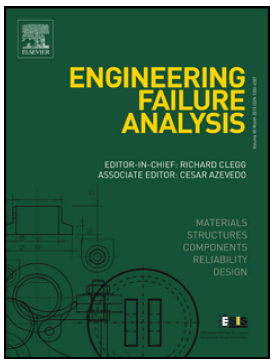


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# Oil Well drill bit failure during pull out: redesign to reduce its consequences.

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***Abstract:***

A drill bit with polycrystalline diamond (PDC) inserts lost one of its three blades when operating in an oil well, leading to a costly failure. Operating conditions and associated stresses were analyzed, bit core material in the failure and adjacent areas was analyzed and tested, and fracture surfaces identified.

Base material is a Ni-Cu-Mn matrix with tungsten carbide precipitates. Fracture surfaces showed cleavage planes and loss of particles, indicating a brittle fracture. Microstructures and hardness were similar in all analyzed regions, and according to specifications.

The symmetry and characteristics of the fracture surfaces allow defining that the loads that caused the failure were not applied during the drilling operation. The blade broke apart due to a downward force applied at its base. Finite elements numerical modeling allowed pinpointing a specific moment in the pulling operation, in which a 28 ton overpull force was recorded, as the immediate operational event that caused the failure.

Operating procedures that reduce the likelihood and amplitude of impact loads, are difficult to implement; more promising is the alternative for a redesign of the drill bit. Commercial designs focus mostly on the efficiency of the cutting cycle; blade geometry can be also optimized to take into account the pull out conditions. The most efficient redesign for this specific drill bit model relies in a re-machining of the blade base, so that a large overpull load would crack a small sector, on which a PDC insert is located. In this gecko-tail type solution, only one insert would be lost, preserving the integrity of the rest of the drill-bit. Subsequent repair would involve standard thermal spray base metal techniques, including reconstitution and brazing of a new insert.

**Key words:** Drill bit; PDC; impact loads; redesign