery of the liquid level.

4) When measuring in winter, the thermal insulation of the instrument should be well done. If the temperature exceeds 25 degrees below zero, the instrument will have no display after starting up, and the oil cannot be measured.

5) For oil Wells with poor pump efficiency, there is a big difference between the amount of oil in the liquid level recovery method and the amount in the glass tube, because the amount of liquid from the formation cannot be fully extracted by the pump.

6) The casing pressure should be well controlled before oil measurement, which should be between 0.5 ~ 0.8mpa. The excessive casing pressure will easily lead to the phenomenon of pressure level, which will make the dynamic liquid level of the test (that is, the inaccuracy of the reference liquid level will affect the calculation result of the final output).

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