BOUNCE DIVING IN 450 - 600 feet WATER DEPTHS AND DEEPER
Donald M Taylor, Editor

Recently, four divers in a hyperbaric chamber at Duke University made a simulated dive to 1,000 feet in only 33 minutes. The men were breathing a new mixture of helium, oxygen and nitrogen. They arrived at the simu-depth with none of the usual losses of mental or physical capacity that afflicts divers breathing the traditional helium-oxygen mixture. They returned to the simulated surface pressure in 96 hours.

By the way of comparison, the normal time for compression in 1,000 feet is 24 hours; and the decompression period now used by the US Navy for a similar dive is 11 days. This amounts to a reduction of 7 days in total elapsed diving time. At lesser depths, the percentage reduction in time runs even higher.

What will this mean to the offshore oil industry? It could mean plenty. Officials of Oceaneering International, Inc., one of the participants in the Duke experiments, say the new technique could extend non-saturated diving beyond its present depth limit of 600 feet to as much as 1,000 feet. And this could reduce diving costs by almost $300,000 per year for rigs operating within this range. The basis for this reduction in costs can be found in current diving practices. To begin with, the time required on bottom for actual work is usually quite short. “An analysis of 4,000 drilling rig dives showed the average time spent on bottom was only 17 minutes,” says D Michael Hughes, Oceaneering’s chairman. “The expense of diving then, is almost entirely a function of the time, effort and materials expended in going to and from bottom. This is why non-saturated or bounce dives hold such promise in the 400 to 600 foot depths.”

The time required for a bounce dive may run as little as 10% of that for a saturated dive. In the bounce dive, the diver is compressed to bottom pressures in a matter of minutes, quickly does his work, and usually starts decompression within the first hour. Because of the short exposure to high pressures his body does not become saturated with the breathing gas, and the period of decompression runs only a fraction of the time that would have been required had he stayed longer under high pressure. Why then, aren’t all dives bounce dives? Hughes, a tall affable man in his mid-30s who started as a diver in the Gulf of Mexico, explains, “Primarily, it’s because we lack precise knowledge about short-duration diving beyond 400 feet. Although a large number of short duration dives have been made in the 500 to 600 feet range, most of them produced an unacceptable incidence of bends. The ones which were not successful pointed up a need for further work if these dives are to become a commercial service.”

One of the most difficult problems starts with the compression cycle. In depths below 430 feet, high speed compression in the helium-oxygen mixture can produce high pressure nervous syndrome (HPNS) which is characterized by nausea, dizziness and tremors. The symptoms become more severe with increasing depth, eventually resulting in somnolence or convulsions. Even if the diver’s mind is clear, he may be physically incapable of working or even of saving himself.

To Dr Peter B Bennett, Professor of Anesthesiology at Duke University Medical Center, this represented a challenge. Animal experiments had previously indicated that the effects of HPNS could be negated by adding a certain amount of anaesthetic or narcotic gas such as nitrogen to the helium-oxygen diving mixture. Experiments had also shown that the effects of nitrogen narcosis, which would then result, could be relieved with increasing pressure.

In August, Bennett, who is an international authority on the physiology of diving, began a series of simulated human dives designed to see whether just the right balance

could be found between helium and nitrogen so that narcosis and HPNS might both be negated. Four divers participated in the dives, three from Harbor Branch Foundation and one, Erik Geerts, from Oceaneering.

Surprisingly, success came early. During a dive to 720 feet in August, using the three gas mixture, the four divers showed no signs of HPNS but did complain of slight narcosis.

In the 1,000 foot dives that followed later in the year, the nitrogen content was decreased. "This greatly reduced the narcosis they had experienced without causing any of the symptoms of HPNS to come back," Bennett said. "The divers had no tremors, giddiness or sickness and felt no pain in their joints."

Advantages of New Mixture

Everybody involved considered the experiments a nearly perfect success. Lad Handelman, Oceaneering's president was particularly happy with the possible time saving because his company has a contract to provide diving services in water depths to 1,000 feet. If divers can be compressed to 1,000 feet in 20 to 30 minutes, then spend 20 minutes working on bottom, they can be decompressed in a fraction of the 11 days normally required. Because divers would not be tied up for such long periods in the decompression chambers, the size of the diving crews could be reduced by, say, 25%. This is a much needed saving which can be passed along to the customer.

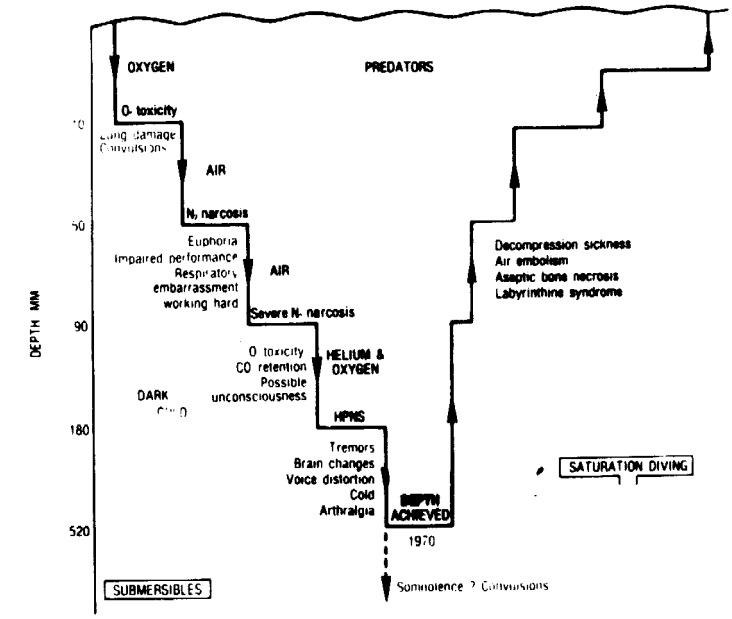
Another saving comes from the speed of response to emergencies. "It costs $40,000 to $50,000 a day for a drilling rig to operate in the North Sea," Handelman said, "If it typically takes a diver 24 hours to compress to 1,000 it, that's a waste of a day right there."

Oceaneering believes the new technique can lead to still another saving. A non saturated dive to 600 feet would require only half the charging gas and no replenishment gas during decompression. A 60% reduction in consumption of expensive gases is possible using bounce diving rather than saturation dive technique. At two dives per month, this new technique could effect a major yearly saving.

The divers, too, prefer the non-saturated for obvious reasons. Following a bounce to 600 feet, the diver will need only about 15 hours in the decompression chamber. A saturated dive at the same depth will require a stay of about 6 days. And this brings up another factor of keen interest to Mike Hughes. That is the matter of diver safety. "Long periods under pressure increase the diver's exposure to possible rig catastrophes such as fire or blowout," says Hughes. "Can you imagine the feelings of a diver if a fire breaks out when he has eight more days to go in the decompression chamber!"

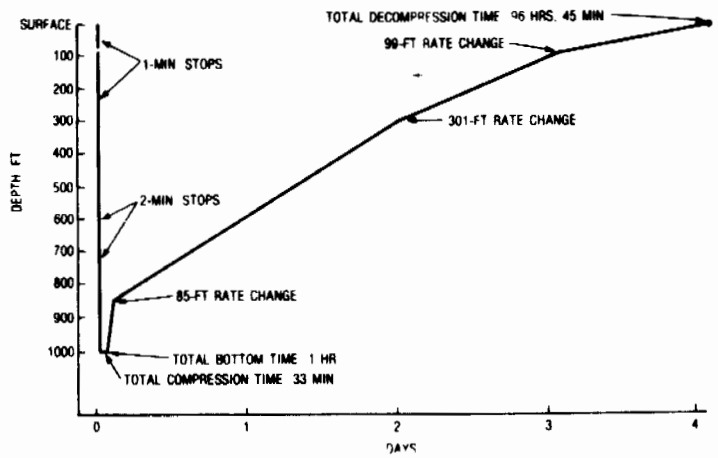
The new diving mixture takes on still greater importance in light of the oil industry's expansion into deeper water. As Dr Bennett put it, "One thousand feet has been the limit of man's working capacity in water, but even this has not been practical commercially because the divers had to go down and come back so slowly they lost much of their functional ability at that depth."

But this depth limit has been set by the combined effects of helium and pressure, he says, and no one yet knows how far man can dive with the helium/pressure effect eliminated by the use of the three gas mixture. It could be considerably deeper. More research is needed to complete studies of rapid compression before this technique can be considered safe for field use, but the potential savings could be tremendous.



Physiologic

Physiological problems of diving.



Graph of 1,000-ft dive showing rapid compression and decompression.

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