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Catastrophic decrease of the drilling efficiency because of the off center rotation of the drill bit on the bottom hole

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Majority of the drilling people and manufacturers of the drill bits even don’t suspect that there is such phenomenon as off center rotation of the drill bit concerning the bottom hole and its consequences. But long ago already it is known [1] that efficiency of the drilling process can decrease in several times when the geometric center of the bit and one of the holes do not coincide.

Of course we say here on the ordinary roller cone bits /or the ordinary PDC and diamond bits/, but no bi-center bits, which ones have invented exactly for to use up the off center for drilling of the hole with diameter more than preceding drilling interval. When the geometric center of the bit and the geometric center of the hole do not coincide, this results in an oversized hole.

Off center wear of the bits can be caused by [2]:

1. Change of formation from a brittle to a more plastic formation.
2. Inadequate stabilization of the BHA.
3. Deviated hole.
4. Inadequate WOB for the formation.
5. Inadequate bit type.
6. Hydrostatic pressure that significantly exceeds the formation pressure.

The off center rotation of the drill bit on the bottom hole was observed during rotary drilling of the last interval of the well at the fields of “Tatneft” with Varel roller cone bit 8 ½ CH44MRS.
It goes without saying the off center rotation of the drill bit can be observed with any type of bit of any company with any drilling method of any interval in any region [3].

Рис. 1. Эксцентричный износ долота 8 $^1/_2$ CH44MRS № 213545. Код износа ВЗПОДО. Проходка на долото 26 м, время бурения 42 ч, мех. скорость 0,6 м/ч

Рис. 2. Лапа долота 8 $^1/_2$ CH44MRS № 213545, взаимодействовавшая со стенкой скважины в процессе бурения

Рис. 3. Лапа долота 8 $^1/_2$ CH44MRS № 213545, не контактировавшая со стенкой скважины в процессе бурения

Last interval of the wells is drilled in “Tatneft” with rotary method and mud circulation. The power of this interval can be from 40 m to 200 m. WOB 14-15 Tons; RPM 65 and flow rate is 14 l/s.

Typical off center wear was during drilling with one of the roller cone bits 8 ½ CH44MRS s/n 213545. This bit is drilled in the well 29005, Vostochno-Leninogorskaya field in the interval 1779-1805 m, and it drilled only 26 meters during 42 hours with ROP 0.6 m/h.

This bit drilled dolomite (1779-1780 m) and after shale (1780-1805 m).
The off center wear of this bit is showed at the fig.1.
Fig.2, 3 and 4 show the shirttail of the bit.
Fig. 2 shows the shirttail with worn inserts because of the contact with hole wall.
Fig. 2 and 3 bear witness on lack of the contact these shirttail with hole wall.
The reason of the off center drilling of this bit is:

1) change of hard dolomite to the plastic shale,
2) no stabilizers in BHA,
3) deviated hole.

Fig.5 shows a big worn of the all cones of the drill bit of another manufacturer. This bit drilled after Varel bit in the interval 1805-1865 m, meterage was 60 m, drilling time 42, 5 h ROP 1.4 m/h.
Interval 1805-1809 m is the shale, 1809-1844 m is the sandstone and 1844-1865 m is the argillite.
Lost of diameter of this bit is 5 mm.

Fig. 6-9 show the worn of the other bits 8 ½ CH44MRS, which ones drilled without off center rotation, i.e. in the normal drilling conditions.
The bit s/n 213547 Fig. 6 drilled 154 m during 104 h with ROP 1.5 m/h in the interval 1757-1991 m of the well 28735 Pavlovskaya field.

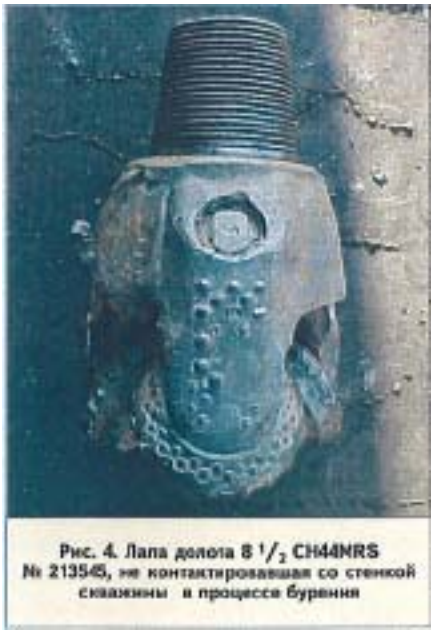

Рис. 4. Лапа долота 8 1/2 CH44MRS № 213545, не контактировавшая со стенкой скважины в процессе бурения

Рис. 5. Износ долота другого производителя. Код износа В3П0Д5. Проходка на долото 60 м, время бурения 42,5 ч, мех. скорость 1,4 м/ч

Рис. 6. Износ долота 8 1/2 CH44MRS № 213547. Код износа В1П4Д0. Проходка на долото 154 м, время бурения 104 ч, мех. скорость 1,5 м/ч

Fig. 7 shows the bit s/n 213550 which one drilled in three wells: well 24793 Aznakaevskaya field in the interval 1625-1710 m (85 m; 52.5 h, 1.6 m/h) well 30375, Alkeevskaya field in the interval 1786-1824 m

(38 m, 29 h, 1.3 m/h) and well 1687B Yuzhno-Romashkinskaya field in the interval 1751-1822 m (71 m, 55.5 h, 1.3 m/h). Total: 194 m, 137 h, 1.4 m/h.

The bit s/n 213549 (Fig.8) drilled in two wells : exploration well 31, Arkaevskaya field in the interval 1984-2112 m (148 m, 121 h, 1.2 m/h) and well 30418, Alkeevskaya field in the interval 1744-1766 m (drilling with turbodrill, 22 m, 3 h, 7.3 m/h) and 1813-1884 m (rotary drilling, 71 m 50 h, 1.4 m/h).
Total: 241 m, 174 h, 1.4 m/h.
It is possible to continue to drill with this bit.

The bit s/n 21355 (Fig.9) drilled in three wells: well 24102, Abdrakhmanovskaya field in the interval 1744-1843 m (99 m, 54.2 h, 1.8 m/h), well 19430 Pavlovskaya field in the interval 1821-1834 m (drilling of the basement, 13 m, 20 h, 0.65 m/h) and well 19431, Pavlovskaya field in the interval 1817-1852 m (35 m, 40 h, 0.9 m/h).
Total: 147 m, 114.2 h, 1.3 m/h.
It is possible to continue to drill with this bit.

Рис. 7. Износ долота 8 1/2 CH44MRS № 213550. Код износа В2П4Д8. Проходка на долото 194 м, время бурения 137 ч, мех. скорость 1,4 м/ч

Рис. 8. Износ долота 8 1/2 CH44MRS № 213549. Код износа В1П0Д2. Проходка на долото 241 м, время бурения 174 ч, мех. скорость 1,4 м/ч

Рис. 9. Износ долота 8 1/2 CH44MRS № 213551. Код износа В1П0Д2. Проходка на долото 147 м, время бурения 114,2 ч, мех. скорость 1,3 м/ч

Fig.10 shows the terrible worn of the drill bit of another manufacturer. This bit drilled in the same well after Varel bit s/n 213551 in the intervals 1852-1923 m and 1958-1973 m (86 m, 47 h, 1.8 m/h). Lost of diameter of this bit is 20 mm.

Рис. 10. Износ долота другого производителя. Код износа В4П0Д20. Проходка на долото 86 м, время бурения 47 ч, мех. скорость 1,8 м/ч

Table 1 shows the results of drilling with the Varel roller cone bits 8 ½ CH44MRS in “Tatneft”. Average meterage is 184 m, drilling time 132.3 h, ROP 1.4 m/h.
Consequently, during the drilling of the same stratigraphic horizons with the same type of rock bit, it is possible to have absolutely different results of the drilling, for example: 26 m and 154, 194, 241 and 147 meters.

So, during the drilling of the wells with rotary or bottom hole motors, it is necessary to decide the problem of the BHA stabilization for exception of the off center rotation of the drill bit on the bottom hole.

In conclusion, it is necessary to note that the Varel roller cone bits 8 ½ CH44MRS have showed an advantage in comparison with any ones in “Tatneft” and have provided an economy $ 7 per meter drilled.

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