FRACTIONAL WATER-SEDIMENT SAMPLER[1]

WILLIAM H. HEINEMANN AND MELVIN J. BROWN[2]

ABSTRACT

The fractional water-sediment sampler enables collecting large-volume representative samples of water and sediment from surface drainage streams. Free fall-flow, such as obtained at drop structures, is required for the operation of the sampler. The total sediment-laden water flow sampled can be split to 50 or 25% of the original sampled flow before being directed to containers by adding one or two splitting stages.

Additional Index Words: **water samples, sediment, pollution, splitter.**

A STUDY to determine the sediment concentration in irrigation canals and surface drains in southern Idaho required large volume, representative sediment-laden water samples. The streams involved varied in width, depth, and velocity of flow. The sediment load, of course, is not uniform in either the vertical or horizontal plane. When the depth and velocities of the streams where "grab" sampling, i.e. holding a bucket in nappe of a drop structure, became impractical, a sampling device was needed. The DH-48 depth-integrating sampler, which uses a pint bottle or even the modified version using a quart bottle, did not collect enough volume of the sediment-laden water required for this analysis.[3] Also with this newly developed water-sediment sampler, the results may not be as nearly dependent upon the skill of the operator as with the DH-48 depth-integrating sampler.

A sampler was developed to collect the full vertical profile at one time, and by moving the sampler across the stream width it collects a fully integrated representative sample of the sediment-laden water. It was designed to operate at the nappe of a drop or check structure having a fall of 30 cm or more. When the flow through the sampler is too large to handle conveniently, splitter stages can be added to subdivide the flow to either 50 or 25% of the original volume (Fig. 1). A total drop of 45 cm (18 inches) is required with one splitter, and 60 cm (24 inches) is required when two splitters are used.

Design

The sampler was made from 16 gage galvanized sheet metal with a slot 3.17 mm wide and 45.72 cm long. The sampler is expanded in a triangular shape so that the least amount of restriction occurs after the flow enters the slot (Fig. 2).

When the flow is to be split and reduced, the mixer-splitter section must be attached. The mixer is a 5.1 cm diameter conduit, 8.9 cm long, with a normally closed spring loaded disk at the bottom. The plunger bearing is machined to close tolerance so side play is negligible. The spring tension permits the disk to open with about 2 cm of water in the mixer. When the sampler is held level and as the depth in the mixer increases, the water is forced out evenly around the perimeter of the disk and directed downward into the splitter.

The splitter is an inverted cone divided into six equal segments. Three divisions are open to the funnel below and three are covered so the water is returned to the stream. The splitter is made of 28 gage galvanized sheet metal with rolled threads. A half sample can be collected by attaching the adapter for plastic tubing to the first splitter or it can be again split in half with the second splitter. The second splitter is identical with the first except for the threaded ends.

A metal point at the lower end of the sampler helps hold the sampler on the wood face of the drop structures. If the face of the drop structure is concrete, a hook, rather than a point, can be used.

The sampler is designed to be held 30 degrees up from the

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[2] Machinist Lead Foreman and Soil Scientist, respectively, Snake River Conservation Research Center, Kimberly, Idaho, 83341.

[3] Knisel, Walter G., Jr., and Ralph W. Baird. 1970. Depth integrating and dip samplers. J. Hydr. Div., Proc. ASCE 96 (HY2):497–507.

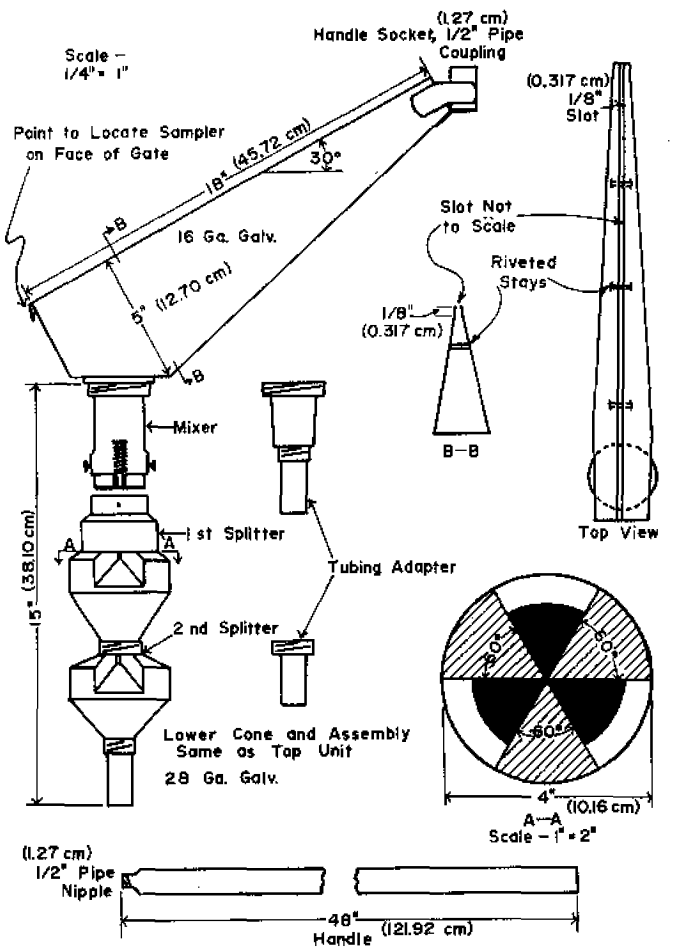

Fig. 1—Fractional water and sediment sampler.

horizontal in the nappe of the flow so that the sample is taken after the critical depth occurs. This prevents a flow disturbance and change of flow upstream from the sampler. The angle is determined using a surveyor's rod level attached to the handle.

Sampling Procedure

Two people are required to take samples with this device. One person holds the sampler and the other person directs the water into a collection bottle.

The operator must place the lower end of the sampler in the air gap below the nappe to assure a complete sample of the stream. The sampler is then leveled, using the surveyor's rod level to insure uniform mixing and splitting. By the time the sampler is leveled, enough water has passed through the device to remove contamination from previous samplings. The second person then directs the plastic tubing into the collection bottle until the desired volume of sample is taken at each sampling point. With a little experimentation, the operators can determine if and how many splitters are required. Also, they can determine the time required at each collection point to get a representative sample.

The total sample volumes collected in the evaluation of this sampler ranged from 8 to 18 liters with samples taken

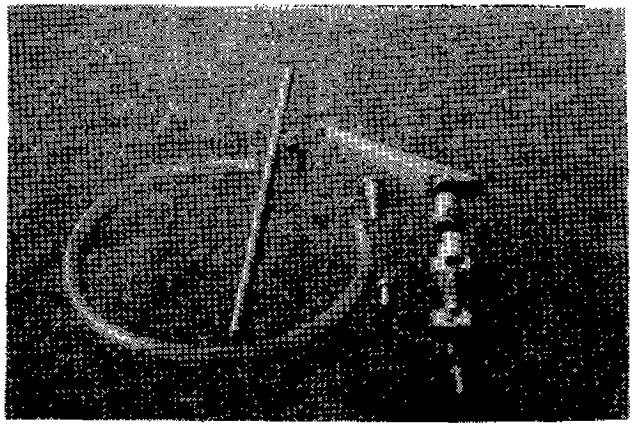

Fig. 2—View of the sampler disassembled.

Table 1—Mean sediment concentration measured in two surfaces drainage streams on different days using the fractional sampler compared to grab samples*

Sampling interval	Stream A, 91cm wide drop structure: No. of subsamples	Stream A: Mean sediment concentration 9/15	Stream A: Mean sediment concentration 9/25	Stream A: Mean sediment concentration 9/29	Stream B, 198cm wide drop structure: No. of subsamples	Stream B: Mean sediment concentration 9/15	Stream B: Mean sediment concentration 9/24
cm		g/liter				g/liter	
7.6	12	0.080†	0.092‡	0.041†	25	0.073‡	0.081‡
15.2	5	.078	.086	.040	12	.071	.078
30.5	2	.076	.092	.040	6	.068	.080
grab	3	.073	.091	.040	6	.073	.082

* The grab sample was collected by dipping a container into the nappe of the stream at equal intervals across the drop structure.
† Sampled with the mixer and one splitter.
‡ Sampled without the mixer or splitter.

at intervals of 7.6 cm (3 inches), 15.2 cm (6 inches), and 30.5 cm (12 inches) across the drop structure (Table 1). The sampler was first placed in the stream and sediment-laden water collected for 10 sec. to estimate the rate of flow through the sampler. The time to collect a sample at each interval without overflowing the sample bottle was then calculated. The estimated time required at each 7.6-cm interval to obtain 14 to 16 liters was 3 sec. Samples were collected for 3 sec. at each sampling point starting 7.6 cm from one side and progressing across the structure at 7.6-cm intervals. The composited sample totaled about 15 liters.

Stream A was also sampled when the flow was small enough to capture the entire flow in a container. In this case, the average of four samples taken with the sampler contained 0.549 g/liter as compared with the 0.554 g/liter average of two samples of the entire stream.

Observation of the close agreement indicates that no significant difference was found between samples taken with the sampler and total stream samples or grab samples. Although the sampler requires two people to operate, it is easier to handle than catching grab samples in large streams. The mixers and splitters allow a wide range of stream flows to be sampled. The sampler is limited to use on streams having drop structures.

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