EVALUATION AND INTERPRETATION OF TOXICITY:
4-CHLOROPHENOL EQUIVALENT FOR ORGANIC CONTAMINANTS

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ABSTRACT
Environmental risk of contaminated environment can be characterized by measuring the contaminant concentration and the adverse effects of environmental samples. These adverse effects are usually quantified by the ED50 and ED90 values (the dose of the environmental sample which causes 20% and 50% decrease in the measured endpoint). To get easily understandable and usable adverse-effect test results we introduce here the “equivalent evaluation and interpretation” and “equivalent calibration” tool for organic contaminants.

The essence of this evaluation and interpretation methodology is that the inhibition of environmental samples is compared to the toxicity of a reference (calibrating) compound, which is the same in case of each measuring set and finally the inhibition of samples is expressed in an equivalent unit of the selected reference substance. This way organic compounds contaminated soils’ toxicity is compared to 4-chlorophenol (4CP) toxicity and expressed in 4CP equivalent: TEQ_{4CP_{50g}} (mg 4CP/kg soil). This technical support tool is similar to those are used by many chemical analytical methods, that need calibration between measured endpoint (e.g. colour) and the concentration of a chemical substance.

INTRODUCTION
In this presentation we describe the application of 4CP equivalent for direct contact toxicity testing of contaminated soils. The main advantage of direct contact toxicity test is that the results can integrate all the interactions between different substances, substances and environmental matrix, the substances and the biota by association of testorganism and the tested soil in vitro. Otherwise the consequences of these interactions are hardly predictable only on the basis of the chemical analytical results (Gruiz et al. 2001).

To calculate the equivalent — similar to chemical analytical calibration methods — a calibration series is prepared and measured parallel to the unknown environmental sample. This calibration series can be prepared in water, or in soil. If it is prepared in soil it is important to use an uncontaminated soil, which is the same or similar to the soil sample to be tested. If it is prepared in water, we apply a correction factor (f_{soil/water}) for simulating matrix effect of soil; sediment or other solid-phase containing samples, with the application of a correction factor. This correction factor was determined from the measured toxicity of 4CP in water and in different type of soils.

MATERIALS AND METHODS
For interpreting the toxicity of soils contaminated with an unknown organic chemical substances we compared the measured effect to the toxicity of 4-chlorophenol (4CP) and expressed it in “4CP equivalent” TEQ_{4CP_{50g}} (mg 4CP/kg soil). With the idea of using the measured toxicity of 4CP series as a calibration curve, the toxicity of a contaminated soil can be expressed as if it were caused only by 4CP in the case of organic substance contaminated soils.

Calibration Series and bioassays
By this time we worked out the calibration series for three different toxicity tests with different end points, which are listed in Table 1. The applied initial 4CP solutions concentrations for Vibrio fischeri bioluminescence inhibition test and the Tetrahymena pyriformis growth inhibition test are made in water, but for Folsomia candida the required 4CP concentration was made in the artificial EOCD soil (OECD, 1984).

Table 1 4CP calibration series for toxicity tests

CONCLUSIONS
The calibration tool is able to characterise and integrate the effect of different soil types, the different sensitivity of testorganisms and the effect mechanisms of contaminants. Using the toxicity equivalent method the different bioassay results can be compared which each other and used for quantitative risk assessment and decision making.

For the calculation of the Risk Quotient (RQ) a no effect concentration (PNEC) is needed, not the dose of the contaminated environmental compartment, however for an unknown pollution we can only measure the effective dose.

With the application of a calibration curve drawn by 4CP and the calculation of 4CP equivalent we get an independent effective concentration value that we can use to calculate a PNEC data for the purpose of quantitative risk assessment and risk based decision making.