Department of Consumer and Employment Protection
Government of Western Australia

Resources Safety

Mines Safety
Significant Incident Report No. 135

Aluminium drill rod failure

Incident

A reverse circulation (RC) drill rig was drilling at a depth of about 94 m when the head drill rod failed. The failure was a long split that rapidly formed from between the pin end tool joint, about 0.5 m from the end of the drill rod, to about 2 m from the same end of the drill rod.

The failed section was located within the drill hole casing a short distance down the hole below the slips table of the drill rig. The slips table was located at the drill deck in immediate proximity to the drill crew work area.

The drill rig compressed air system was supplying high-pressure compressed air to the down-hole hammer and was running at a pressure of about 3860 kPa (560 psi) and flow rate of about 39.6 m^3/min (1400 cfm). When the rod failed there was a sudden and uncontrolled release of high-pressure compressed air from the split, which flowed up the inside of the drill collar with enough force to dislodge the steel drill rod slips at the surface.

Fortunately, the drill crew working in the area was not injured and there was no other damage. If the failure had occurred above, at or nearer to the surface then there would almost certainly have been injuries.

Since the occurrence, the mining company (principal employer) and drill rig owner (employer) have removed all aluminium drill rods from service.

Use of aluminium drill rods

The use of aluminum drill rods is not common in Australia, although their use is more prevalent in other countries such as the United States. The primary circumstance associated with the use of aluminum drill rods at the drilling operation where this incident occurred was that a hovercraft drill rig was used on lake beds. Consequently, minimising weight was seen to be important in the effective operation of the drill rig.

The lighter weight of the aluminum drill rods meant that more drill rods could be carried, allowing deeper holes to be drilled using high-pressure compressed air. The weight saved by using aluminum drill rods was estimated at 62 kg per rod compared with steel rods. The use of the hovercraft drill rig and its capability to drill deeper holes were also seen as important aspects of the principal employer's drilling operations.

At the time of the incident, it was estimated that this batch of drill rods had completed 17,000 m of drilling, which is not considered to be excessive.

Previous occurrence of damage to aluminium drill rods

From inquiries made, it was discovered that there had been a previous occurrence of an aluminium drill rod failing and sustaining damage near the tool end joint.

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The tool end joint of an aluminium drill rod is typically a round steel section where a spanner or Stilson-type wrench makes contact with the rod to allow for the joint to be screwed or unscrewed, using the drill head to rotate one drill rod while another is held fast.

A feature of the tool end joint is a machine-turned steel insert with two flat machine-milled sections, which is screwed into the end of the drill rod itself using machine-turned threads and a locking compound, such as Loctite, to prevent the tool end separating from the drill rod.

Cause of failure

Based on available evidence, the likely cause was a fault induced by the manufacturing process and associated with contamination of the raw aluminium billet material as it was extruded through dies to form raw aluminium pipe. A lubricant is required in the process and, in some instances, there can be contamination towards one end of the raw pipe. This can produce a flaw that may result in a seam, possibly not be visible to the naked eye.

Hazards

The hazards associated with the sudden release of high-pressure compressed air in drilling operations, particularly in the immediate vicinity of the drill crew work area, are well known and documented. It was fortunate that, in this occurrence, the failure was some distance down the hole. If it had been at or near the surface then people near the drill collar would almost certainly have been injured.

All drill rods, whether made from steel or aluminium, sustain wear and damage from the drilling process. Aluminium is typically softer than steel and has differing mechanical properties, which must be assessed for the application so that personnel are not exposed to hazards or risks. It is important to verify the suitability of all plant, including aluminium drill rods, before its introduction into drilling operations.

It was evident from the recorded measurements taken of the failed aluminium drill rod that there were variations of up to 2 mm on the outside diameter.

It was also apparent from viewing the batch of used aluminium drill rods —including the failed rod — that the drilling process has a much more aggressive effect on the outside surface of the aluminium drill rods than on comparable steel rods. Hence the monitoring of wear and damage to aluminium drill rods is very important.

The drilling process also places tremendous forces on drill rods, such as compression forces when under feed during drilling, tensile forces when being pulled back up the hole and torque while being rotated, in combination with high internal pressures from high-pressure compressed air. There are also other factors to be considered, such as heat, flexure and shock loading, during the down-hole hammer drilling process.

Another risk factor is concerned with the method of joining the tool end joint to the aluminium drill rod. In this incident, the split failure appeared to begin at the end of the internal threaded section of the aluminium drill rod where the steel insert was screwed into it.

From inquiries and a review of the available evidence, it appears that an adequate hazard or risk assessment had not been completed before or after the introduction of aluminium drill rods at the drilling operations, nor following the first failure of an aluminium drill rod.

Recommendations

An appropriate hazard or risk assessment must be undertaken and completed by all parties concerned, including the manufacturer of the drill rods. Principal employers and employers must ensure that they are satisfied that manufacturers can demonstrate compliance with the relevant regulations, and that appropriate procedures and systems of instruction, training, competency assessment and supervision are established and maintained to ensure safe selection, use, inspection, maintenance and discard criteria for all drill rods, not only the aluminium rods that failed in this instance.

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23 August 2005