

DESIGN OF A MARINE SEDIMENT TRAP AND ACCESSORIES

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ABSTRACT

The marine sediment trap and the mooring accessories were developed indigenously and were used successfully for the collection of settling sediments in the Arabian Sea. The experience gained in using sediment trap and further improvements incorporated are described in detail. The type of mooring, deployment and recovery method followed are discussed.

INTRODUCTION

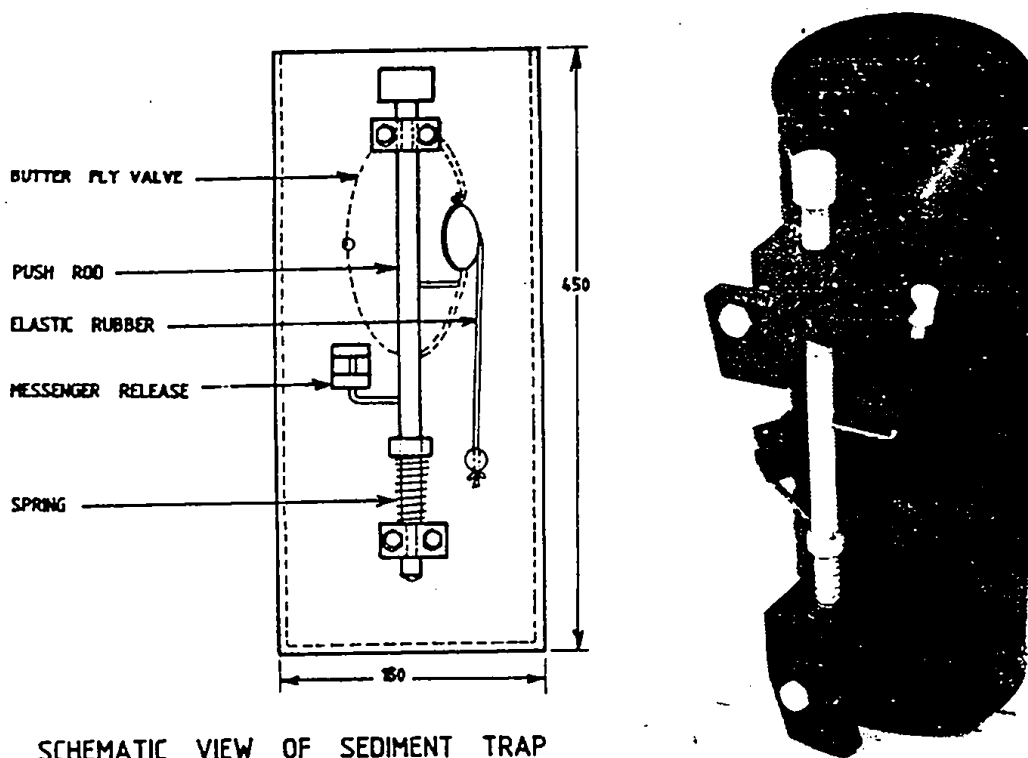
A moored sediment trap would help to measure the downward settling flux of particulate matter in standing waters at any desired location. Different type of sediment traps are reported by Sedøefield (1973), Fuhs, (1973) and Hackanson (1976) to name a few authors.

The moorings mostly deployed in India are confined to instruments for the collection of physical environmental parameters like waves and currents etc. The necessity for collecting the settling sediment particles has led to the indigenous design and development of a cylindrical sediment trap for the first time in 1984. Simultaneously, it has led to the development of various accessories like mooring line, cage for mooring floats, stainless steel shackles, thimbles, messengers and dead weight anchors.

The first set of sediment trap moorings were deployed off Marmugao at a depth of 9 m in May, 1984 and was recovered after a period of one week. The second set was deployed in Arabian Sea at depth of 90 m in April, 1985 and recovered after a period of three months. The third set was deployed within Marmugao estuary at 5 m water depth in February, 1986 and recovered after a week. Interpretation of data from the samples collected from the second set of moorings are discussed by V. Ramaswamy (1986).

DESIGN ASPECT OF SEDIMENT TRAPS

Two models were evolved in designing the sediment trap and in both the cases the traps made were of cylindrical type. In the first model, a cylindrical PVC pipe of 83 mm diameter and wall thickness 3.5 mm was used. The length of the trap was 710 mm. The bottom was sealed with 6 mm thick plexiglass disc using Araldite. This design was adopted for the first set of sediment trap mooring. The second design was made by incorporating certain additional features in the trap. In this model, a PVC pipe of 150 mm internal diameter with wall thickness of 5 mm was used. The length of trap designed as 450 mm. A butterfly closing valve, a push rod with a spring were incorporated. The butterfly valve can be activated to close by a falling messenger weight on the push rod and thereby releasing the tension on the elastic member.



SCHEMATIC VIEW OF SEDIMENT TRAP

FIG. 1

Summary of technical specification for the trap:

Cylindrical pipe	- Commercial quality PVC
Dimensions	- Length 450 mm; ID 150 mm; OD 160 mm
Elastic member	- Surgical quality rubber
Spring	- Stainless steel
Weight of the trap	- 2.8 kg.

The schematic diagram and the photograph the sediment trap is

shown in Fig.1. These improved version of the sediment traps were used in second and third set of moorings.

Messenger

In the second and third set of moorings in order to operate the closing mechanisms, messengers made out of stainless steel were used (Fig.2).



FIG. 2. MESSENGER.

Once the messenger is released by the timer, it travels through the mooring line and strikes the push rod in the sediment trap and thereby activates the closing mechanism. This releases the second messenger to close the second trap and so on.

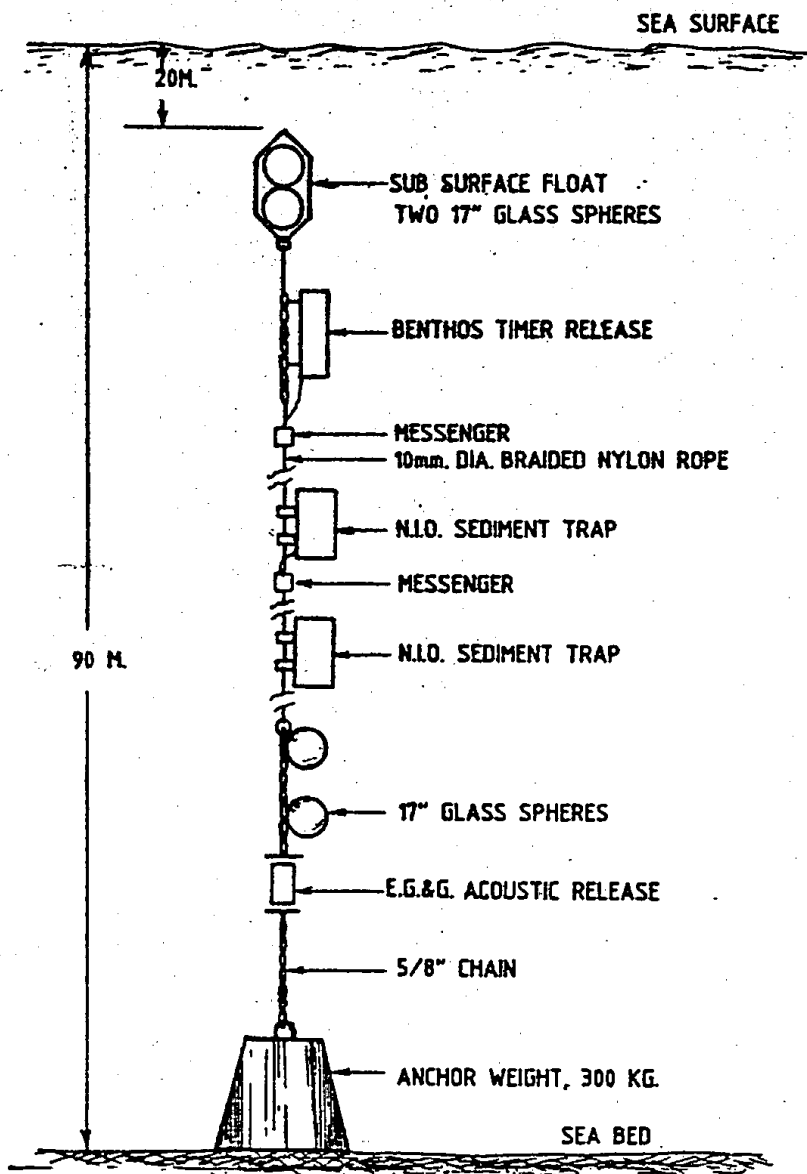
MOORING SYSTEM

Mooring lines

The typical sediment trap mooring used at 90 m water depth is shown in Fig. 3. For preventing galvanic corrosion sacrificial anodes were attached in the vicinity of dissimilar metals along the mooring line. The strumming effect (Bertheaux, 1976) is known to loosen the threaded fasteners. Hence all shackles were arrested by means of split pins or seizing wire and lock nuts and spring washers were used in all the bolted connections. Care was taken to avoid bi-metallic contacts.

In the first set of moorings stranded polypropylene rope of 12mm diameter was used. These stranded ropes were found to form too many kinks. For the second set of moorings the braided nylon rope of 10 mm diameter was used. The mooring lines were observed to be in good condition even after its three months stay underwater. Comparing to stranded ropes, the braided ropes possess better resistance to kinks. For the third set of moorings 6 mm PVC jacketed wire rope was used as the mooring line. The

ends of the mooring sections had been connected using thimbles and bulldog grips. The nuts of the bulldog grips were sealed with epoxy in order to avoid failure caused by loosening.



TYPICAL SEDIMENT TRAP MOORING SYSTEM
FIG. 3.

Cage for subsurface floats

The subsurface glass floats of 420 mm diameter were assembled in a stainless steel cage as shown in Fig.4, and they were assembled to the mooring line. As the floats are enclosed in the cage, it reduces the mooring assembly time at site and also avoids the direct load acting on the hard-hat of the glass float. The cage is fabricated in stainless steel-316 rod having a diameter of 10 mm. The weight of the empty cage is about 6 Kg.

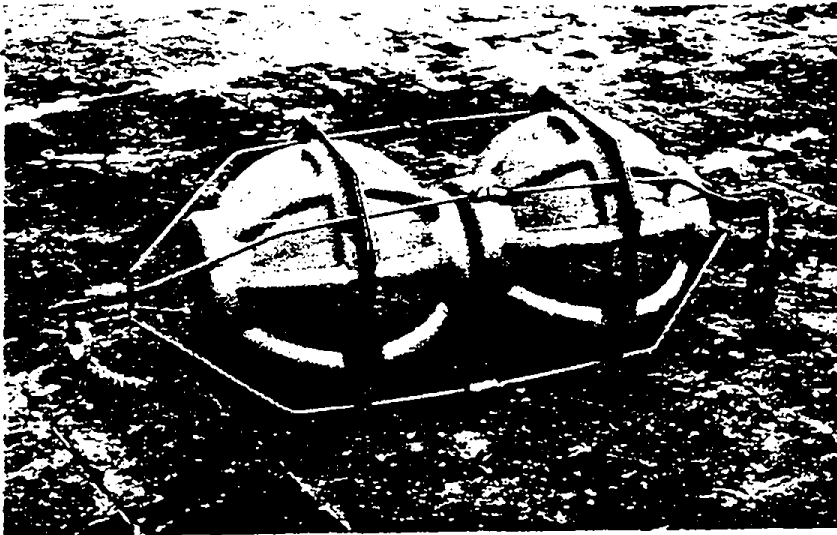


FIG. 4. CAGE FOR SUBSURFACE FLOAT.

Stainless steel shackles and thimbles

The material used for connecting different sections of the mooring lines such as shackles and thimbles play a vital role in the success of a mooring line. The S.S. shackles thus manufactured indigenously had been used in the first set of moorings. Hot dip galvanised shackles and thimbles were used in the second and third set of moorings in order to compare the performance with the S.S. accessories. After inspecting the corrosional features in the galvanised iron shackles it was found to be having satisfactory performance and the extra precaution of using S.S. shackles are deemed to be not very much essential.

Dead Weight Anchors

a) Steel chains b) Concrete blocks and c) Scrap cast iron blocks (Fig.5) were used as dead weight anchors in the first, second and third set of sediment trap moorings respectively. Non availability of anchor chains led to the design of concrete blocks for the second set of moorings. The disadvantage observed with the concrete blocks was their bulky weight (200 Kg and 100 Kg) and shape, causing inconvenience while transportation and deployment. As only a small canoe was available for

the third set of moorings deployment, dead weight anchors had been fabricated from four scrap cast iron blocks of 20 Kg each. These four modular blocks were assembled together onboard in to an 80 Kg anchor concrete weight and deployed manually. The problems created by a single huge concrete block can be overcome by using modular wheels of 40 to 50 Kg each, passed through a central shaft and bolted later on board to any desired (Fig.5d) weight.

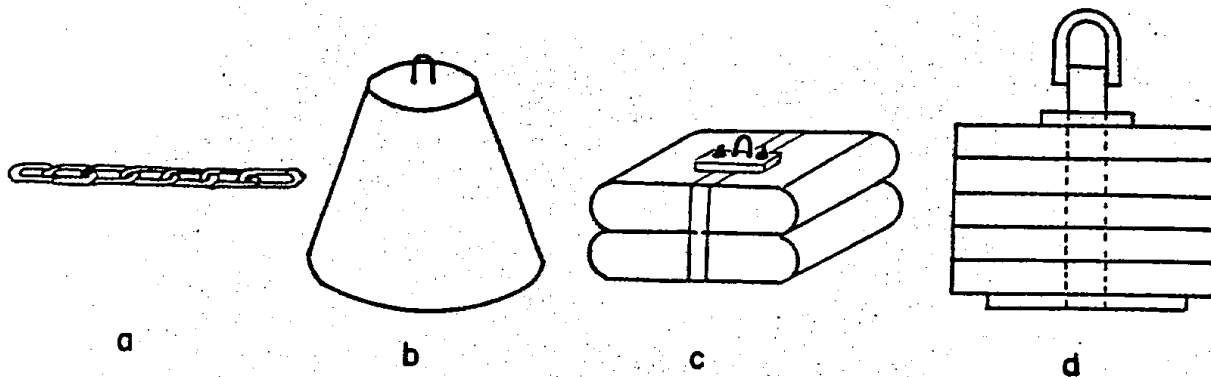


FIG.- 5. DEAD WEIGHT ANCHORS

Deployment and recovery

Anchor last method was followed for all the deployments. EG&G acoustic transponder release were used in the first and second set of moorings in order to facilitate the recovery. For the third set, the sediment traps were closed and brought to the surface, then the mooring lines were released from the anchor weight. Both these tasks were accomplished with the help of divers.

CONCLUSIONS

The indigenously developed sediment trap with mooring accessories were used successfully. The sediment trap having a closing mechanism meets the requirements satisfactorily for the collection of settling sediments in ocean environments. The ropes and mooring accessories available within the country had been successfully used. This has given the confidence to explore the possibilities of using indigenous materials for deep sea and longer duration moorings. Experience gained in the design, development, deployment and recovery of sediment trap mooring systems in shallow waters has enabled to take up deep sea sediment trap and other instrumental moorings with great confidence.

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