Percussion Drilling

Holes are drilled by raising and dropping a drilling tool or bit into the ground by means of steel wire rope. This is basically effected by a device called a "Pitman" arm which moves up and down on the drilling rig. The rope is secured on a drum, passed under a sheave wheel at the end of the Pitman arm and up over a head sheave located at the top of a boom or mast and then down where it is attached to the drilling tool.

The downward stroke of the arm on the rope causes it to raise the drilling tool and the upward stroke allows the cutting tool to fall and strike the bottom of the hole. Additional cutting impact is provided by a jar connected between the rope and the bit. It can be appreciated that the rope is subjected to continuous on and off shock loading.

Ropes Used on Percussion Drilling Rigs

(a) Drilling Rope. The recommended construction is 6 x 19 (6+6/6/1) / Fibre Core Ordinary Left Hand Lay 1800 MPa Non-preformed.

Nominal Rope Diameters used are 13,0 mm, 16,0 mm and 18,0 mm.

The rope is left hand lay in order that the threaded fittings on the tool which have normal right hand threads, do not unscrew due to torque effects of the rope.

As the rope is subjected to continuous shock loading it is desirous that this shock be absorbed by as much of the working rope as possible. For this reason the rope is non-preformed in manufacture, i.e. the strands are not pre-shaped to take their place in the rope when the rope is closed.

(b) Baling Lines

The Baling Line is used in conjunction with an auxiliary winch on the rig for the purpose of cleaning the bottom of the hole by means of a baler. The 6 x 7(6/1) / F Ordinary Right Hand construction, due to the large wire diameter, is preferable in corrosive and abrasive conditions, but the 6 x 19(12/6/ 1) / F Ordinary Right Hand is also widely used. These ropes should be galvanised.

The prime consideration with this application is corrosion resistance as the rope is usually working in a hole with sand, rock and water present.

(c) Mast Guy Ropes

These ropes support the mast during drilling operations against the movement caused by the tool being raised and lowered.

The most commonly used construction is the 6x19(12/6/1)/F Ordinary Lay. These ropes should be galvanised.

Optimising Drilling Rope Life

Operational Hints

The performance of the drilling rope is largely dependent on the skill and experience of the operator who controls the rope tension and whip by experienced "feel" while drilling.

The drilling rope is stored on one side of a drum which is separated in the middle by a divider plate. The live or operating portion of the rope is wound onto the other side of the drum by passing it through a slot in the divider plate.

There should never be more than one layer of rope on the live side or less than 3 turns of rope. If there are less than 3 turns, the rope will rub on the divider plate and result in very severe localised wear or fatigue of the rope.

The stroke of the Pitman arm , or spudding sheave should be increased or decreased as drilling conditions change. The spring or rubber shock absorber mounted between the heads-heave and the mast must be kept in good

condition as any deterioration will adversely affect rope life. Some operators end-for-end the rope when they have used half the rope on the drum. This is good practice.

7.2.2 Inspection and Maintenance

(a) Non-preformed drilling ropes must be well seized with serving wire before they are cut or the rope will unlay itself.

(b) The portion of the rope in the vicinity of the splice in the mandrel should be cut back at frequent intervals as this is the section most vulnerable to fatigue failure due to the fact that all vibration and shock loading is terminated at this point.

(c) The section of rope at the divider plate should be moved at reasonable intervals, particularly if the rock is hard and drilling is slow.

(d) The rope should be kept well lubricated.

(e) The divider plate should have smooth radii where in contact with the rope.

(f) Sheave wheel bearings should be well lubricated and free moving to eliminate the possibility of the rope skidding on the sheaves.

(g) When the new ropes are installed it is wise to examine the sheave grooves for undersize wear. (Sheave grooves should measure nominal rope diameter plus 7,5 %).

(h) Cast sheaves, when new, should be examined for rough and high spots.

(i) The rope should be frequently inspected for broken wires. Remove them by bending backwards and forwards with pliers so that they break off in the valleys of the strands thus preventing further damage to adjacent wires.

(j) Fatigued or broken wires in the vicinity of the splice at the mandrel indicate that either the splice has not been renewed often enough or that sharp edges are present on the radius of the mandrel. This latter occurrence is usually accompanied by deformation of the wires where they have been in contact with any sharp edge.

(k) Wire failures in the portion of rope in the divider plate indicate:

· that the rope had not been repositioned but had worked in that position for some time.

· that the rope has operated with less than three dead turns on the working side of the drum, resulting in severe localised wear at the divider plate.

(l) Fatigued or broken wires in the gussets of the strands indicate that a sheave groove is tight or undersize causing secondary bending of the wires in the strands with resultant failure. This means that an individual wire bends as the rope passes over the sheave and simultaneously bends in the opposite plane as the rope is forced to take an oval shape as it passes through the undersize sheave.

(m) Broken wires on the crowns of individual strands (i.e. all failures occurring in one, or two or three individual strands) are a result of, in the case of one strand only, that particular strand being proud with respect to the remaining five. If, say, three adjacent strands were affected it would point to mishandling of the rope. This could be by incorrect uncoiling of the rope from the drum or coil in its supplied form.

(n) Fatigue failure at inter-strand contact points indicate that the rope is possibly preformed.

(o) Abrasion of the wire results in the wires on the crowns of the strands being eventually completely worn away. Sharp, chisel shaped ends at the wire failures are indicative of this.

(p) Corrosion as a cause of failure of a rope could either be a factor in the premature fatigue of the wires as a result of pitting or as complete erosion of the wire.

(q) Mechanical damage to a rope could take many forms and is often clearly visible as such. Deformation of the wires or strands or rope is usually visible.

(r) Overloading of the rope resulting in complete failure could be caused by the rope having been fouled or by the tool not hitting the bottom of the hole. The most usual reason however, is overload when fishing for tools. Failure in tension can be identified by examining the ends of the wires at the failure. The ends, if broken in tension will be "necked down".

(s) Kinks in the rope as a result of mishandling cause a reduction in the strength and/or broken wires.

This condition can be seen in the form of a "dog-leg" in the rope and extreme localised shortening or lengthening of the lay.

7.3 Rotary Drilling

The main rope application in rotary drilling is, in effect, a hoisting duty. Extremely heavy loads of drill stems or pipe have to be raised or lowered by the drilling lines to enable the drilling bit to be replaced or in some cases to remove core which has been produced.

To do this, ropes of between 20 mm and 40 mm diameter are reeved in up to 20 falls. This means that the lifting speed is very slow unless the winch speed is kept high and to this end winch drum diameters are usually' relatively small, leading to multi-layer coiling.

To ensure that the rope cross-over points do not all occur on one side of the drum, thus causing out of balance masses, a patented type of double crossover is often used on this application. This type of rope coiling is also effective in reducing rope whip between drum and sheaves.

The constructions of rope most frequently used for drilling lines are 6 x 19(9/9/1) / IWRCand 6 x 25 (12/6F+6/ 1) / IWRC, always in ordinary lay, to prevent excessive twisting of the fall blocks. 6 x 26 C / IWRC UHP ropes have proved a major success in rotary drilling applications.