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VibeCore Application Note:

This application note is intended to answer typical questions and offer comments on the use of the VibeCore-D. It also provides some of the reasoning behind the design of the VibeCore. The VibeCore-D can take 2” or 3” diameter core samples and the new VibeCore-4D adds the ability to take a 4” diameter core sample. The SDI VibeCore can operate at up to 120 foot water depths and takes up to a 20 foot long core tube.

Some of the frequently asked questions ask about;

“Operating water depth”

The VibeCore is effective from virtually no water depth to about 100 feet or up to 200 feet if the deep water option is selected. The vibrating head goes underwater so there is no need for longer core tube than the sediment sample needed. Other systems you may be familiar with clamp onto the side of a core tube and the coring head needs to stay above water. This is not the case for the VibeCore.

“Core sample length”

We have taken 18 foot long samples with a 20 foot core tube on the VibeCore. We reached the point of refusal at about 18.5 ft. The VibeCore will reach refusal if it encounters large gravel, a root, rock or sediment with very low water content. Generally we find we reach refusal in man made lakes a few inches into the pre-impoundment material as the pre-impoundment material water content drops below 10 to 15% and has rocks and debris not usually transported a significant distance from the edge of a reservoir after impoundment.

“Core compression”

Another factor in core sampling is "core compression" This "core compression" term is a bit of a misnomer. Water is virtually incompressible and usually even less compressible when dealing with water saturated sediments. The core material does not compress. A more accurate description is that the material fails to enter the core tube.

Taking a look at the physical properties of what is going on during forcing or vibrating a core tube into the sediment, you are displacing material of a volume equal to the volume of core tube you force into the bottom. The thicker the core tube you use the more volume of material you must displace. Some of the large vibracoring devices use a thick-walled pipe with a plastic liner inside the pipe and a cutter head on this arrangement. The total thickness of the core pipe and liner plastic can exceed 1/4" wall thickness. These coring devices typically have large "core compression" in that the length of the core inside the core tube is considerably less than the depth to which the core tube was inserted.

Let us consider how this problem is created and how it becomes worse the deeper you go into the sediment. At 3 feet below the seafloor you must push a volume of material out of the way that is equal to the cross-sectional area of the core tube and liner times the 3-foot length of the core tube. The thicker the tube and liner the more material you must make room for in the sediment. This material must go somewhere. Unless you have a lot of trapped gas in the sediment so you can compress the gas, the only way to create this volume is to push up the surrounding sediment enough to create this volume. The deeper you go into the bottom the more difficult it is to push up the surrounding sediment to create the new volume for the core tube. There is more sediment on top of you the deeper you go. Sediment characteristics define how “fluid” the sediment is and how easy it is to create this motion of the surrounding sediment. As the sediment characteristics change the ability to create this motion in the sediment changes. It becomes obvious that the less volume you need to make for your core tube to penetrate the bottom, the less of a problem this surrounding sediment movement becomes. This is the reason the VibeCore-D uses a thin wall tube when vibrating to depth and one of the main reasons the small and light VibeCore-D can outperform much heavier and more power hungry systems.

Another problem with the other vibracore units comes from the use of a “cutter” on a core tube that is sloped outward from the center of the core. Using this cutter, you are forcing the displaced material to move away from the core sample and thus less material enters the inside of the core tube. The thin wall core tube on the VibeCore-D naturally cuts through obstructions without a thick walled cutter that reduces the material entering the core tube.

A lesser effect, but still worth considering, is the friction between the core tube and the surrounding sediment. The longer the core sample, the greater the resistance to material entering the core tube due to the result of friction between the core material inside the core tube and the core tube itself. The material that is inside the core tube resists moving further inside the core tube and the result is that less material enters the core tube the further down into the sediment you try to take the core. This is most significant in gravity cores as the resistance inside the core tube is many times that of a VibeCore device. The VibeCore works by vibrating the entire core tube at such a high frequency that the interstitial water in the sediment particulate becomes a lubricant for the particulate and the material becomes liquid. This effect is localized to the material immediately adjacent to the core tube. The thickness of this layer is dependant on the grain size, grain size distribution and the water content. However with sufficiently high vibrating frequency and reasonably small grain size, the typical disturbed layer is only a mm or two thick and the rest of the core is undisturbed. The high operating frequency of the VibeCore-D aids in this liquefaction of the sediment.

Using a thin wall rigid core tube on the VibeCore-D, you can typically achieve 90 to 95% or more capture of sediment inside the core tube as compared to the penetration depth. Thicker walled vibracore devices and gravity cores achieve a considerably lower ratio of sample length to penetration depth. A significant problem created by this displacement is the depth of the material inside the core tube is not well related to the depth at which it originally occurred. This effect is also non-linear with more "compression" occurring at deeper penetration due to the difficulty in moving buried sediment out of the way. It also changes with material characteristics. A thin wall core tube driven by a VibeCore operating at high frequency minimizes this sample unknown and sample loss. You get a more accurate representation of the sediment depth and the true vertical distribution of the sediment.

“Capture of soft upper sediment layers”

Another subject we addressed in designing this VibeCore unit was the design of a check valve that closes when the core tube is retrieved. The older existing designs we investigated used a spring loaded valve that stays closed until the pressure of the sediment entering the bottom of the tube forces the valve to open. When open, the water in the tube can escape out the top of the core tube thus allowing the sediment to flow into the core tube. There is a problem with light aqueous mud on the top of firm sediment as this mud generates insufficient pressure to open or

to fully open a spring loaded valve. The water trapped inside the core tube will not displace and the softer sediment materials encountered at the bottom of the core tube are rejected. We designed a light check valve for the VibeCore-D that virtually floats open as the VibeCore is lowered through the water column thus assuring that the light material can enter the core tube. If you are interested in capturing the light deposits on the top of the sediment this will allow you to do so. The valve consists of a light aluminum plate with a series of cast polymer half o-rings molded to the bottom of the plate. It functions well as a check valve but improves the ability of the VibeCore-D to capture the entire sediment column.

“Why the VibeCore-D and why does it perform as well or better?”

By way of a little more background, we decided to build the VibeCore as a result of a customer that used our acoustic sediment mapping system to survey reservoirs in upstate New York. These were very old reservoirs and no roads existed to them. All boats and materials had to be hand-carried in to the lake. The acoustic survey showed a hard layer about 6 feet below the bottom with the possibility of more material below this layer. It was not possible to map anything deeper with acoustics so we recommended they take core samples. This would be very expensive as they would need to cut a road in to bring in a boat, a generator and a vibracoring device. They opted to not do so. The hard layer turned out to be gravel transported in during the 1954 hurricanes. This deposited material masked significantly more sediment below the layer. The additional dredging cost was high and unanticipated. It was obvious there was a need for a more transportable core sampler. We decided to design a more efficient coring device that could be hand carried and yet return a similar core sampling capability.

Looking at the design of the then present coring devices it was apparent there could be improvements. They typically use a large AC motor in pressure housing with added weights and an AC generator to supply enough energy to vibrate this large mass. The VibeCore-D was designed to use a light weight, high energy motor which we seal and pot inside a rigid aluminum light frame. This assembly vibrates very well but is too light to drive the core tube. We added the necessary weight, not by coupling it to the VibeCore head, but by casting a ring weight that sits on rubber bumpers. The bumpers are about 99% efficient springs. The result is that we get the necessary downloading without losing energy in accelerating the weigh up and down. Most of the energy used to compress the bumpers is returned. We calculate that other machines get about 12% of their energy into the core tube while we estimate we achieve closer to 60% of the energy into the core tube. The increased efficiency allows us to run our VibeCore from a pair of car batteries. The Vibecore-D still requires a lot of power but for a very short period of time. This is exactly what a car battery is good at providing. Since the VibeCore-D is on for less than a minute for each core, even a small set of car batteries can supply all the energy needed to take core samples for several days without recharging. Recharging every night is still recommended as it prolongs the life of the battery to keep it near full charge.

“Optional equipment available from SDI”

Winches
Looking at the boats and required lifting capability, you may have more than will be needed. We use a 2,600 lb. rated hand winch and probably rarely need to pull more than about 300 to 500 lbs. to break the core free from the bottom. A 20 foot core in the right sediment and the pull could go higher. There is the option of switching on the VibeCore for a second as we try to pull the core tube up. This can break it free of the bottom and ease the recovery of the core. Of course, we like to limit this as it can cause a loss of core sample.

“Coring in shallow water”

Coring Frame
There are an endless number of conditions under which you may want to take cores. Sometimes the problem is not deep water but the lack of it. In this case, taking a very long core sample may be difficult. You may not have the height to lift the VibeCore for the core tube to fully clear the water bottom.

One intrepid user built a tall frame on a wooden platform to take cores with virtually no water.

Using a boat in very shallow water this may require a lifting frame that is nearly as high as your maximum core tube length. Another user pulled his core tubes with a two step operation by throwing a line over the frame and tying it to the core tube to get the last foot or so of lift needed to retrieve his core. SDI offers a coring frame with additional leg extensions to avoid this problem.

The light weight and portability of the VibeCore allows taking deep core samples from very small boats. The picture to the left shows 10 foot core samples pulled while using a pair of 12 foot Jon boats. The Jon boat rig is available from SDI.

“Dual Jon Boat option”

SDI offers the DJB-1243 as a way to take cores in areas without a boat ramp. The DJB is a matched pair of Jon boats which we have modified to allow you to join them into one stable work platform. The SDI coring frame attaches directly to the DJB, a core tube rack is included along with several other items that make taking cores in small lakes simple.

“Coring in deeper water”

Deep Water Option

The VibeCore-D has an option for taking cares in up to 140 foot water depths. The VibeCore users to the left rigged an inverter to the batteries and used a power drill to speed up core retrieval when taking cores in 140 foot water depths.

“Core Retention”

Keepers
In most cases the problem is more how to get the sample out of the core tube not keeping it in the core tube. The times when keepers are useful include coring in soft material with too short a core tube to allow the core to reach the point of refusal. for instance if the core tube is 6 feet long and there is 10 feet of soft high water content silt before you get to firm sand or clay, then the soft silt may try to fall out before you get a chance to cap it. A longer core tube would cure this problem as the firm sediment could be reached and the core recovered. If all you have is short core tubes on board, the keepers are handy.


Installing a keeper in the core tube.

“Retrieving your Core Sample”

Hard packed sand is very hard to push out. You can “Vibe” is out by turning on the VibeCore or try chipping it out.

Keepers that can be installed in the core tubes while on board the boat but find probably 90% or more of the time they are not needed. Some of the EPA users and those working for the EPA may be required to use a standard procedure that includes the use of keepers. In most other applications core keepers are not needed.

Another approach is to cut the core tube length wise for sampling. The downside to this is the sacrificing of the core tube.

12 foot core tubes cut lengthwise

“Core Tube Sizes”

The VibeCore has interchangeable adapters so you can use many types of core tube on the same VibeCore. We offer 2" plastic and aluminum, 3" plastic, aluminum core tubes. The new 4” VibeCore is now available for 4” aluminum or plastic core tube. The plastic is clear and comes as either Acrylic or Polycarbonate depending on your needs. We custom make core tube adapters for the core tube available locally to the user and find this an advantage for overseas users. The adapters can be changed on the boat in about 5 minutes should you need to take multiple cores for differing applications.

“Boat Mountable Frame”

We also offer a coring frame that gives you about 8 feet of lift above the deck and extensions for those that want more lift. These leg extenders can provide another few feet of lift. For long cores we don't try to lift a full core length. Usually if you can pull the core tube free of the bottom and the VibeCore head a few feet or more above the deck, then we walk the coring head aft (coring off the bow) so we can get to the end of a long core and cap it. Shorter cores we lift above the deck to cap the bottom.

Ask for our set of pictures from some of our users so you can see some of the many rigs they have used to collect and sample the cores.

“Float/Weight Option”

SDI offers a float and weight ring option that assists taking cores in currents or deep waters. A set of floats are suspended above the VibeCore head from a set of weight rings around the bottom of the core tube. When the VibeCore is turned on, the VibeCore slides down these ropes. This keeps the VibeCore vertical until it is well into the sediment. In most cases this will not be needed.

“Availability”

The standard availability is quoted as 1 to 2 weeks. However, the VibeCore-D is usually available from stock from SDI. We do prefer at least a one to two day warning so we can fit the adapter for your pipe size and close the shipping crate for shipment. SDI also maintains several rental units. The majority of users that rent the VibeCore opt to keep them by exercising their option to convert the lease to a purchase. SDI can provide a frame and mounting feet for a pontoon boat. This rig is designed to make tilting the frame down and laying it on the deck or removing it easy. Some of our users need to pass under low bridges and the tilt-down is handy. It is also good if you are transporting the boat on roads. We supply rotating feet that are bolted to the deck. The frame slides into and is pinned into these feet when in use.

SDI’s Vibecore-D is designed to make taking core samples a simple task. We stock core tubes in acrylic, polycarbonate, and aluminum.

Please let us know how we can help you with your coring needs. Contact Paul Higley or Ruth Josey at 972 429 7240.