

METAL SPECIATION AND THE IN-SITU ACCUMULATION BY THE MUSSEL *DREISSENA*
POLYMORPHA

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ABSTRACT

A survey in the river Rhine and its downstream man-made lake showed the existence of geographic gradients in cadmium and copper. Cadmium accumulation in the freshwater bivalve *D. polymorpha* is strongly related to in-situ dialysable "free" cadmium of river and lake water. In-situ dialysable "free" copper is only weakly related to copper accumulation by *D. polymorpha*, probably by biological regulation. "Free" metal is measured by DPASV under standardised conditions irrespective of the origin of the water sample.

INTRODUCTION

In the Dutch struggle against the sea a large dam was built in 1932 closing off a coastal lagoon (IJsselmeer). This operation created a large freshwater body containing 5.5 km³ of water, mainly fed by the river Rhine. The estuarine ecosystem had disappeared within 3 years. Large amounts of contaminants are discharged in the lake and accumulate in sediments. This topic is discussed by Salomons during this conference. The route and fate of heavy metals during the summer of 1982 in the river Rhine was investigated by a team of biologists and chemists in a study sponsored by the Dutch government. This paper will be restricted to the biological monitoring of cadmium (a non-essential element) and copper (an essential element) in relation to aquatic metal speciation in the region studied (Fig. 1).

A previous field study (Ref. 1) showed a weak correlation between filtrate water and soft tissues for cadmium and a poor correlation for copper in river sections.

MATERIALS AND METHODS

The freshwater bivalve *D. polymorpha* responds in a similar way to cadmium pollution as other organisms and is suitable for biological monitoring studies (Ref. 1).

D. polymorpha (15-20 mm) was sampled at a relatively clean area, the Afsluitdijk, randomised to samples of about 100 individuals and exposed during 40 or 60 days at selected locations. The animals were put in hard-polythene baskets, 1-2 metres below the water surface.

After collection samples were stored frozen (-20 °C). The soft tissues were homogenised with an Ultra Turrax (deldrin cutters) and stored in acid-cleaned glassware until analyses. After wet ashing cadmium and copper were determined with ETAAS (Perkin Elmer 430, HGA 500). The percentage of ash-free dry material was determined by drying (105 °C) followed by ashing in a muffle oven (600 °C).

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Dose-response relationships for both metals at a location of the river Meuse (with different characteristics: e.g. lower pH and chlorinity) fit in well with the overall picture of the river Rhine system. This indicates that "free" metal levels of dialysates may be used to predict biological uptake in entirely different aquatic systems. Further studies will be necessary to investigate this possibility.

CONCLUSIONS

DPASV-measurements of in-situ dialysates under standardised conditions seem promising for prediction of biological uptake of cadmium, irrespective of the type of river system involved. The prediction of copper levels is more complicated as biological regulating mechanisms and/or competition with other metals at the same binding sites in the organism may influence the dose-response relationship.

ACKNOWLEDGMENTS

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LITERATURE

1. J.M. Marquenie, Proceedings of Heavy Metals in the Environment, 1981.

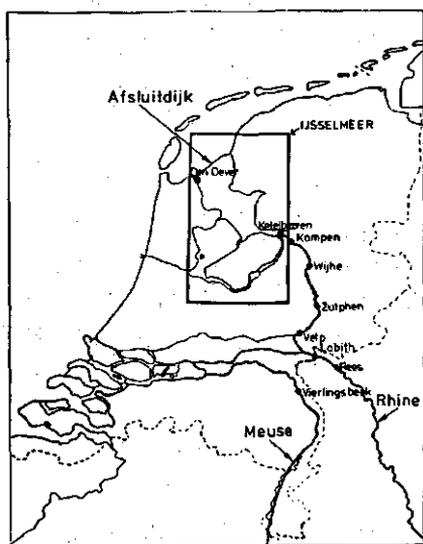


Fig. 1. Map of The Netherlands showing the sampling locations.

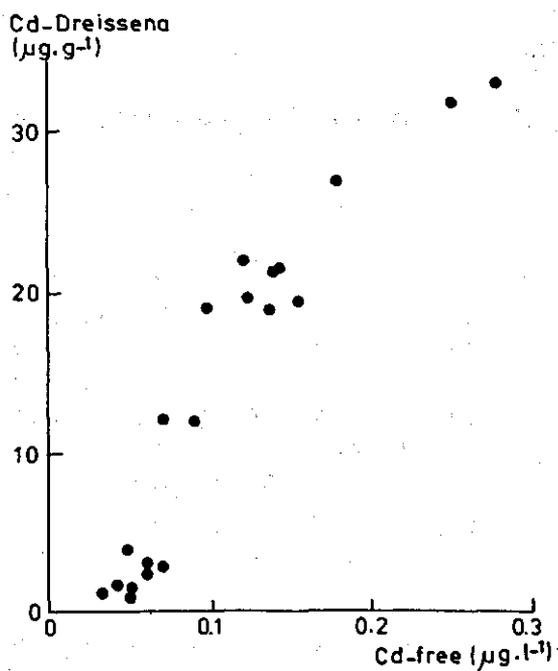


Fig. 3. Relation between dialysable "free" cadmium in water and biological uptake.

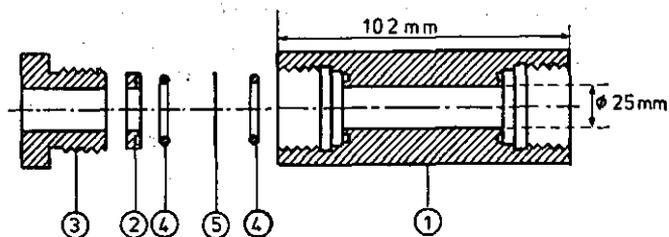


Fig. 2. Schematic diagram of the dialysis cell. 1. Body, 2. Holder, 3. Screwcap, 4. "Viton" ring, 5. "Amicon" filtre. Body, holder and screwcap from PTFE.

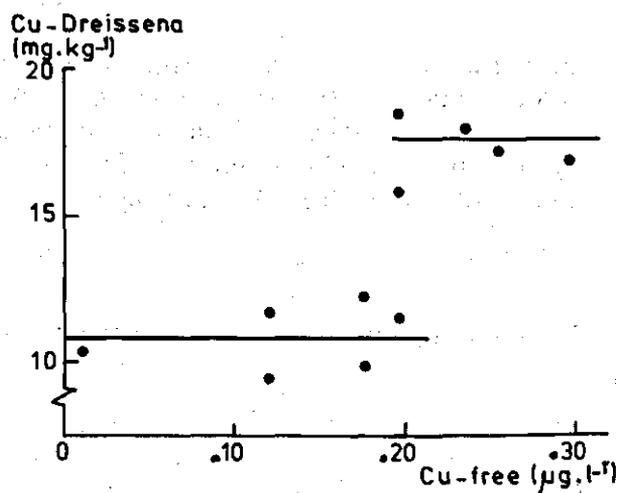


Fig. 4. Relation between dialysable "free" copper in water and biological uptake.

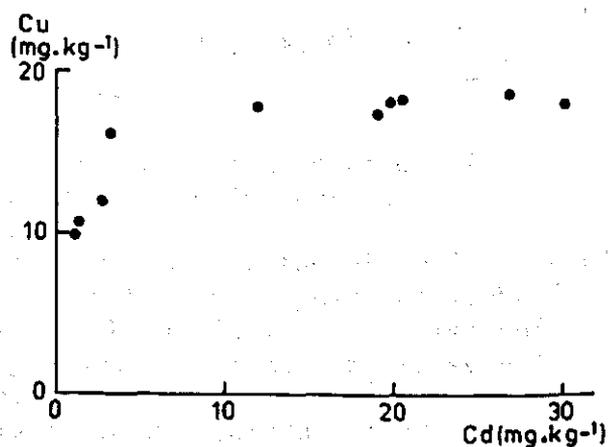


Fig. 5. Relation between cadmium and copper concentrations in *D. polymorpha* for each location.