OSCOR

THE NEW UNDISTURBED SANDY SEDIMENT SAMPLER

BY

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Undisturbed sampling of sandy sediments is considered by marine scientists to be very difficult. Grabs of various design do generally provide a surface sample, but the sediment more-or-less disturbed. Gravity and piston corers are used extensively for undisturbed sampling of soft sediments. In most cases even a thin sand layer will, however, effectively inhibit penetration and core recovery except maybe for the heaviest of corers. Vibro-corers and hammer-corers are used rather extensively for sandy sediments but due to size and weight constraints their use is limited to large scale operations.

The need for a corer of reasonable size for easy undisturbed sampling of sandy sediments especially for environmental studies is obvious. OSCOR was developed at the Geological Survey of Finland for just this purpose.

Photo: courtesy of Dr. Cees Laban, Dutch Geological Survey
The name of the corer - OSCOR - is an acronym for oscillating corer, i.e. descriptive of its principle of operation. As any diver knows, it is virtually impossible to drive a pole or even a thin walled tube into a compact seafloor sand unless using an oscillating rotary motion sediment. The OSCOR (Figure 1) utilizes a reciprocating rotary motion to drive a plexiglas or polycarbonate core barrel (OD 100 mm) into the bottom. Power for the task is derived from a self contained battery operated 12 volt electric drill motor and transferred to the barrel via a spring loaded lever. A standard “hydrographic” wire winch with a 4 mm diameter wire, or a rope of equivalent tensile strength, is required for the deployment of the corer.

Figure 1. The OSCOR sampler for short cores of sandy sediments ready to be deployed overboard to stand freely on the bottom for the duration of the coring procedure. Battery operated drive motor starts automatically upon contact with the sea floor.
Figure 2. A schematic representation of the OSCOR and its main components. The drive motor, battery pack, and magnetic switch are mounted on a base plate that moves freely along vertical guide posts. The penetration into the bottom is based on the oscillatory movement of the core barrel and the weight of the unit. The plastic core barrel is attached to the oscillating drill head with a simple clamp arrangement. A piston arrangement prevents sample loss during the initial pull out of the core barrel from the sediment. The core barrel is automatically closed by the spring loaded core catcher blade once the lower end is above the bottom.

Principle of operation

The basic corer unit (Figure 2), in its stainless steel frame can be easily handled by two persons. Due to the weight saving construction, additional lead or stainless steel weights are provided both for extra corer stability and enhanced penetration. The corer can normally be deployed even from a small vessel although a power winch is recommended. The unit is simply lowered to the bottom, where the battery powered drive motor is activated by a bottom contact switch connected to the lifting harness. Depending on the type of sediment and the required length of sample the
The corer is left on the bottom to operate, with sufficient slack on the lifting wire, for 1 to 10 minutes before retrieving. The amount of penetration will depend on the amounts of weights used, the time run time and naturally the type of sediment (Figure 3).

The initial hoisting operation locks the piston inside the core barrel. At the same time the core catcher locking pin is freed. The piston within the core barrel helps to retain the sample within the barrel during the initial phase of retrieval. When the lower cutting edge of the core barrel passes the spring loaded core catcher it swing quickly out closing tightly the lower part of the barrel. On deck the air bleeder valve on top of the piston shaft is opened to allow air in under the piston. This permits the piston to be pulled up to its topmost position for easy removal of the core barrel and subsequent sample extraction or sub-sampling using a simple slicer device.

Figure 3. The plexiglas barrel containing a short core of sandy sediment removed from OSCOR after a short deployment. Thin layers of organic debris (black) can be seen separating different phases of sand deposition.

Frame

The corer is based on a tubular stainless steel frame (Figure 4). The two large base frames are hinged to the main body and fixed with telescopic braces. The telescopic brace is automatically locked either in its outward position or pulled in with the bases when folded up against the main frame for easy transportation. The drive unit and core barrel are fixed between two guide posts and the support for the core catcher. Due to its construction the frame is not capable of with-standing large lateral forces, e.g. encountered during hoisting if the ship is not exactly above the corer,
thus resulting in a sideways pull. If the corer is retrieved carelessly either the core barrel or the frame can be damaged.

Figure 4. The stainless steel tubular frame can be collapsed by unlocking the telescopic braces (struts) and folding the two base halves up against the main frame.

Drill unit

The components of the drill unit, i.e. the drive motor and core barrel, battery pack, magnetic reed relay on/off switch, are installed on a thick metal base (Figure 5). The centre piece with a nylon sleeve acts as the main bearing for the oscillating movement of the core barrel. The piston shaft penetrates through the centre of the sleeve and is fixed in place during the coring operation by a spring loaded ball lock unit.

The drive motor and the battery pack are installed on both sides of the centre piece. The drive motor is modified from a heavy duty Skill 12 volt battery operated power drill with a suitable reduction gear (two choices). The lower speed is used with the 100 mm core barrel. If a smaller diameter barrel is used the higher speed can be employed.
Figure 5. The drill unit with its components. Both the drive motor and the battery pack are encased in pressure proof housings and connected by pressure proof, easily detachable connectors. For charging the batteries the connector is pulled off and a similar connector attached to the charging unit is inserted. Depending on the type of sediment, varying number of weights can be used to facilitate penetration. The air bleeder valve is closed during coring, but opened prior to pulling the piston to its top position for easy removal of core barrel with sediment sample.

The drive motor is housed in a pressure proof housing. The shaft seal is a high precision, pressure compensated o-ring seal, good for a depth of 250 metres. The drive motor turns an eccentric which transfers the rotary motion of the motor into oscillating motion. Two spring loaded pegs on both sides of the eccentric roller convey the power to the transfer lever which turns the core barrel quickly back-and-forth with a 15 to 20 degree sector movement. The springs prevent the motor from being damaged in case the rotary friction on the core barrel exceeds the maximum output of the drive motor.
Electric system

The corer uses two hermetically sealed 6 volt 6 Ah VARTA lead-acid batteries connected in series to give 12 VDC. A spring loaded stainless steel magnetic switch, utilizing a reed-relay and a permanent magnet, actuates a heavy duty relay inside the pressure proof battery housing. The relay closes the circuit between the battery and the motor. This occurs when the OSCOR lands on the sea floor and slack is given to the hoisting cable. A cable with a SubConn water proof connector transfers battery power to the motor. In loosely packed sandy sediments generally 10 to 20 samples can be acquired per charge of batteries.

Coring operation

The OSCOR is an easy to use and reliable corer provided proper operational procedures are followed. Prior to using the corer care should be taken that the batteries are charged using the special VARTA automatic charging unit provided with the corer. All electric cables should be checked for proper connections.

Before installing the core barrel, the piston shaft should be pulled to its uppermost position. Close the air bleeder valve. Then install the core barrel carefully fitting it to the drive head and clamping it in place. The notch on the barrel head should mate with the stopper. Finally turn the core catcher lever and lock it in place using the long trigger pin (Figure 5). Before the pin can be engaged in the hole, it has first to be pulled slightly sideways against the spring. The corer is now ready to be hoisted overboard and lowered gently to the bottom.

Figure 5. The core barrel fixed to the drill unit showing clamp and core catcher cocking lever and locking pin.
Depending on the type of sediment the corer is allowed to operate on the bottom for several minutes up to 10 or even more minutes. This is a matter of experience. It is imperative that the hoisting wire runs vertically before lifting the corer off the bottom to prevent bending or breakage of the core barrel and/or the frame.

On deck the magnetic switch is fixed with the wedge supplied for the purpose to prevent the motor from operating when the tension on the hoisting wire is released. Now the bleeder valve is opened and the piston is pulled gently up by its shaft to facilitate removal of core barrel. Unlock the clamp and remove the barrel sliding it sideways. Cup a hand under the lower end of the barrel to prevent sample loss and move it to the optional slicing or extrusion device, whichever is to be used.

**Maintenance**

Regular maintenance of the OSCOR is limited to rinsing in fresh water after use and charging of batteries. A thin film of silicone grease should occasionally be applied to the mating surfaces on the pins of the SubConn connectors to ensure easy plugging and good water proofing.

*NOTE! Due to possible wear of the shaft seal the motor should not be operated out of the water except for testing for a few seconds prior to deployment.*