United States
Environmental Protection
Agency

Office of Research and
Development
Washington DC 20460

EPA/600-R-01/009
December 1999

Innovative Technology Verification Report

Sediment Sampling Technology

Aquatic Research Instruments Russian Peat Borer

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: **AQUATIC RESEARCH INSTRUMENTS RUSSIAN PEAT BORER**

COMPANY: **AQUATIC RESEARCH INSTRUMENTS**
ADDRESS: **1 HAYDEN CREEK ROAD**
LEMHI, IDAHO 83466

WEB SITE: **http://www.aquaticresearch.com**

TELEPHONE: **(208) 756-8433**

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 Russian Peat Borer designed and fabricated by Aquatic Research Instruments.

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 Russian Peat Borer along with one other sediment sampler. This verification statement focuses on the Russian Peat Borer; a similar statement has been prepared for the other sampler. The performance and cost of the Russian Peat Borer 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 Russian Peat Borer 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 Russian Peat Borer 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—Aquatic Research Instruments Russian Peat Borer" (EPA/600/R-01/010).

TECHNOLOGY DESCRIPTION

The Russian Peat Borer is a manually driven, chambered-type, side-filling core sampler designed to collect discrete, relatively uncompressed sediment samples. Sampler components include a stainless-steel core tube, aluminum extension rods, a stainless-steel turning handle, and a Delrin® core head and bottom point that support a stainless-steel cover plate. The cover plate and bottom point are sharpened to minimize sediment disturbance during sampler deployment. The core tube is hinged to the cover plate by two pivot pins at the top and bottom of the plate. Support equipment for the sampler may include a slide-hammer mechanism to aid sampler deployment and retrieval in consolidated sediment. To collect a sediment sample, the Russian Peat Borer is manually inserted into sediment, and the core tube is turned 180 degrees clockwise. This procedure allows the core tube to rotate and its sharp edge to longitudinally cut through the sediment, collecting a semicylindrical sediment core. While the core tube is manually turned, the stainless-steel cover plate provides support so that the collected material is retained in the core tube.

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 below sediment surface [bss]), to collect a specified number of samples, the Russian Peat Borer required 33 percent more attempts than expected (65 actual versus 49 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 Russian Peat Borer required 21 percent more attempts than expected (46 actual versus 38 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 71 to 84 percent were achieved by the Russian Peat Borer, 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 26 to 42 percent for the Russian Peat Borer, whereas the reference samplers' RSDs ranged from 0 to 33 percent. For the moderate depth interval, mean sample recoveries ranging from 75 to 101 percent were achieved by the Russian Peat Borer, whereas the reference samplers' mean sample recoveries ranged from 21 to 82 percent. The RSDs for the Russian Peat Borer ranged from 6 to 31 percent, whereas the reference samplers' RSDs ranged from 3 to 161 percent. (Note: sample recoveries exceeding 100 percent resulted from the volumetric measurement error associated with the presence of void spaces when the sediment was transferred to a graduated container.)

Consistently Collecting Sediment in a Given Depth Interval: The Russian Peat Borer collected samples in all depth intervals and demonstration areas, which contained various sediment types. The reference samplers were unable to collect samples in the deep depth interval (4 to 11 feet bss). For the shallow depth interval, the Russian Peat Borer's actual core lengths equaled the target core length in 98 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. However, the results for the samplers were significantly different for the moderate depth interval: 93 percent for the Russian Peat Borer compared to 13 percent for the reference samplers.

Collecting Samples with Consistent Characteristics from a Homogenous Layer of Sediment: Based on particle size distribution results, both the Russian Peat Borer 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: The Russian Peat Borer collected samples from a clean sediment layer below a contaminated sediment layer that were at least as representative as the samples collected from the clean layer by the reference sampler (the Hand Corer); contaminant concentrations in the samples collected by both samplers were not statistically different at a significance level of 0.05.

Sampler Decontamination: Both the Russian Peat Borer 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 Russian Peat Borer not only was able to collect samples in all depth intervals and demonstration areas but also reduced sampling time by 16 to 77 percent, depending on the area.

Sampling Costs: Of the sampling costs estimated for two of the four areas sampled, in one area the sampling costs for the Russian Peat Borer were 90 percent less than those for the reference sampler (the Vibrocorer), and in the other area the sampling costs for the Russian Peat Borer were 22 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 Russian Peat Borer, 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 Russian Peat Borer 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 Hand Corer was operated using a tripod-mounted winch. The Vibrocorer operation required a motor-operated winch, whereas the Russian Peat Borer was operated without a winch throughout the demonstration.

Sampling Under a Variety of Site Conditions: The Russian Peat Borer collected samples in all depth intervals and demonstration areas, which contained various sediment types. The reference samplers were unable to collect samples in the deep depth interval (4 to 11 feet bss). Neither the Russian Peat Borer nor the Hand Corer requires a power supply. In contrast, 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.

Collecting an Undisturbed Sample: The Russian Peat Borer collected representative core samples of consolidated sediment in discrete depth intervals. Visual observations indicated that these samples were relatively uncompressed. In addition, the Russian Peat Borer collected sediment samples containing live biota. The reference samplers collected relatively compressed core samples of both consolidated and unconsolidated sediments from the sediment surface downward. In moderate and deep depth intervals, samples collected by the reference samplers may be of questionable representativeness because of core shortening and core compression. In the samples collected by the Russian Peat Borer, sediment stratification was preserved for consolidated sediment but not for unconsolidated sediment. Sediment stratification was preserved for both consolidated and unconsolidated sediments in the samples collected by the reference samplers.

Sampler Durability and Availability: Based on their materials of construction and engineering designs, both the Russian Peat Borer and reference samplers are considered to be sturdy. The Russian Peat Borer 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 Russian Peat Borer can be operated by one person with minimal skills and training and does not require support equipment such as a winch and power source even when collecting sediment samples at depths up to 11 feet bss. The sampler can collect representative and relatively uncompressed samples of consolidated sediment in discrete depth intervals. The sampler preserves sediment stratification in consolidated sediment samples, but sediment stratification may not be preserved in unconsolidated sediment samples. The Russian Peat Borer is a superior alternative to conventional sediment samplers, particularly for sampling consolidated sediment. 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

NOTICE: EPA verifications are based on an evaluation of technology performance under specific, predetermined criteria and appropriate quality assurance procedures. The EPA makes no expressed or implied warranties as to the performance of the technology and does not certify that a technology will always operate as verified. The end user is solely responsible for complying with any and all applicable federal, state, and local requirements.