

Synthetic mooring systems could be choice future

MOORING SYSTEMS CONTAINING polyester rope have been available to the offshore industry for the past six years or so, but they may finally be gaining some acceptance. Polyester mooring lines have been used sparingly during that time, particularly in the Gulf of

one anchor handling vessel. The eight mooring lines were then pre-installed at a later date, allowing for quick connection when the rig arrived on location.

Pre-installed, or preset mooring systems generally are going to be either taut-leg or semi-taut-leg configurations.

With a catenary system, the anchoring radius is going to be about twice the water depth. Semi-taut systems are typically 1.4 to 1.5 times the water depth, and with a taut-leg mooring system it can be one to one ratio.

The advantages of preset mooring includes a significant time savings of anchoring the rig when it arrives on location. This can be reduced from several days to about 24 hours. Preset mooring systems can also be configured

with submerged buoys to alleviate much of the load from the rig. A smaller, earlier generation rig can be used in a lot of instances to drill in water depths that previously exceeded the rig's capabilities.

The applications of polyester mooring on the Ocean Confidence and Deepwater Nautilus probably added to the confidence of drilling contractors in the technology, at least as far as Diamond Offshore is concerned.

"I think (polyester) is absolutely the thing of the future for ultra deepwater," said **Phil Keaton**, Director of Marine Operations Worldwide for Diamond Offshore, "for most of the obvious reasons that anybody would consider such as the weight, capabilities of the rig mooring, winches to handle the weight and the available anchor handling vessels in the Gulf of Mexico."

SUCTION ANCHORS

The use of lighter weight polyester rope coupled with taut or semi-taut anchoring can result in a rig being capa-

ble of drilling in significantly deeper water than its original rating using a catenary mooring configuration. Removing the catenary configuration makes the mooring stiffer resulting in a water depth increase.

A critical component of a taut-leg mooring system are the anchors, since they need to be capable of withstanding high vertical loads. Suction anchors are accepted as the primary anchoring system with taut-leg systems on mobile rigs and floating production units such as spars and floating production storage and offloading vessels (FPSO).

The advantage of the suction anchor system is the ability to hold at higher uplift angles. This reduces the circumference of the mooring pattern and watch circle maintained by the rig.

"Conventional mooring with chain and wire rope has been used up to 5,000 ft of water," said **Peter Dove**, Principle specialist in Mooring and Marine Operations with Technip Offshore Moorings. "However, going much beyond 5,000 ft it is difficult for the rig to stay on station within the required watch circle."

A suction anchor basically is a cylindrical suction caisson with an open bottom. When it is placed at the location, a remotely operated vehicle (ROV) pumps out the water from the top of the caisson until it is completely penetrated into the seabed.

The soil captured within the anchor acts as an integral component of the caisson deadweight and increases the vertical uplift capacity compared with driven piles and drag anchors.



Delmar Systems' suction anchors for a preset mooring system are being deployed in the Gulf of Mexico.



BP installed polyester mooring in a taut anchoring system on Diamond Offshore's Ocean Confidence in the Gulf of Mexico.

Mexico, although Petrobras has been using them for a number of years. The biggest development recently regarding polyester mooring systems is that they are going to be utilized for permanent mooring systems on spar-type production facilities in the Gulf of Mexico.

POLYESTER ROPES

The first application of a mooring system utilizing polyester rope was when BP installed a system on **Diamond Offshore's Ocean Confidence** on November 2001. BP was leasing the rig under long-term charter, and is also leasing the mooring system from **Technip Offshore Moorings Inc.** Each mooring leg on the rig included 9,000 ft of the polyester rope connected to chain on each end.

The mooring system was on the Ocean Confidence for about four or five months but it has not been used since that application. BP's lease on the mooring system runs for five years.

Transocean's semisubmersible Deepwater Nautilus was moored in more than 8,000 ft of water with the deepest anchor in 9,100 ft of water using polyester rope connected to suction anchors. This application utilized a Delmar Systems mooring configuration. Suction anchors were pre-installed using only

Because of the installation method, suction anchors can be precisely placed in an optimum mooring pattern. Removing the suction anchors is a matter of reversing the installation procedure, that is, by pumping water into the top of the caisson.

As Delmar Systems Inc. describes its installation procedure, Delmar uses its proprietary single vessel/single line installation method to preset the mooring lines utilizing one work boat and an ROV. The anchor is lowered and pumped into the seabed. The preset mooring line is attached and suspended with a surface or submersible buoy awaiting the rig's arrival.

When the rig arrives on location it is connected to the mooring legs by an anchor handling vessel. This procedure takes 3-4 hours per leg. Submersible syntactic buoys in Delmar's mooring system reduce the weight of the mooring leg on the rig.

The company's suction anchor system incorporates its patented subsea connector allowing the anchor to be deployed with a single line and the mooring line to be connected or disconnected at any time by an ROV.

The ABS-approved connector is comprised of male and female parts that are connected and disconnected by an ROV at or near the installed anchor, allowing for deployment of suction anchors by one vessel with mooring line attachment.

"The subsea mooring connector is in two parts that can be remotely connected with the assistance of an ROV," said **Andy Wilson**, Director of Permanent Mooring Systems for Delmar Systems.

"We have split the installation of the anchor and mooring leg," he continued. "We put the anchor down first and then come down with the mooring leg and make up the connector and lay out the mooring leg."

"That allows the operation to be conducted with one anchor handler," Mr Wilson said.

EMBEDDED PLATE ANCHOR

An alternative to the suction anchor is a recent development introduced by Technip Offshore Moorings. Dubbed the Suction Embedded Plate Anchor (SEPLA),

it is essentially a large steel plate that is driven and embedded into the seafloor at the base of a suction anchor, called an installation follower by Technip. The installation follower is removed and brought back to the surface.

The SEPLA is driven into the seabed vertically but once it is pulled it rotates, resulting in a conventional plate versus a soil type anchor such as a suction anchor. A line is installed at the time the anchor is deployed attached to a buoy that sits just above the seafloor.

In order to recover the SEPLA, the recovery line is hooked by an ROV and pulled, rotating the plate to a vertical position that enables the relatively easy removal of the anchor.

SEPLAs were utilized with the Ocean Confidence when it was installed with polyester mooring ropes, which was the first use on a large scale for the anchors. **ExxonMobil** purchased and will utilize 19 SEPLAs during a development drilling project off Angola.

A joint industry project organized by Technip Offshore Moorings that includes BP, **Shell** and ExxonMobil, will examine some of the questions brought up by industry regarding the use of SEPLAs for permanent installation with production facilities, according to Mr Dove.

He also noted that SEPLAs are going to be accepted by the ABS for permanent mooring systems as well as for temporary drilling rig applications.

Advantages of SEPLAs are that they are easy to fabricate, easier to install than suction anchors, and a complete set for mooring a typical eight-point spread can be transported to the field location by one vessel. In fact, Technip's vessel, the Dove, carried the complete set of SEPLAs for the Ocean Confidence.

The cost for polyester ropes is about half that of the equivalent steel system using submersible buoys," said Mr Dove. "Using SEPLA anchors can probably cost a couple of million less." ■