

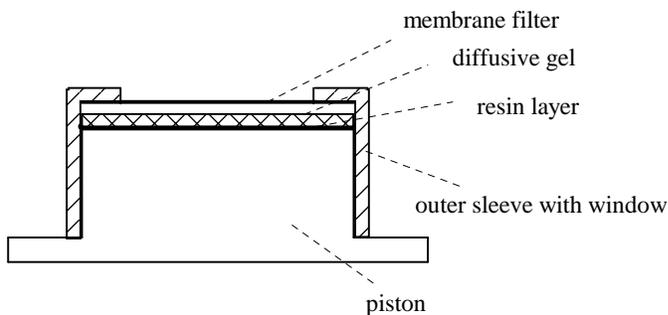
EWM series – Exposmeter Metals for water series samplers

A passive, integrative tool for measuring metal concentrations in water

EWM series samplers based on DGT (Diffusive Gradient Thin Films) technology. It is a method for quantitative measurement of metals in aquatic environments. The technique is based on a simple device which accumulates trace metals on a binding agent after passage through a diffusion membrane layer. Metals can subsequently be analysed employing ICP-MS or other instruments. This accurate, quantitative measurement can be for either ultra trace or high concentrations and can be related to free water concentrations.

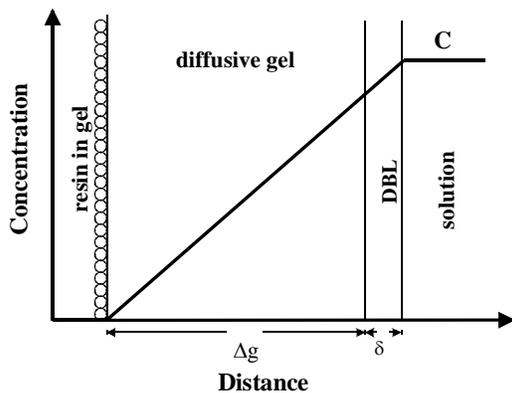
The simple, plastic EWM series sampler can readily be deployed in-situ in streams, lakes, rivers or effluents and sampling is independent of flow. The EWM series samplers automatically separate the metals from solution while it is deployed. It measures only what is in solution, avoids chemical changes that occur after sampling and mimics the exposure of bioavailable compounds.

The EWM series sampler is based on a simple device that accumulates metals on a binding agent after passage through a hydrogel which acts as a well defined diffusion layer.



a

b



c

Figure 1. a and b - Loaded solution deployment mouldings, c - Schematic cross-section through a DGT device in contact with solution, showing the steady-state concentration gradient. The diffusive layer is shown as a single layer of gel, but it can include a gel layer and filter. The thickness of the diffusive boundary layer (DBL) in solution depends on the rate of water movement.

Different binding agents with selectivity for different substances can be deployed. A binding agent is immobilised in a thin layer of hydrogel (binding-gel). It is separated from solution by an ion permeable hydrogel layer (diffusive gel) of thickness Δ_g . Between the diffusive gel and the bulk solution there is a diffusive boundary layer (DBL), of thickness δ where transport of ions is solely by molecular diffusion. Within a few minutes of immersion, a steady state linear concentration gradient is established between the solution and the resin gel.

In practice the EWL series device is deployed for a fixed time, t (s). On retrieval the binding-gel layer is peeled off and the mass of the accumulated ions in this layer is measured. The mass can be measured directly in the binding-gel layer by drying it and using a beam technique such as laser ablation ICP-MS. More commonly, ions in the binding-layer are eluted with a known volume of solution (1 or 2M HNO₃ in the case of metals bound to Chelex resin). The concentration of ions in the eluent are then measured by any suitable analytical technique after appropriate dilution.

Concentration in the bulk solution can be calculated from the known values of Δ_g , D and A , the measured deployment time, t , and accumulated mass, M .

$$C = M\Delta_g / DtA$$

where D is the diffusion coefficient ($\text{cm}^2 \text{s}^{-1}$),

A is area of the exposed diffusive layer, (cm^2)

Δ_g is thickness of hydrogel layer (diffusive gel), cm

EWL series samplers distinguish between species both kinetically (according to their lability) and by size (whether they can pass through the diffusive gel layer). By using different gel compositions it is possible to effectively measure inorganic and organically complexed metal species separately in situ. These capabilities offer substantial advances in our ability to make simple measurements for bioavailability and regulatory purposes.

DGT - Metals (Cd, Co, Ni, Cu, Zn, Pb, Fe, Mn, Al)

Binding agent: Chelex resin immobilised in a thin layer of hydrogel
Diffusive gel: ion permeable hydrogel layer (polyacrylamide)

Diameter: of plastic assembly - 4,0 cm, gel discs - 2,5 cm, exposure window - 2,0 cm

Height of plastic assembly: 2,0 cm

DGT-P

Binding agent: Iron oxide immobilised in a thin layer of hydrogel
Diffusive gel: ion permeable hydrogel layer (polyacrylamide)

Diameter: of plastic assembly - 4,0 cm, gel discs - 2,5 cm, exposure window - 2,0 cm

Height of plastic assembly: 2,0 cm

DGT-As

Binding agent: iron oxide immobilised on thin layer of hydrogel Diffusive gel: ion permeable hydrogel layer (polyacrylamide)
Diameter: of plastic assembly - 4,0 cm, gel discs - 2,5 cm, exposure window - 2,0 cm
Height of plastic assembly: 2,0 cm

DGT-Hg

Binding agent: Spheron-Thiol resin immobilised in a thin layer of hydrogel Diffusive gel: ion permeable hydrogel layer (agarose gel)
Diameter: of plastic assembly - 4,0 cm, gel discs - 2,5 cm, exposure window - 2,0 cm
Height of plastic assembly: 2,0 cm