THIRD GENERATION HDD DRILL PIPES

The growing spread of HDD technology in the world and the resulting increase in the number of drilling enterprises, engineers and technicians working in the sector calls for the utmost efficiency of operation of each of the components of HDD equipment to respond to the specific needs and challenges of the application in question.

Therefore, drilling equipment performance and requirements, as specifically assessed by specialised technicians, are becoming the factors most likely to affect the specifications of HDD equipment components in those markets where this technology has by now become well established.

Technological development of the various parts of any HDD system has had to advance at the same pace at which the number of operators and field application designers grows. There is no doubt that drill pipes are no exception to this trend.

As little more than a piece of steel (1st generation pipes) just five years ago, this fundamental part of a HDD equipment has now become a technology-intensive mechanical component, crucial to the operation of the entire HDD system (2nd generation pipes).

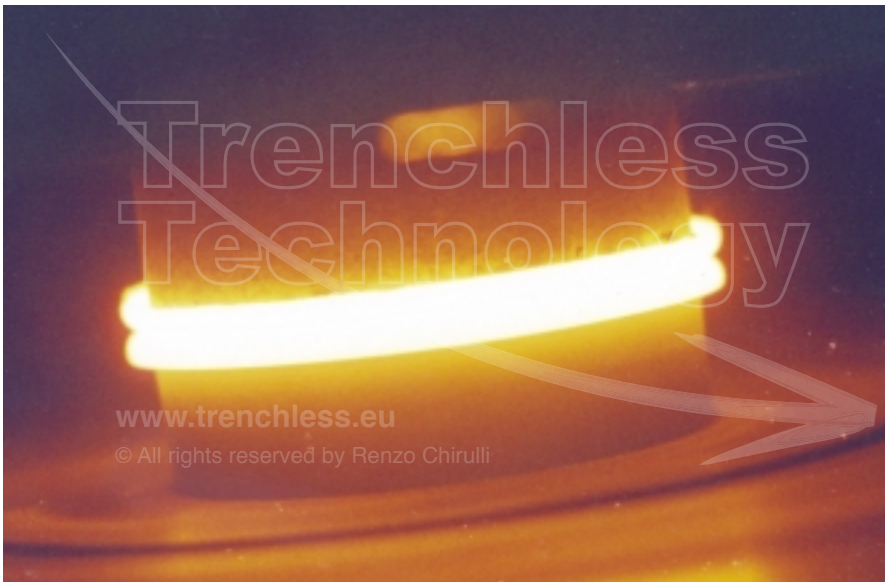
Drill pipes are most likely to collapse due to the breaking of the pin or male tool joint.

This phenomenon occurs more frequently in full-OD pipes (i.e. pipes with tool joint and pipe of the same diameter) although such pipes boast a series of important application advantages essentially due to the fact that no debris gets stuck in the borehole.

The same phenomenon is likely to occur in external set-up pipes (tool joint diameter larger than that of the pipe) because of ill-designed tool joints.

CRITICAL POINTS

When analysing the typical profiles of two drill pipes, one with external set-up and the other with full OD configuration (fig 1), the presence of three critical cross sections can be seen where calculations must be carefully checked in the design phase of the drill pipe to be able to resist field operation stresses. The first critical section is, no doubt, that of the pin. In conical threads with a pitch ranging from 4 to 5 threads/inch and a opening angle from 6° to 14°, the section most likely to collapse is that between the 1st and the 3rd thread, indicating that this section of the pipe is the least resistant. If, as mentioned, this



Friction welding.

accounts for the main phenomenon likely to bring about the collapse of this part in full-OD drill pipes, this collapse should never take place in well-designed external set-up drill pipes. Unfortunately, though, most of time this does not seem to be the case. Another type of collapse that is linked to ill-designed pipes may involve the shoulder section of the female tool joint. In this case, the collapse results in a daisy-shaped opening of the female tool joint. Again, this should never be the case in well-designed external set-up drill pipes.

Indeed, when these two critical sections are properly designed, the section of minimum strain strength overlaps the annular section of the pipe.

Focusing attention on the pipe section, it can be seen that a distinction exists, in terms of resistance, between one-piece forged drill pipes and assembled drill pipes (i.e. constructed by connecting two pre-machined threaded tool joints to a pipe). In the former case the material used keeps the same properties along the entire drill pipe and therefore, if well designed, the drill pipe will not breaks but just bend.

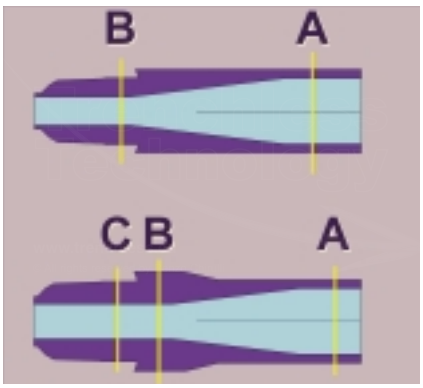


Fig 1.

Of course, the bending of the pipe entails that the drilling string cannot be utilised anymore and should be discarded as bend removal would call for costly and time-consuming operations such as full annealing and quenching & tempering.

In assembled pipes there exist two jointing sections between the tool joints and the pipe. The only welding method for joining tool joints to pipe normally considered is the highly reliable friction welding technique. This means that in assembled pipes there are at least two geometrically identical annular cross sections exhibiting different levels of strain strength depending on the mechanical characteristics of the metal they are made of (fig 2).

In 2nd generation assembled drill pipes the least resistant section is generally located at the site of the ring-shaped tail of the tool joints immediately above the pipe. It is for this reason that collapse generally occurs at this section. As, in most cases, the drill pipe does not undergo permanent bending, once recovered from the borehole, it can be repaired by replacing the broken tool joint.

Nevertheless, in most cases, pipe bending is better than the collapse of a component of the pipe itself. This is

Fig 2.

because it is easier to recover the pipe from the bottom of the borehole, an operation that would not be possible in a case of collapse, resulting in the loss of the site/borhole and a significant waste of time and resources.

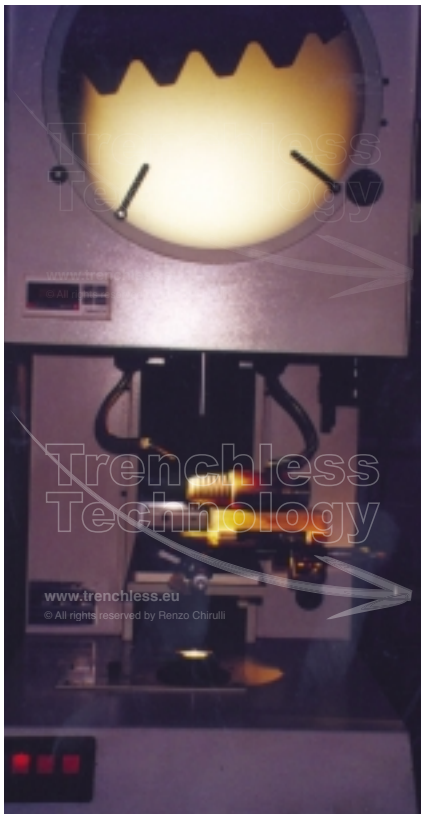
In the past, some producers tried to solve this problem by constructing drill pipes with a more ductile material, giving up the mechanical properties offered by some special steels that do not exhibit a ductile behaviour. If it is true that this criterion has brought about pipes that do not break but just bend, it is also true that this option has heavily restrained drill pipe performance.

NEW GENERATION

Italy's Colli Drill, an innovation-oriented HDD drill pipe producer, is putting on to the market a new type of drill pipe. Referring to it as the 3rd generation, it is known as PCC (Progressive Controlled Collapse) drill pipe. This innovative product combines the state-of-the-art section design methodologies with the use of highly-resistant materials.

In particular, the PCC drill pipe, which utilises the assembled type design, claims to rank first in the range of products available on the market today in terms of performance thanks to its mechanical properties that outnumber those offered by other high-resistance drill pipes, and has a PCC mechanism that results in the bending of the pipe thus avoiding the collapse of the tool joints in the presence of stress.

Finishing drill rod threads on a CNC lathe.



Profile analyser.

PCC pipes are the result of years of study and continuous investment in technological innovation and research on production and materials technology by Colli Drill.

From 1995 to date, the company has doubled its production of pipes and also its production plant capacity. With a total number of 14 employees, 7 of whom devoted to production, in 1999 Colli Drill had a turnover of $US2 million in sales of drill pipe, much of which was exported to many countries of the world.

Colli Drill is presently the holder of two patents and is applying for new ones thus demonstrating its intensive and ongoing research effort.

All the workshops of the Colli Drill production plant are computer-controlled for a more accurate monitoring of production processes. Quality control assessments in terms of processing lines, materials and products are conducted partly by an internal laboratory and partly by authoritative external research institutes. In 1997, this has led Colli Drill to obtain ISO 9002 quality certification.

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