UV water disinfection

An efficient way to disinfect water is to expose it to ultraviolet (UV) radiation from a special germicidal lamp. This type of UV will quickly kill typhoid, paratyphoid, dysentery, cholera and other harmful bacteria and viruses in the water, leaving no taste.

UV has been used for many years to disinfect drinking water, but the problem is system cost: commercial units may cost as much as US$400. The cost for this home-made UV water purifier and an associated cloth filter is just over $50. The only item needing periodic replacement every 12 months is the UV lamp.

In this design, the UV lamp is suspended over the water, which passes through a trough at a controlled rate of flow. Water entering the purifier can be from either a pressure or a gravity-feed system; output is via gravity flow.

Germicidal UV lamps are available from most major lamp manufacturers in various sizes from 4 to 40 W. For home or institutional use, 8 W is probably the best choice – it is small, but will treat 4 litres per minute.

The trough and cover are made with 22–26 gauge stainless steel sheet metal; corners are soldered using lead-free solder. The capacity of the chamber between the lamp filaments is 1 litre (see Figure 1). The outlet opening is larger than the inlet in order to prevent overflow. The upstream weir is perforated, while the downstream weir is shorter and solid – this prevents water from running too quickly across the tops of the weirs.

The combination of these flow controls (with perhaps some adjustment to incoming water pressure) should limit the flow rate through the trough to the maximum rate of 4 litres per minute for effective treatment. This rate allows each litre of water to receive 15 seconds of UV radiation which is more than sufficient to inactivate harmful bacteria and most viruses. It meets the recommendations of regulatory agencies worldwide.

Limiting factors. Use of germicidal UV lamps for water treatment comes with two limitations and two pre-requisites. The first prerequisite involves reducing any iron in the water to less than 1 part per million. Kits to test for iron in water can be purchased from laboratory supply firms, but most people are usually aware if there is iron in their water. If iron is present, it can be removed very effectively by a slow sand filter.

The second prerequisite is pre-treatment via filtration to remove particles in the water that can absorb or cause shading of the UV rays. A slow sand filter will efficiently remove particles, as will standard commercial cartridge filters, but sand filters are maintenance intensive and commercial filter cartridges expensive. At a pinch, two or three layers of T-shirt material over a bucket works tolerably well.

Alternatively, a very satisfactory particle filter using PVC pipe and cloth as the filter element can be cheaply and easily built. This design will remove more particulate matter than the 5 micron filters commonly supplied with commercial UV purifiers. It is constructed by wrapping several layers of white cotton flannel cloth around a section of perforated PVC pipe which is inserted inside a larger piece of PVC pipe into which the raw water is channelled. The water will be forced through the cloth and out the perforated pipe at the top where it can be directed to the UV purifier. The cloth should be washed with soap each week, but it can be re-used many times.

The major limitations to using UV are the lack of residual germicidal effect and reductions in UV intensity in cold weather. 'Lack of germicidal effect' means that the water can again become contaminated after exiting the UV purifier. All catch containers must, therefore, be free of contaminants.

Substantial decreases in UV intensity occur if the lamp is operated in temperatures below 21°C (maximum output actually occurs at 32°C). If a UV water purifier is used in a location where the temperature is 10°C, for instance, UV intensity is reduced by two-thirds.

Electrical requirements. A UV purifier, of course, requires electricity, either 120 or 240 V AC, or 6 or 12 V DC. Most standard fluorescent ballasts, rated for the lamp size and voltage used, will satisfactorily power the UV lamp. The lamp ballast is what converts the supply voltage to whatever voltage the bulb requires to activate the gases inside.

With a DC ballast matched to the particular UV lamp wattage, any UV

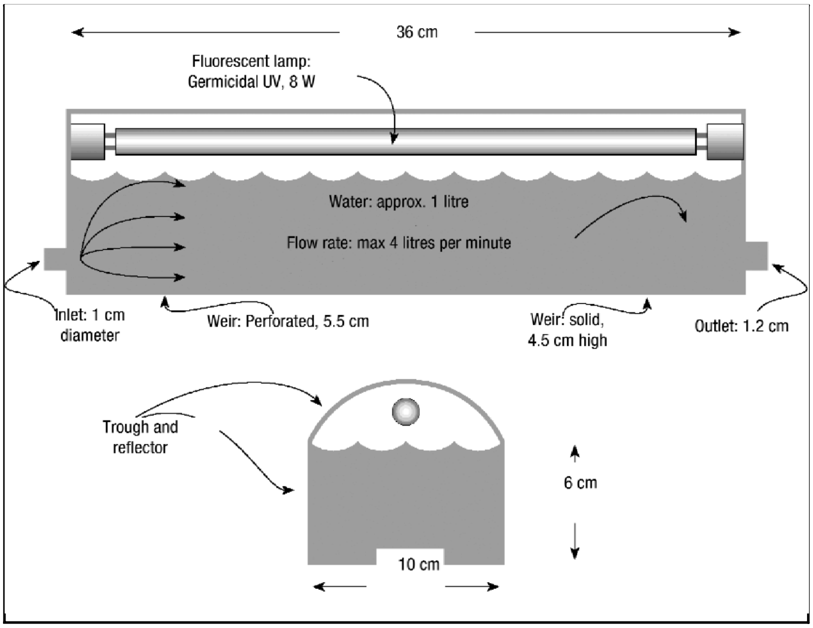

Figure 1

purifier can be operated with DC from a solar-electric system. The electrical consumption is low. You can easily operate an 8 W purifier for an hour or two at midday with just a 10 W photovoltaic module, running through a 4 amp-hour motorbike battery.

Field trials. The Winfried Farmer Aid Fund has tested the gravity purifiers in schools, hospitals, and clinics in Myanmar and various locations in Laos since 1998. This work was done in association with Médecins Sans Frontières (MSF) in Myanmar and the Women's Union in Vientiane Municipality, Laos.

A reasonably good supply of municipal electricity is available at the project sites in villages in Laos. In Myanmar, however, the difficulty is the unreliability of electricity. Batteries were used for a time, but problems arose with keeping them charged. Using PV appears to be the only practical answer, and we are working with MSF and UNICEF to incorporate photovoltaics as quickly as possible.

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agency **news**

Countries with greatest need receive least water aid

Only 12 per cent of total aid to the water sector in 2000–2001 went to countries where less than 60 per cent of the population had access to safe water. This is one of the findings from an OECD analysis of bilateral and multilateral aid to the water sector.

The water supply and sanitation sector receives about 6 per cent of bilateral aid, and some 4–5 per cent of multilateral aid. Annual average aid allocations to the total water sector are US$3 billion, with an additional $1–1.5 billion in loans.

Most aid goes to a handful of large urban projects and nearly half goes to just ten countries: China, India, Vietnam, Peru, Morocco, Egypt, Mexico, Malaysia, Jordan and the Palestinian-administered areas. Many countries where most of the population lacks access to safe water received very little, if any, aid and this is reflected in a slight decrease in Africa's share of water aid.

Nevertheless, the number of projects using low-cost technologies (e.g. latrines, hand-pumps, rainwater harvesting) seems to be increasing. About 10 per cent of water sector funding goes to water sector reform, institutional support and capacity building, while only a tiny fraction is for education and training.

The largest donor is Japan (33 per cent). Together, the World Bank, Germany, USA, France, UK and the European Community (EC) contribute 45 per cent.

For more information see: OECD (2003) *Creditor reporting system on aid activities: aid activities in the water sector 1997/2002* Volume 2003 Issue 1 http://oecdpublications.gfi-nb.com/cgi-bin/OECDBookShop.storefront/EN/product/432003553P1