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Time Efficient Method to Renew Water in Static Sediment Toxicity Tests

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Protocols for static renewal sediment toxicity tests call for maintenance of water quality and minimal disturbance of sediment throughout the test (ASTM 1993; US EPA 1994). Water quality in midge tests is often maintained by aeration to prevent oxygen sags and/or daily renewal of a portion of the overlying water to prevent the buildup of metabolites (Ankley et al. 1993). Disturbance of sediment at test initiation can be minimised by techniques such as pouring the overlying water over a watchglass (Zumwalt et al. 1993).

Daily water renewal can be a time consuming activity and semi-automated systems that decrease the time required for water renewal have been reported (Benoit et al. 1993; Ankley et al. 1993; Zumwalt et al. 1994; Leppanen and Maier 1998). In these systems, the test containers are 300 mL beakers with 100 mL sediment and 175 mL water. The systems accurately deliver the required quantity of water by displacement of old water with fresh. The system reported by Leppanen and Maier (1998) is a single unit that delivers water to 49 beakers. However, the size of their system necessitates a temperature-controlled room to house it.

Our laboratory does not have a temperature controlled room and therefore an alternate system for carrying out bulk sediment bioassays was required. The system described uses 1 L beakers with 200 mL sediment and 400 mL moderately hard overlying water (US EPA 1993). The test species used is *Chironomus maddeni,* a midge indigenous to South Australia. Previously, the initial 400 mL of overlying water was added by pouring over a watch glass and 200 mL water was renewed daily by siphoning beakers individually and renewing with the watch glass method. These activities typically took three to four hours daily. Aeration was provided via individual airlines in a temperature control cabinet. This paper describes an efficient system for water renewal and an improved aeration system.

MATERIALS AND METHODS

One litre beakers (Pyrex') for each treatment (4 replicates) were kept in trays constructed from sheet metal guttering. The guttering was 125 mm wide and 50 mm high. The trays were 460 mm long and constructed by cutting 560 mm lengths and folding 50 mm of metal at each end back and riveting to the sides to

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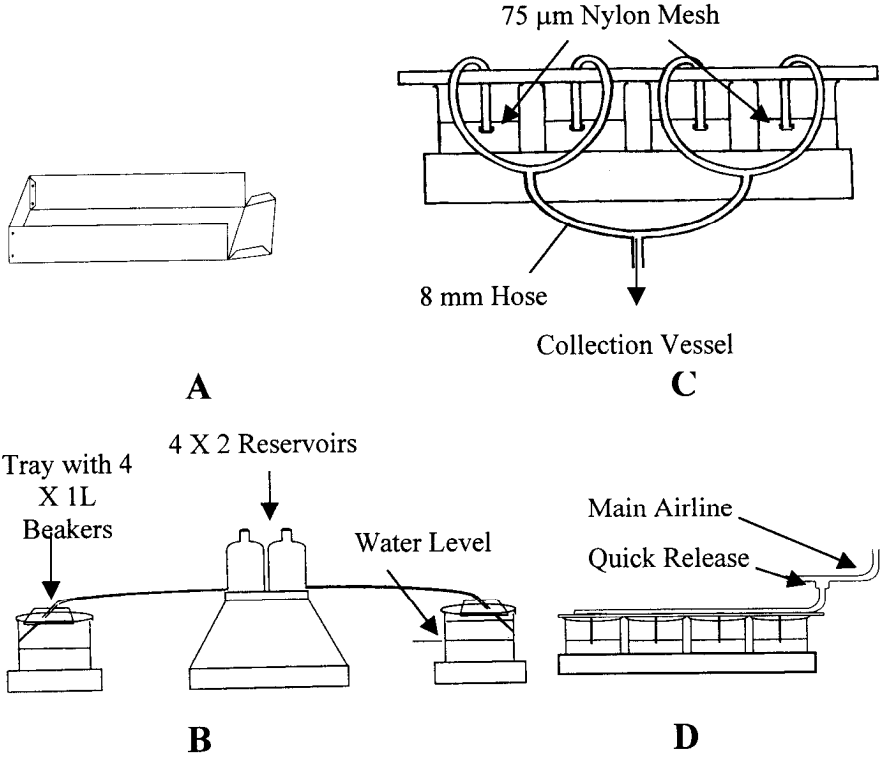

Figure 1. Schematic diagrams of apparatus for water renewal and aeration of bulk sediment bioassays. A: tray to hold 4 X 1 L beakers, B: water renewal, C: siphoning overlying water, D: aeration of test beakers (see text for dimensions).

form ends (Figure la). After measuring 200 mL of sediment into each beaker, a perspex plate (500 X 60 X 4 mm) was positioned on the 4 beakers in such a way that the hose ends were touching the side of the beakers above the final water level. 400 mL of water was measured into each of the four reservoirs with flow governed by the choice of hose diameter, and the height that the reservoirs were above the beakers (Figure lb). Visible resuspension of fine particles was avoided by controlling these two factors.

The following day, 200 mL of overlying water was removed from each beaker using the siphon apparatus (Figure 1c). This apparatus was constructed using a perspex plate (500 X 60 X 4 mm) and plastic hoses. The plastic hoses (6 mm od, 4 mm id) in the beakers were set at the appropriate height to draw off the desired quantity of water. Nylon mesh (75 µm) covered the end of the hoses to prevent larvae escaping. These hoses were connected by "Y" joints culminating in one hose (10 mm od, 8 mm id) for draining into the collection vessel. A pipette bulb was used to initiate suction and the hose was then left in the collection jar to siphon. 200 mL of fresh moderately hard water was added to each beaker (figure lb). Second instar larvae are then pipetted into the beakers. Water renewal was carried out daily for the test duration.

Air was provided to the temperature control cabinet from a central source (Figure 1d). The airline was constructed from flexible polyurethane tubing and quick release fittings (Legris System 3000™). The main airline was positioned along one wall of the temperature-controlled cabinet. Perspex strips (500 X 60 X 4 mm) on the top of the beakers supported the individual airlines to each tray which connected to the main airline via quick release "T" joints situated at the appropriate points in the airline system. An 8 mm od hose was fixed along the length of the perspex strip and capillary tubing (200 µm od, 50 µm id) fed into individual beakers. The length of this tubing was such that sufficient aeration was provided to prevent oxygen sags but there was no visible resuspension of sediment particles.

RESULTS AND DISCUSSION

Dissolved oxygen levels greater than 60% saturation are considered acceptable in static renewal sediment tests (Ankley et al. 1993). Over 30 bioassays have been carried out using this system and D.O. has never been less than 70% and was usually over 80% saturation for the duration of the test. Variation in dissolved oxygen concentrations between and within treatment beakers was less than 0.5 mg/L. Once familiar with the operation, one person was able to carry out the water renewal and physico-chemical analysis (pH, D.O., conductivity and temperature) of 32 beakers (eight treatments) in less than one hour.

Although the system reported by Leppanen and Maier (1998) only requires 10 minutes to carry out water renewal, the system reported here has other advantages. It requires minimal construction time and cost, and takes up little space when not in use. It does not require the use of a temperature-controlled room. No extra effort was required to collect overlying water for further testing (with cladocerans etc.). In conclusion, we believe this system is an efficient method for carrying out renewal of bulk sediment bioassays in laboratories that are not equipped to use semi-automated systems.

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