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How to Deploy the Moored Data Buoy with Small Vessel [1]

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Abstract

With more and more data buoys are produced to study the oceans, how to deploy them in a convenient and economic way is very important. In the past, the deployment is often accomplished by large special vessel, which needs a lot of manpower and material resources. Here we introduce a novel deploying method for moored data buoy based on small vessel. This method employs a small vessel with two pulleys(one is served as movable pulley, the other is stable pulley.) and a winch. By way of the relay, it drops all the mooring chain into the water step by step. At last, the anchor is made into ocean water. After several experiments inspection, this anchor-last deploying method for moored data buoy is safe and efficient.

Keywords: Deploying method; Moored data buoy; Small vessel; Safe and efficient.

1. Introduction

Fully automated data buoys are commonly used in coastal and offshore waters to monitor the atmospheric and sea conditions prevailing at the site. Usually moored buoys can measure and transmit barometric pressure; wind direction, speed, and gust; relative humidity; visibility above the sea; air and sea temperature; and wave energy spectra from which significant wave height, dominant wave period, and average wave period are derived. Even the direction of wave propagation is measured on many moored buoys. Ocean currents, salinity, turbidity, chlorophyll, dissolved oxygen and so on are measured at the same time[1]. These data acquisition systems collect real-time meteorological and oceanographic measurements for operational and research purposes. Data from the buoy can be transmitted real-time and stored internally. The size of the data buoy mostly is larger than 3.0m to maintain its stability and ensure that accurate data obtained. It is recommended that a single rectangular block of concrete/iron weighing at

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least 2000kg be used to anchor the data buoy. What's more, the buoy may be moored using an all-chain mooring and hundreds of meters of more than 19 mm diameter, proof-coil, low-carbon steel chain is used to connect the anchor to the surface buoy. Connections are made using an appropriate combination of safety shackles, swivels and thimbles[2]. All of these together constitute a very complex system and the deployment usually needs a relatively large vessel and the special equipment on board. Large crane, the vast deck space, anchor chain storage hole and anchor chain release machine are needed, as shown in Fig. 1.

Fig. 1 A special vessel for the buoy deployment

But the disadvantage is that the use of large vessels is expensive. Here we introduce a novel deploying method for moored data buoy based on small vessel （the tonnage is about 100t）which is relatively economic.

2. Preparations for deployment

2.1 Tested in harbour

After being checked and sealed, the buoy is usually tested about 48 hours before deployment. We remove it from shore and moor it in the harbour and check if the buoy data is OK. If everything is OK, the buoy can be deployed. If there is some doubt about the signal we do not deploy and we check the buoy until it's OK.

2.2 Arrangement of anchor chain

Moorings fix the buoy to the seabed including mooring chain and anchor. Buoy design must account for the behaviour of the buoy given applicable wind, wave and current conditions and tanker sizes. This determines the optimum mooring arrangement and size of the various mooring leg components. According to the depth of the mooring point, moorings maybe include a few of anchor chains with the length of about 30 meters. After put the chain on the vessel deck, we connect the chains together and

arrange them in accordance with “S” shape. One end which is connected to the anchor is arranged at the end of the small vessel, and the other end which is connected to the buoy is put in the front of the small vessel. Because the vessel is small, the side of the deck may be used to arrange the chains.

2.3 Towage of buoy body

Two ropes are used to connect the buoy body and the small vessel. One is tied upper of the buoy body, and the other is tied down of the buoy body (Fig. 2). According to adjusting the length of the two ropes, the buoy body can follow with the small vessel keeping the balance in the sea. It can neither be embed into water, nor be excessive fade away. The speed of the small vessel does not exceed six knots.

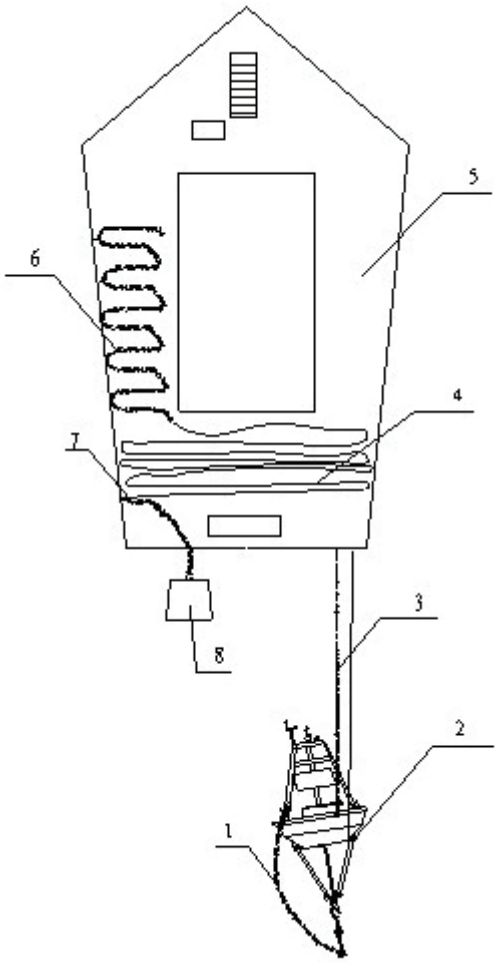

Fig. 2 Arrangement of anchor chain and towage of the buoy body 1) chain on buoy body; 2) buoy body; 3) towage rope; 4) chain Ⅰ; 5) small vessel; 6) chain Ⅱ; 7) rope fixed anchor, 8) anchor block.

3. Deployment

Here we employ anchor-last deployments. In anchor-last deployments the buoy body is deployed first and the mooring paid out as the pulley steams away from it. Wherever possible the line of deployment should be about 3 times the depth contour in which the buoy is to be deployed. Once all the mooring chain is in the water the anchor is deployed at the position which confers the greatest probability of it landing at the desired depth and location.

As shown in Fig. 3, the detailed deployment is described as follows. When the small vessel takes the buoy system including buoy body, mooring chain and anchor to the desired position, we stop the ship and choose one person as commander. Firstly, we put the movable pulley and fixed pulley in the front of the small vessel and use release rope to connect them together. One end of the release rope is coiled on the winch, and the other end is fixed on stable place. Secondly, we cross the chain II to the movable pulley and connect it and the chain on buoy body. Thirdly, the release rope is spooled off the winch and chain II is released into water. When the movable pulley is moved to the tail of the vessel, we fix the chain on the deck and move the movable pulley to the front of the vessel. At the same time, the release rope is spooled on the winch and the chain I is through the movable pulley. Fourthly, we repeat last step again and again, and all the chain is put into the water. Finally, we cut the rope fixed anchor and the anchor is released to the bottom of the sea and the buoy takes its place. So far we complete the buoy deployment.

If problems arise with gear, or if sea conditions become unfavourable during the deployment, it can be aborted, with mooring and buoy being hauled back[3].

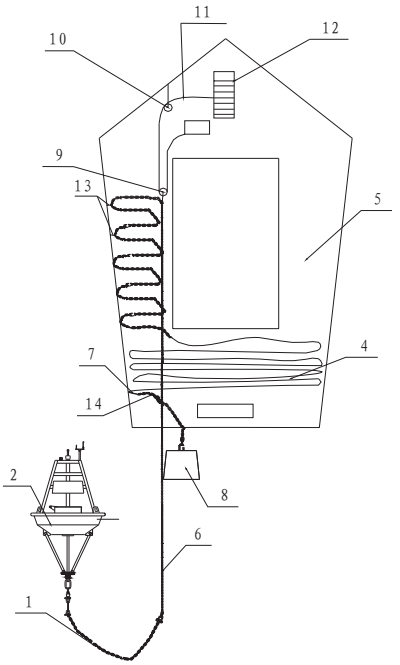

Fig. 3 Release process of the buoy based on small vessel 1) chain on buoy body; 2) buoy body; 3) towage rope; 4) chain Ⅰ; 5) small vessel; 6) chain Ⅱ; 7) rope fixed anchor, 8) anchor block; 9) movable pulley; 10) fixed pulley; 11) release rope; 12) winch; 13) ropes fixed chain, 14) chain Ⅲ.

4. Conclusion

Anchor-last deployments are much safer than other methods when small vessel is employed, and they permit adjustments during the deployment process. It should be pointed out that the anchor sinks after being deployed, the drag caused by the mooring rope increases dramatically[4]. Engineering studies have shown that, once the anchor is let go, tension on the mooring increases steadily as the anchor descends and reaches its highest point just before the moment of impact, when it is about equal to the static weight of the anchor. The result is that the anchor and the buoy move together in the horizontal dimension, each one being pulled by the other. But overall, this method is very effective way to deploy the buoy basing on small vessel.

Acknowledgment

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