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Development, properties and drilling test of high performance $\Phi 147$ mm aluminum alloy drill pipe

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Aluminum alloy drill pipe (ADP) has been widely used in continents and oceans for deep or ultra-deep wells drilling. Compared with steel drill pipe, ADP shows lower lightweight, high corrosion resistance, non-magnetism and steady mechanical properties in many harsh environments [1, 2].

In this paper, high performance $\Phi 147 \times 13$ mm aluminum alloy drill pipe has been developed and tested. Two grades of aluminum alloy, 7075Al and 2024Al were selected as drill pipe materials. 9.1m long aluminum alloy tubes with variable cross-section were extruded by using a double-action extrusion press in a single process without any other machining procedure.

The mechanic properties of samples taken from different parts of the aluminum alloy tube were tested. The tensile strength and yield strength of 7075Al samples were ranging from 559~593MPa and 500~534 MPa, respectively. The tensile strength and yield strength of 2024Al samples were ranging from 510~544MPa and 346~370 Mpa, respectively. Moreover, when tested at elevated temperature (up to 300°C), the tensile strength and yield strength of 2024Al were ranging from 160~520MPa and 155~390 MPa.

Both hot and cold assembling methods were used to ensure reliable connections between aluminum alloy tube and steel joints [3]. The tensile strength, the resistance to internal and external pressure of full-size ADP were tested. The ultimate tensile strength of 7075Al and 2024Al ADP were 503MPa and 546MPa, respectively. The maximum internal and external pressure resistance of 7075Al ADP were 69.51Mpa and 107.4Mpa. The maximum internal and external pressure resistance of 2024Al ADP were 48.65Mpa and 72.3Mpa.



7075Al ADP was tested in a deviated well with design depth of 1200m. The formation was mainly composed of shale, mudstone and siltstone. Mixed aluminum-steel drill string was used from 219.83m to 984.66m and bit was powered by down-hole turbine motor. After testing, there was no obvious surface wear and bending damage and the ADP kept intact.

Figure 1: Aluminum alloy drill pipe with steel joints

References:

[1] Basovich, V. et al. (1998): SPE 49957

[2] Mikhail, Ya et al. (2003): SPE 79873

[3] Jianshe Mao. et al. (2014): International Journal of Earth Sciences and Engineering 07(02):533-539

