COMBINED TOXICITY OF FOUR TOXICANTS (Cu, Cr, Oil, Dispersant) TO *Artemia salina*

G. VERRIOPOULOS, M. MORAITOU APOSTOLOPOULOU and E. MILLIOU
Zoological Laboratory, University of Athens, Athens (Greece)

In sea waters multicontaminant pollution appears to be the rule rather than the exception. For a realistic approach of pollution effects it is essential to estimate the combined toxicity when two or more pollutantants are acting in combination to marine animals.

In this study we have tried to estimate the joint toxicity of some pollutants commonly found in nearshore polluted waters: two metals: copper and chromium, an oil(Tunesian crude oil zarzaitine type) and an oil dispersant(Finasol OSR2) to *Artemia salina*.

The acute toxicity of the four toxicants acting individually^{+} or jointly(all combinations of two, three or four chemicals) was estimated by determination of LC_{50} 48h (concentration of a toxicant which kills 50% of the test animals after 48 hours of exposure) according to the Bliss method.

In the experiments of evaluation of multiple toxicity we have calculated each toxicant concentration to be added in the mixture as part of the relevant LC50 (eg 10%, 20% of the LC50). In this way all components in the solution are equitoxic contributing equally in the toxicity of the mixture. The toxicity of two toxicants mixture was determined using the additive toxicity index developed by Marking and Dawson. The necessary calculations for the index are: $\frac{Am}{Ai} + \frac{Bm}{Bi} = S$ where A and B are chemicals, i and m are the toxicities (the LC50 values) of the individual toxicant and the mixture respectively and S is the sum of Biological Activity. To establish linearity and to assign a reference point of zero for simple additive toxicity, Marking and Dawson calculated the index as follows: Additive index (A.I.) = $I-1.0$ for $S \leqslant 1.0$ (greater than additive toxicity) or $S(-1)+1.0$ for $S \geqslant 1.0$ (less than additive toxicity). Additive indices of $-, 0, +$ indicate less than additive, additive and more than additive toxicity respectively. The same formula was used with the three and four toxicants mixture.

When the two metals are acting individually to *Artemia*, copper proved much more toxic(more than 20 times) than chromium. The calculated LC50 values(ppm) are: Cu:0,485, Cr:12,838. The LC50 values for oil is 297,8 ppm and for Finasol 0,90 ppm. When the two pollutants are acting in mixture of two, two types of joint toxicity are observed : a) strict additive. This is the case of the mixtures: Cr+oil(A.I.=

=-0,016 practically 0),Cr + Finasol (A.I.=-0,105 practically 0),Cu+Finasol (A.I.=-0,109 practically 0) and b) less than additive.The less than additive effect was less intense in the mixture Cu+Cr (A.I.=-0,53) and clearly pronounced in the mixture oil+Finasol (A.I.=-1,87) and Cu+oil (A.I.=-2,03).

When three of the pollutants are acting jointly,in all cases a less than additive reaction was observed.This type of joint activity was very clearly pronounced in the case of the mixture Cu+oil+Finasol (A.I.=-3,75).

The mixture of the four pollutants exhibited an important (A.I.=-1,63) less than additive reaction.

The problem of toxic effects of pollutants acting jointly seems a very complicated one.The interaction of pollutants depends not only from the components of the mixture but also from the organism affected.Various forms of interaction either chemical or physiological may occur when pollutants are acting jointly.Chemical interactions involve the mutual influences between pollutants that result in new compounds,chelate complexes etc. Physiological interactions can occur in altering the sequences of events eg the binding of toxicants to the target tissue.Much remain to be done concerning such interactions.The various mechanisms involved in pollutants interactions remain little known;extrapolation of laboratory data to field situation is difficult due to the sheer complexity of the interacting factors.

+ The acute toxicity(LC50 48h)of oil and Finasol to Artemia was estimated in a previous paper