Patterson, ICO bring new techniques to pipe coating

FOR DECADES, the drilling industry has sought the perfect coating for its drill pipe and tubulars. With drill pipe, specifically, the roughness of the steel within the pipe creates deleterious frictional effects on mud pumping. At the same time, uncoated pipe deteriorates from corrosion pitting, especially around the critical box and pin connections. The industry learned that by coating its drill pipe, mud-pump flow rates could be increased by as much as 15%. In addition, the pressure of the mud pumps could be better controlled.

Drill pipe coating began in the 1950s. In the last 2 years, however, 2 companies, **ICO** and **Patterson Coatings**, have introduced products designed to improve drill-pipe performance and life.

ICO'S POWDER COATING

The original drill-pipe coatings were liquid. However, in the 1970s, pressured by the newly passed Clean Air Act, the industry tried to implement powder coatings to cut use of solvents and, hence, emissions. Early efforts to coat drill pipe with powder were less than wildly successful. The coatings proved too rigid for drill pipe, which, thanks to downhole torsion, compression, tension and deviation, routinely flexes and bends like s so much linguine.

Then, in September 1996, ICO introduced its IPC 100 powder-coating formulation. "This is the first significant improvement in drill-pipe coating in 15 years," stated ICO's **Art Lowry**, Vice President of Corrosion Control Sales. "The material has several good properties and is finding a place in numerous applications while gaining acceptance among drilling contractors."

One of the major advantages of this material is its ability to withstand temperatures as high as 350° F without circulation, explained **Al Siegmund**, ICO Vice President of Technical Services. "This means that formation temperatures can reach about 400 F," he said, adding that circulation can therefore be reduced without sacrificing performance.

Furthermore, IPC 100 resists wireline damage and corrosion, Mr Siegmund added. One wet-scratch hardness test of wireline abrasion indicated that the material outperformed one thin-film liquid by more than 4 times. And that's likely low, as the test was terminated after the test mechanism failed before the powder coating was damaged. In other words, the coating outlasted the testing device.

Similarly, tests of IPC 100's resistance to both organic and inorganic acids showed that this powder coating could withstand far more than the coatings it was tested against. Field results echo the laboratory results. For example, Mr Siegmund said, in the highly corrosive downhole environments of Northwest Lousiana, drill pipe coated with IPC 100 lasts about a year, compared to about 5-6 weeks for uncoated pipe.

"This powder coating stands up to the new drilling fluids, as well," he explained. "including the zinc bromides and the acids used to drill some of these wells."

Its corrosion resistance renders the material viable for drilling using air or brines, such as in the Austin Chalk and other underbalanced operations. Here,

Figure 1: Temperature characteristics

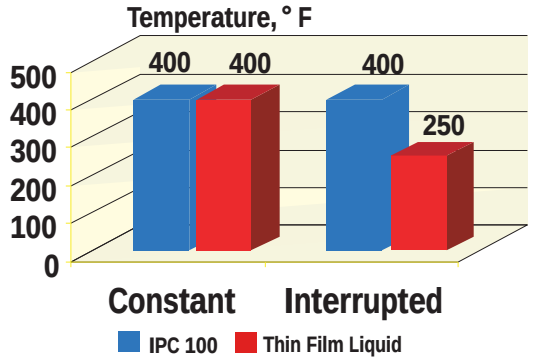


Figure 2: Inorganic acid behavior

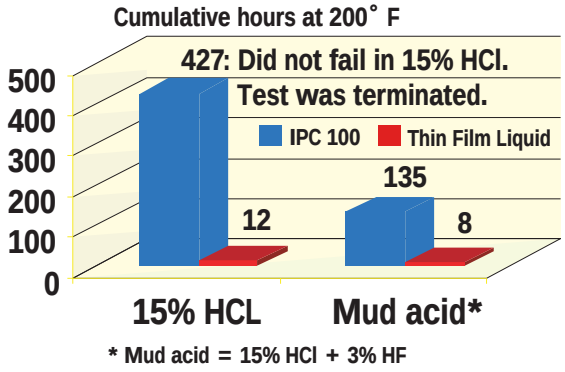


Figure 3: Organic acid behavior

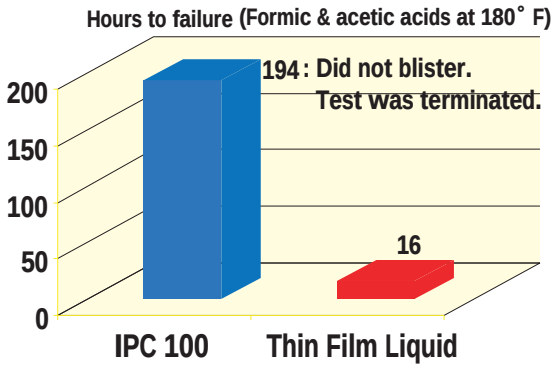
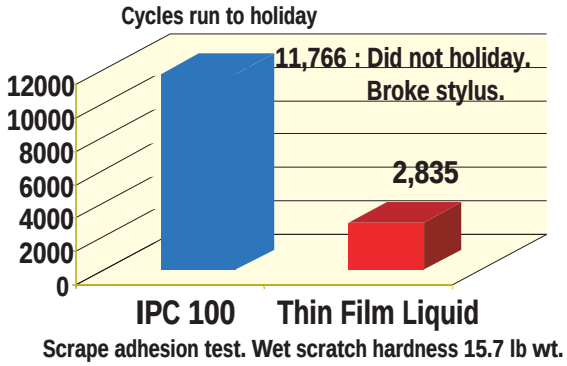


Figure 4: Wireline abrasion simulation*



The renaissance of powder coating: Powder coating for drill pipe has gotten a new lease on life with the advent of ICO's IPC 100 material just 2 years ago. As seen above , tests by ICO indicate that IPC 100 outperforms thin-film liquids for resistance to acids, temperatures and mechanical abrasion.

Patterson draws on unique resources: Patterson recently installed facilities enabling it to coat 90-ft sections of riser, which can later be loaded aboard barges and shipped to rigs in the Gulf.

Mr Siegmund says, the material's temperature characteristics are once again a major advantage.

Similarly, the material is well-suited for running completion fluids through the drill string, he added.

In addition, the material's coefficient of friction is lower, allowing higher flow rates, Mr Siegmund said.

"If you can get a 10%-15% improvement in mud flow and therefore reduce the size of the mud pumps and rig weight, it makes a significant difference," he said.

The powder is applied 100% "holiday free" (no discontinuities) at thicknesses of 8-13 mils, Mr Siegmund said. First, the pipe is thermally cleansed at 750° F for up to12 hours. A primer is then applied to the bare steel, the pipe reheated and powder blown though it. After the powder melts, the pipe goes through a conveyorized oven for curing.

PATTERSON: SHOTGUN TOUGH

Patterson's material, an internal liquid applied pipe coating**,** certainly should be tough enough for downhole conditions: The coating, trade named CeRamKote 54, was originally devised to coat the inside of shotgun barrels. Patterson Coatings opened in February 1996 and has also been gaining ground in the drill-pipe market, reports General Manager **John Boyd**.

In addition to coating new pipe, the company has made inroads into coating good used drill pipe. Mr Boyd cautioned, however, that only premium used pipe should be coated. He defines premium used pipe as that with 0-15% wall thickness loss and with no pitting corrosion.

Mr Boyd points to the savings an investment in pipe coating will realize for the drilling contractor. "For the cost of coating, about 8%-10% of the pipe cost, you can at least double the useful life of the pipe," he said. "If you can take $10 and make it $100, that difference goes into your pocket.

"A lot of people out there don't use coating," he continued. "If they get pitting and crack propagation, especially in the transition zone, they've got a serious problem that can result in premature failure and added costs.

"In the Gulf Coast area, you're drilling primarily in soft formations, so you don't get a lot of external wear," Mr Boyd said. "In comparison, out in the Rockies and in West Texas, external loss is much more severe."

Case studies, he said, show that drill-pipe life can be extended 400,000 ft with internal coating. Further, however, a coating and re-coating program can extend string life to as much as 800,000 ft drilled, Mr Boyd said.

"If there is minimal external wear," he explained, "and we can re-coat the pipe before pitting-type corrosion occurs, pipe life can be extended another 200,000 ft or so. That's the advantage of internally coating pipe. Major contractors that believe in it are saving money."

OCEAN DRILLING PROGRAM

In oilfield operations, drill-pipe exterior generally remains uncoated. Downhole abrasion can strip coating away in a heartbeat. However, Mr Boyd pointed to one application for which Patterson does coat pipe exteriors—the Ocean Drilling Program at **Texas A&M University**. Unlike oilfield operations, the drill string's principal exposure in the Ocean Drilling Program is to seawater. While water depths are extreme (15,000-20,000 ft), drilling is fairly shallow (less than about 300 m) and mainly through loose sands and sedimentary rocks. In addition, coring samples of the earth's crust for scientific research is the main goal, not oil and gas exploration.

The ODP coats pipe for corrosion protection, Mr Boyd said. Patterson has coated some 1,500 joints for the program, using an inorganic zinc-silicate system. ODP, he added, uses a 5% wall thickness loss criterion, which is more stringent than generally accepted in the oilfield.

"In the Ocean Drilling Program, tension on the drill string reaches about a million pounds or more on 5 and 5 ½-in. S140 drill pipe," Mr Boyd said. "If there is pitting or corrosion which is the precursor to crack propagation, catastrophic failure can occur. They have become a believer in coating pipe."

Patterson, renowned for its rental tool

(See **PIPE**, *p 41)*

Avoid current API high-strength ID system

Thomas B Smith, Smith Consulting Services

THE OLD API identification marks (single groove and milled flat) served the industry for more than 2 decades. Its early success may have been because most strings contained E75 tubes and 1 high strength grade. Separation of these 2 grades was easy.

In recent years, E75 is ordered less frequently and many strings are made up of 2 high strength grades. Grade differentiation must be made by reading the stencil in the milled flat or at the pin base. This is time consuming, difficult and sometimes impossible. Mix-ups happen more frequently and failures, because of these mix-ups, have occurred.

API was requested to devise a marking system that would allow quick, easy and accurate identification of various high strength grades. A work group devised the current API system which has pin grooves: 3 for S135; 2 for G105; 1 for X95.

This system made identification across the rig floor possible, but it had some unforeseen and undesirable side effects:

- The 3 grooves for S135 are particularly damaging to stripper rubbers;
- In at least 1 instance, the smaller grooves appear to have contributed to fatigue failures on a slimhole string;
- Some feel that 3 grooves eliminate too much of the pin tong surface.

Another API work group has been formed to come up with a new and better marking system. 1 current idea is to use drilled holes in the pin tong surface. There will be holes every 120° so if the pin can be seen, the grade marking will be visible. The numbers of holes will denote grade: 3 for S135; 2 for G105; 1 for X95.

The tube weight can be shown by the stenciled weight code following the grade code at the pin base.

RECOMMENDATIONS

- Avoid using the current API high strength identification system;
- Specify the proposed drilled holes system; or,
- Use the old groove and milled flat system.

Note: *Your comments on the marking of high strength drill string are welcome. Direct your remarks to the author, in care of* DRILLING CONTRACTOR. ■

PIPE: *(Continued from p 39)*

business, got into internal pipe coating after successfully trying CeRam-Kote 54 in 3 ½-in. and 4-in. rental pipe. Mr Boyd explained that the company had tried competitive coatings and was not satisfied with the mechanical performance. Of course, rental pipe generally experiences the toughest treatment and is used in the most excruciating operations.

Patterson coated some Grade G 3 ½-in. and 4-in. pipe with CeRamKote 54 in 1994.

"That rental pipe," Mr Boyd said, "is still in use, except for a few joints we've pulled for show and tell."

CeRamKote 54 contains 90% by weight ceramic material loaded in an epoxy binder resin. After being sprayed though the pipe, the liquid applied coating is cured and chemically crosslinked to achieve its performance properties. The epoxy-ceramic combination, he said, provides a very tough surface that is both impact and abrasion resistant. The resulting mechanical toughness helps provide longer service life, Mr Boyd said.

The material was originally developed in 1986 by **Freecom Inc** in Big Spring, Texas. When steel shot replaced lead, abrasion within the gun barrel became a problem.

COATING 90-FT RISERS

Internally coating riser pipe is another active market for Patterson. The company has positioned itself as a "one-stop shop" for riser coating, with facilities to coat, assemble, store and transport this critical pipe. Patterson has the distinction of being the only company able to coat full 90-ft lengths of riser. Plus, Mr Boyd points out, Patterson's waterfront location on the Houston Ship Channel in Channelview allows it to provide cost-effective transport by barge to offshore drilling units.

"Houston is where the risers are manufactured and is strategically located to the deep-water market," he said. "One of our advantages is that we are already on the water. This saves our customers a great deal on freight costs, which, for 90-ft lengths, can be exorbitant." ■