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Development of Pneumatic Type Buoy for Surface and Subsea Region

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ABSTRACT

In this paper, development of new type buoy, pneumatic type buoy for surface (up to 20 meters water depth) and subsea region (up to 200 meters water depth) is introduced. Under the developments, several performance confirmation tests for prototype and model buoys were conducted, and the superior points against the existing buoy such as steel and plastic buoy are evaluated.

KEY WORDS: Buoy; pneumatic; mooring; surface; subsea; deep water.

INTRODUCTION

In recent years, deep-water development has been increased at offshore marine industry (e.g. T. Mikagawa, et al.; 1999). There are many studies about new mooring system for the marine terminal (B.P. Jacob, et al.; 1999, M. Francois; 1999, S. Chucheepsakul et al.; 1999). In this development, floater and buoy become one of the key equipments for the system. Usually steel buoy and plastic buoy are applied to the mooring system. However there are several issues on those buoys. For the steel buoy, the weight is heavy and it takes large space against net buoyancy, and the handling is not convenient. On the other hands, the plastic buoy is easy to be broken under severe usage. Furthermore each buoy is too hard for the operation because the contact or collision sometimes breaks the work ships, and the original shape is collapsed and not recovered if the buoy is used over its rated water depth due to the corresponding water pressure. In order to improve the issues for the existing floaters and buoys, a new pneumatic type buoy has been developed and applied for surface and subsea use; "GLOBUOY", which uses a unique design and manufacturing technology on automobile tires and pneumatic fenders. This pneumatic buoy is fulfilled with pressurized air inside the body. In order to confirm property of the buoy such as net buoyancy, handling on the operation and behavior under excess water depth, field test for a prototype buoy in size; 2.5m diameter by 5.5m length and in net buoyancy; about 20ton, was conducted. The rated water depth is specified as 20m and the internal air pressure of buoy is designed as 200kPa, which corresponds to the water depth. Through many field trial tests, the pneumatic buoy has been evaluated as an effective new buoy and floater. The development of the buoy is continuing to deeper rated water depth up to 200m as a subsea buoy.

In this paper, development of the pneumatic type buoy for surface and subsea region is described, and several evaluation tests under the offshore field tests and the factory tests are introduced.

PROBLEMS OF EXISTING BUOY

The existing buoys such as steel and plastic buoys have several problems at the usage. The problems are summarized as below.

1. heavy and hard
2. easy to be broken at severe usage
3. collision with the work ships
4. permanent deformation at the usage over the rated water depth
5. large space in storage

In order to solve the problems, development of a new type buoy was required for effective and cost saving offshore operation.

PNEUMATIC SURFACE BUOY

Design and Basic Structure

Design concept

Design concept of pneumatic type buoy is summarized as below.

1. rated water depth; 20 meters
2. buoy with shock absorber
3. Total pressure resistance at 20 meters water depth is induced by pressurized air inside the buoy.
4. The pneumatic buoy has enough endurable pressure against pressure at the rated water depth.
5. The minimum endurable pressure shall be larger than four times against the initial internal air pressure; 200kPa.
6. To save the space, it can be deflated easily

Basic structure

The basic structure of the surface pneumatic buoy is shown in Fig. 1. The buoy consists of outer rubber, synthetic cord layer and inner rubber as well as automobile tires and pneumatic fenders (ISO17357; 2002). When the mooring load for the buoy is too large to support it by the buoy itself effectively, chain net is attached on the buoy to support the mooring load.