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Agency

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Innovative Technology Verification Report

Sediment Sampling Technology

Arts Manufacturing & Supply, Inc. Split Core Sampler for Submerged Sediments

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, DC 20460

Environmental Technology Verification Program
Verification Statement

TECHNOLOGY TYPE: **Sediment Sampler**

APPLICATION: **CORE SAMPLING OF SEDIMENT**

TECHNOLOGY NAME: **ART'S MANUFACTURING & SUPPLY, INC., SPLIT CORE SAMPLER FOR SUBMERGED SEDIMENTS**

COMPANY: **ART'S MANUFACTURING & SUPPLY, INC.**
ADDRESS: **105 HARRISON**
AMERICAN FALLS, IDAHO 83211

WEB SITE: **http://www.ams-samplers.com**

TELEPHONE: **(208) 226-2017**

VERIFICATION PROGRAM DESCRIPTION

The U.S. Environmental Protection Agency (EPA) created the Superfund Innovative Technology Evaluation (SITE) and Environmental Technology Verification (ETV) Programs to facilitate deployment of innovative technologies through performance verification and information dissemination. The goal of these programs is to further environmental protection by substantially accelerating the acceptance and use of improved and cost-effective technologies. These programs assist and inform those involved in design, distribution, permitting, and purchase of environmental technologies. This document summarizes results of a demonstration of the Split Core Sampler for Submerged Sediments (Split Core Sampler) designed and fabricated by Art's Manufacturing & Supply, Inc.

PROGRAM OPERATION

Under the SITE and ETV Programs, with the full participation of the technology developers, the EPA evaluates and documents the performance of innovative technologies by developing demonstration plans, conducting field tests, collecting and analyzing demonstration data, and preparing reports. The technologies are evaluated under rigorous quality assurance (QA) protocols to produce well-documented data of known quality. The EPA National Exposure Research Laboratory, which demonstrates field sampling, monitoring, and measurement technologies, selected Tetra Tech EM Inc. as the verification organization to assist in field testing two sediment sampling technologies. This demonstration was funded by the SITE Program.

DEMONSTRATION DESCRIPTION

In April and May 1999, the EPA conducted a field demonstration of the Split Core Sampler along with one other sediment sampler. This verification statement focuses on the Split Core Sampler; a similar statement has been prepared for the other sampler. The performance and cost of the Split Core Sampler were compared to those of two conventional samplers (the Hand Corer and Vibrocorer), which were used as reference samplers. To verify a wide range of performance attributes, the Split Core Sampler demonstration had both primary and secondary objectives. Primary objectives for this demonstration included evaluating the sampler's ability to (1) consistently collect a given volume of sediment, (2) consistently collect sediment in a given depth interval, (3) collect samples with consistent characteristics from a homogenous layer of sediment, (4) collect a representative sample from a clean sediment layer below a contaminated sediment layer, and (5) be adequately decontaminated. Additional primary objectives were to measure sampling time and estimate sampling costs. Secondary

objectives included (1) documenting the skills and training required for sampler operation, (2) evaluating the sampler's ability to collect samples under a variety of site conditions, (3) assessing the sampler's ability to collect an undisturbed sample, (4) evaluating sampler durability, and (5) documenting the availability of the sampler and its spare parts. To ensure data usability, data quality indicators for precision, accuracy, representativeness, completeness, and comparability were also assessed based on project-specific QA objectives.

The Split Core Sampler was demonstrated at sites in EPA Regions 1 and 5. At the Region 1 site, the sampler was demonstrated in a lake and wetland. At the Region 5 site, the sampler was demonstrated in a river mouth and freshwater bay. Collectively, the two sites provided multiple sampling areas with the different water depths, sediment types, sediment contaminant characteristics, and sediment thicknesses necessary to properly evaluate the sampler. Based on the predemonstration investigation results, demonstration objectives, and site support facilities available, (1) the Hand Corer was used as the reference sampler in the lake, wetland, and freshwater bay and (2) the Vibrocorer was used as the reference sampler in the river mouth. A complete description of the demonstration and a summary of its results are available in the "Innovative Technology Verification Report: Sediment Sampling Technology—Art's Manufacturing & Supply, Inc., Split Core Sampler for Submerged Sediments" (EPA/600/R-01/009).

TECHNOLOGY DESCRIPTION

The Split Core Sampler is an end-filling sampler designed to collect undisturbed core samples of sediment up to a maximum depth of 4 feet below sediment surface (bss). The sampler collects samples from the sediment surface downward, not at discrete depth intervals. Sampler components include one or more split core tubes, couplings for attachment to additional split core tubes, a ball check valve-vented top cap, a coring tip, one or more extension rods, and a cross handle. All these components are made of stainless steel; carbon-steel extension rods are also available from the developer. The sampler may be used with a core tube liner to facilitate removal of an intact sample from the split core tube. To collect a sediment sample, the sampler can be either manually pushed into the sediment using the cross handle or hammered into the sediment using a slide-hammer or an electric hammer. The check valve in the sampler's top cap allows water to exit the sampler during deployment and creates a vacuum to help retain a sediment core during sampler retrieval. The sampler can be retrieved by hand, by reverse hammering using the slide-hammer, or by using a tripod-mounted winch.

VERIFICATION OF PERFORMANCE

Key demonstration findings are summarized below for the primary objectives.

Consistently Collecting a Given Volume of Sediment: In the shallow depth interval (0 to 4 inches bss), to collect a specified number of samples, the Split Core Sampler required 7 percent more attempts than expected (46 actual versus 43 expected), whereas the reference samplers required 14 percent more attempts than expected (49 actual versus 43 expected). In the moderate depth interval (4 to 32 inches bss), the Split Core Sampler required 38 percent more attempts than expected (40 actual versus 29 expected), but the reference samplers required 156 percent more attempts than expected (64 actual versus 25 expected).

For the shallow depth interval, mean sample recoveries ranging from 89 to 100 percent were achieved by the Split Core Sampler, whereas mean sample recoveries for the reference samplers ranged from 85 to 100 percent. The variation in sample recoveries as measured by their relative standard deviations (RSD) ranged from 0 to 26 percent for the Split Core Sampler, whereas the reference samplers' RSDs ranged from 0 to 33 percent. For the moderate depth interval, mean sample recoveries ranging from 37 to 100 percent were achieved by the Split Core Sampler, whereas the reference samplers' mean sample recoveries ranged from 21 to 82 percent. The RSDs for the Split Core Sampler ranged from 0 to 51 percent, whereas the reference samplers' RSDs ranged from 3 to 161 percent.

Consistently Collecting Sediment in a Given Depth Interval: Both the Split Core Sampler and reference samplers collected samples in shallow and moderate depth intervals in all demonstration areas, which contained various sediment types. No sampler was able to collect samples in the deep depth interval (4 to 11 feet bss). For the shallow depth interval, the Split Core Sampler's actual core lengths equaled the target core length in 96 percent of the total sampling attempts. The reference samplers' actual core lengths equaled the target core length in 94 percent of the total sampling attempts. For the moderate depth interval, the Split Core Sampler's actual core lengths equaled the target core length in 39 percent of the total sampling attempts. The reference samplers' actual core lengths equaled the target core length in 13 percent of the total sampling attempts.

Collecting Samples with Consistent Characteristics from a Homogenous Layer of Sediment: Based on particle size

distribution results, both the Split Core Sampler and reference samplers collected samples with consistent physical characteristics from two homogenous layers of sediment (a sandy silt layer and a clayey silt layer).

Collecting a Representative Sample from a Clean Sediment Layer Below a Contaminated Sediment Layer: In sampling a clean sediment layer below a contaminated sediment layer, the Split Core Sampler and reference sampler (the Hand Corer) collected samples whose contaminant concentrations were statistically different at a significance level of 0.05. Arsenic concentrations in the samples collected by the Split Core Sampler were less than those in the samples collected by the Hand Corer. However, because of the greater opportunity for sample compaction in the Split Core Sampler, no conclusion could be drawn regarding this sampler's ability to collect representative samples from a clean layer below a contaminated layer.

Sampler Decontamination: Both the Split Core Sampler and reference samplers demonstrated the ability to be adequately decontaminated after sampling in areas contaminated with either polychlorinated biphenyls or arsenic.

Sampling Time: Compared to the reference samplers, the Split Core Sampler reduced sampling time by 15 to 52 percent in three of the four areas sampled but increased the sampling time by 8 percent in the remaining area.

Sampling Costs: Of the sampling costs estimated for two of the four areas sampled, in one area the sampling costs for the Split Core Sampler were 95 percent less than those for the reference sampler (the Vibrocorer), and in the other area the sampling costs for the Split Core Sampler were 8 percent more than those for the reference sampler (the Hand Corer).
Key demonstration findings are summarized below for the secondary objectives.

Skill and Training Requirements: The Split Core Sampler, like the Hand Corer, is easy to operate and requires minimal skills and training. However, operation of the Vibrocorer is relatively complicated and requires moderate skills and training. The Split Core Sampler was operated by one person, whereas the Hand Corer was operated by one or two persons and the Vibrocorer was operated by two persons. When more than two extension rods were required, the Split Core Sampler and Hand Corer were operated using a tripod-mounted winch. The Vibrocorer operation required a motor-operated winch because of the weight of the sampler.

Sampling Under a Variety of Site Conditions: Both the Split Core Sampler and reference samplers collected samples in shallow and moderate depth intervals in all demonstration areas, which contained various sediment types. No sampler was able to collect samples in the deep depth interval (4 to 11 feet bss). For more efficient recovery of samples, an electric hammer should be used to induce vibrations in the Split Core Sampler; a 110-volt power supply is required to operate the electric hammer. The Vibrocorer requires a three-phase, 230- or 440-volt, 50- to 60-hertz power supply, which is a sampler limitation if the power supply fails. The Hand Corer does not require a power supply.

Collecting an Undisturbed Sample: Based on visual observations, both the Split Core Sampler and reference samplers collected partially compressed core samples of consolidated and unconsolidated sediments from the sediment surface downward. Samples collected by both the Split Core Sampler and reference samplers in moderate and deep depth intervals may be of questionable representativeness because of core shortening and core compression. Sediment stratification was preserved for both consolidated and unconsolidated sediments in the samples collected by the Split Core Sampler and reference samplers.

Sampler Durability and Availability: Based on their materials of construction and engineering designs, both the Split Core Sampler and reference samplers are considered to be sturdy. The Split Core Sampler and its support equipment are not expected to be available in local retail stores. Similarly, the primary components of the Hand Corer and Vibrocorer are not expected to be available in local retail stores; extension rods for the Hand Corer may be locally available.

Based on the demonstration results, the Split Core Sampler can be operated by one person with minimal skills and training. For more efficient recovery of samples, an electric hammer should be used to induce vibrations in the sampler. When more than two extension rods are used, a winch is recommended for sampler operation. The sampler is designed to collect sediment samples up to a maximum depth of 4 feet bss and, based on visual observations, collects partially compressed samples of both consolidated and unconsolidated sediments from the sediment surface downward; sample representativeness may be questionable because of core shortening and core compression. The sampler preserves sediment stratification in both consolidated and unconsolidated sediment samples. The Split Core Sampler is a good alternative to conventional sediment samplers. As with any sampler selection, the user must determine the appropriate sampler for a given application based on project-specific data quality objectives.

Gary J. Foley, Ph.D.

Director
National Exposure Research Laboratory
Office of Research and Development

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