AGMIN NEWSLETTER No. 223

Absorption of Copper on Sediment Particles and Biota

Absorption of copper from algicides, such as Cupricide® and Kupramine®, depends on complex interactions between soluble copper species, the sediment particles and receptor organisms in the environment.

Some of the key interactions include:

a) Chemical characteristics and concentration of the contaminant;
b) Physical and chemical characteristics of sediments;
c) The presence of complex mixtures that can confound the contaminant interactions with both the sediment constituents by such environmental factors as temperature, nutrient availability and habitat, which can modify the exposure both between species and temporally within a species;
d) The length of sediment/contaminant contact time that can change bioavailability.

In addition to the size, the physical-chemical characteristics of inorganic particles dictate the absorption of natural organic material as well as algicides on to the particles. A sediment particle can be viewed as an inorganic base that contains one or more minerals and which is coated with the natural organic molecules, for example, humic substances (Figure A). Each of the mineral types has a characteristic surface charge, and this charge influences the nature and extent of the interaction between natural dissolved organic matter and mineral surfaces. Finally, this particle-associated organic matter largely controls the sorption of organic algicides on to the sediment particles. More than 90% of copper is absorbed by montmorillonite clay in 24 hours.

Evaluating the effect of contaminants on various levels of the aquatic food chain has traditionally used concentrations in the external environment. When mixtures of chemicals or multiple sources are involved, and the exposures are complicated by significant bioavailability limitations such as exposures in sediments, then assessing effects based on the external environment may not be very predictable. Rather, there is a body of knowledge that is developing to evaluate the effect of chemicals based on the internal concentration in organisms. This is analogous to utilising blood levels in mammals to predict drug effects and behaviour.

The ranges of concentrations that produce effects (mortality or other waste response) vary with both the mechanism of action and the duration of exposure. The use of internal concentrations and the resultant effects is now beginning to develop, and the utility of this approach is obvious. When organisms are exposed to multiple sources, where none are dominant or where simple equilibrium models do not effectively reflect the concentration, then the prediction of body burdens through kinetic models and assessing effects based on internal dose should provide better estimates of environmental hazard.

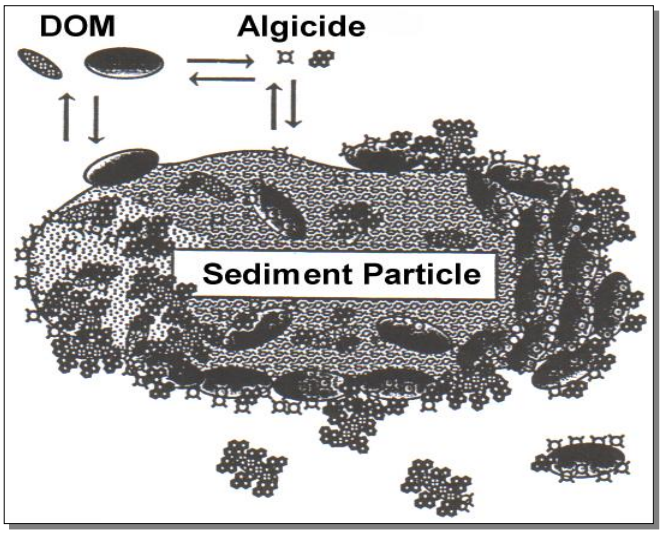
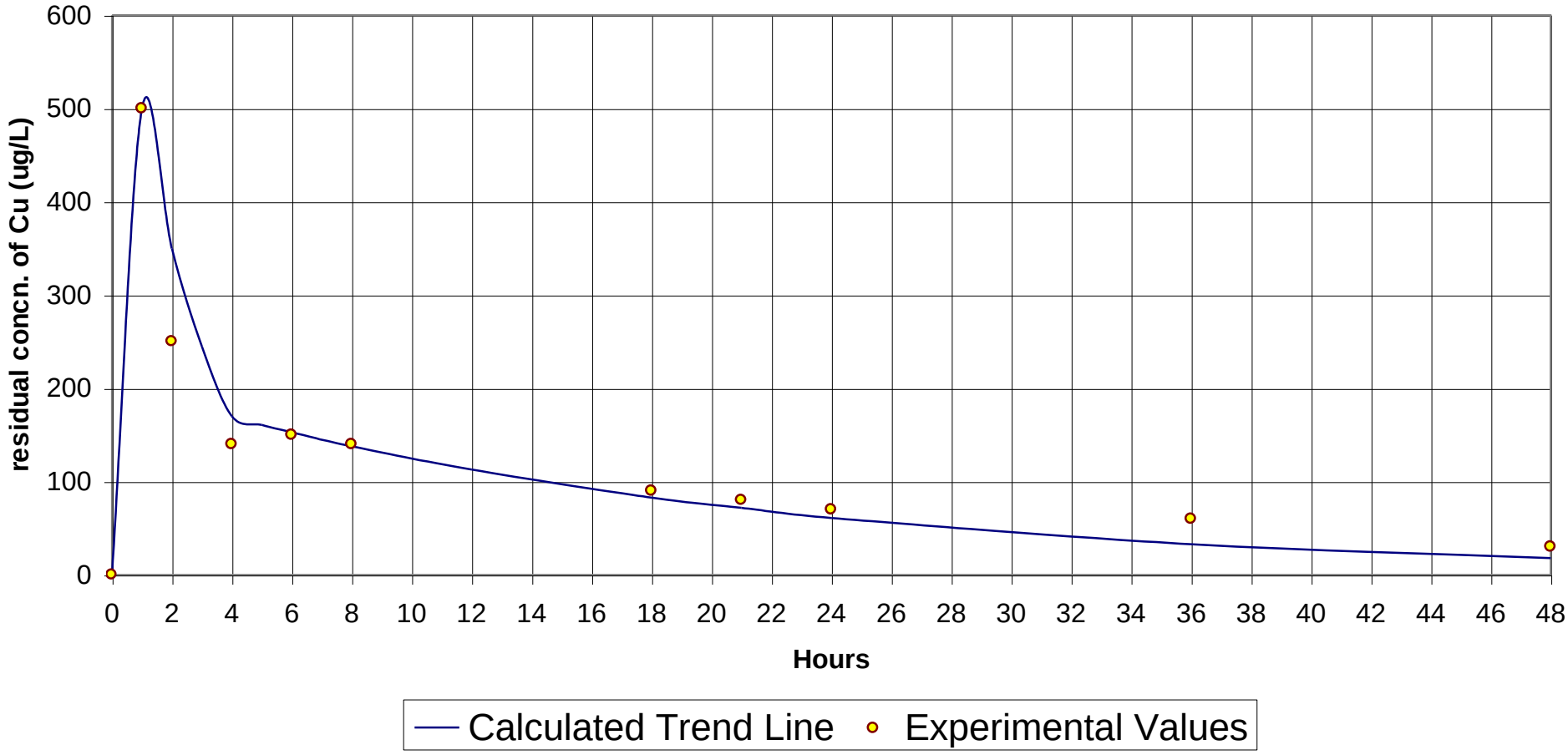


Figure A *(Left)*. A conceptual model of a sediment particle where different 'molecules' of dissolved organic matter (DOM) form a coating on the inorganic particle with the subsequent binding of organic algicides, mainly to the organic coating.

Residual Copper vs. Time after Application of Cupricide



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