Setting standards and guidelines for PCDD/PCDF - an attempt of an integrated approach with special respect to ambient air pollution

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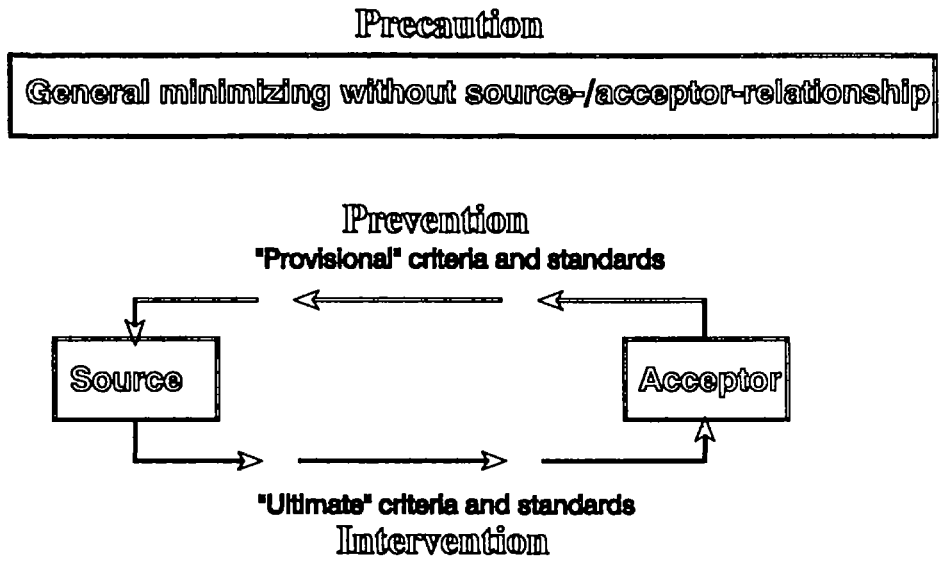
The investigation and evaluation of polychlorinated dioxins and furans (PCDD/PCDF) attract at present great attention in the Federal Republic of Germany. The conference of the Ministries for Environmental Affairs have concluded on their meeting on November 21 to 22, 1991 that the Federal Government should propose criteria and standards for PCDD/PCDF in the media soil, water and air as well as in forage and food, which are scientifically proved and technically feasible. The basis for these criteria and standards should consciously follow the principle of precaution, in German terms "Vorsorge".

Although different working groups are engaged in setting these standards for different media, an integrated approach of linking the manifold views and considerations in this complex field is not only desirable but also absolutely necessary. In this paper the system of setting standards for ambient air pollution in terms of concentration and deposition according to the latest stage of discussion in Germany shall be presented. The frame in which these procedure takes place and the applied systematic nomenclature are points which are also stressed. Some of these aspects have been presented already on occasion of the symposium DIOXIN '90 in Bayreuth/Germany[1]. Meanwhile the discussion has proceeded, however, and some new interesting results concerning the relationship between the uptake and accumulation of PCDD/PCDF in the different media have been gained.

According to the scheme in Fig. 1 three stages of control *measures* in the field of environmental protection, namely *precaution*, *prevention* and *intervention* can be differentiated. *Precaution* means that all efforts should be taken to minimize the input of PCDD/PCDF into the environment from the very beginning on. The limitation of emission from waste-incinerators and similar sources by 0.1 ng TEQ m^{-3} is such an example. The restriction to non chlorine-containing burning material would be another, even comprehensive example. Source/acceptor-relationships and toxicological considerations are to a large extent subordinated to the straight-forward principle of technical feasibility.

Prevention means that within the stage of licensing procedure of a new plant clear standards for the ambient air in terms of concentration and deposition are applied which are strictly bound to the principle of excluding undesirable risks for health or other disadvantagous effects. For establishing such standards the tolerable daily intake (TDI) of PCDD/PCDF and the different paths of intake as well as the transfers between the different

Fig. 1: Scheme of general measures in environmental protection



compartments must first be known. This means that along the arrows in Fig. 1 some "provisional" criteria and standards for the different media like soil, food, forage etc. have to be established first, which lose their importance, however, as soon as the final standards in terms of maximum concentration or deposition have been reached. From this moment on the licensing procedure will concentrate not ot exceed this concentration or deposition standard by the new plant in question instead of judging the effect itself, because the criterion of air quality can be better related to paramters of emission and dispersion than anyone of the other threshold values within the source acceptor chain, including the yardstick of food contamination.

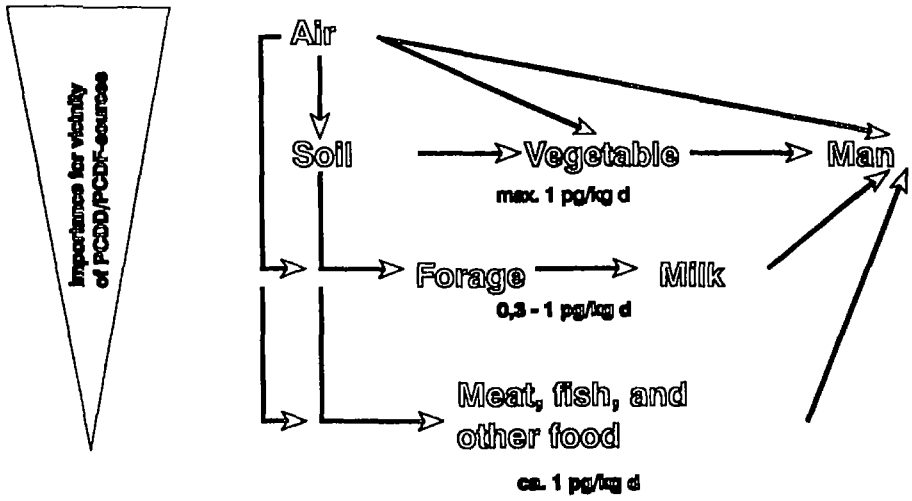
Intervention means avoidance of hazard in an acute case, mainly by withdrawal of contaminated food. Control measures should therefore concentrate on the very last link of the source/acceptor chain in the direction of the arrows in Fig. 1. That means that at best the content of PCDD/PCDF in food or even in blood fat is measured for evaluating the timerisk. This procedure, which can be applied only if the source for PCDD/PCDF-emission already exists, ensures maximum safety.

Dependent on the distance between the acceptor "man" and the point where within the source/acceptor chain control is executed - ambient air or food as the both extremes - different degrees of certainty concerning the judgement of risk exist. Therefore different TDI's may be applicable which according to the present state of discussion could lay within the range of 1 and 10 pg TEQ (kg body weight)$^{-1}$ day^{-1}. While the lower boundary of this range could be used for a scenario of measures for the purpose of *precaution*

the upper boundary should represent the maximum yardstick for *intervention*. The TDI for the purpose of *prevention* should approach the value of 1 TQE (kg body weight)$^{-1}$ day^{-1} without being necessarily identical with it if the already existing situtation stands against such a goal. So for example the present uptake of PCDD/PCDF by man is estimated as high as near 2 pg (kg body weight)$^{-1}$ day^{-1} even in rural areas. Therefore it is unrealistic to demand a level of ambient air pollution for industrial areas which undercuts this dosis. According to the vote of the WHO Regional Office for Europe the value of 10 pg (kg body weight)$^{-1}$ day^{-1} represents the border between not harmful and harmful effects[2]. This statement is, however, not unequivocal. Unfortunately an official answer to this question with a high dgree of agreement in public is still open.

For the derivation of air quality standards for PCDD/PCDF as a *preventive measure* the most important paths of uptake of PCDD/PCDF by man are represented in Fig. 2. There are systematic differences in the

Fig. 2: Representation of the partial paths for intake of PCDD/PCDF by man

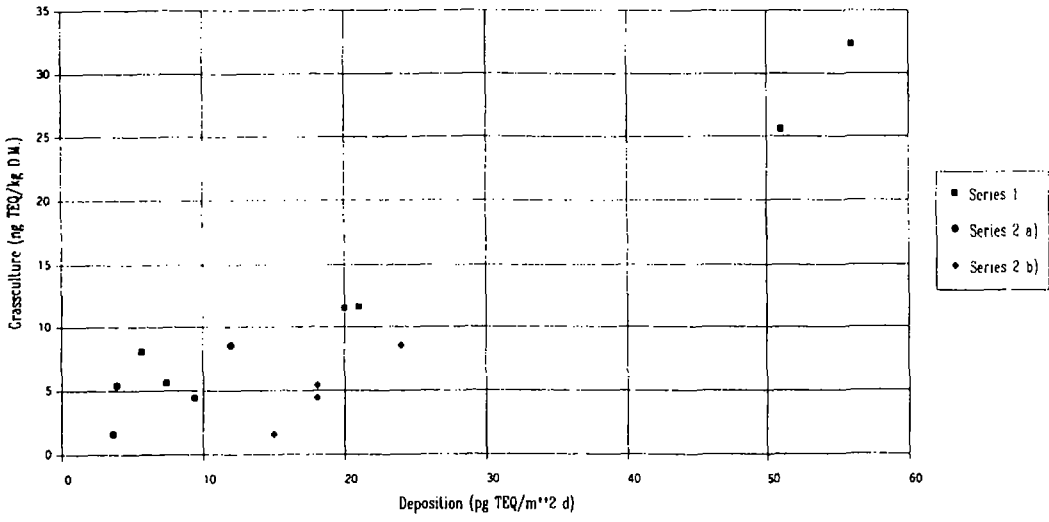


possibility to influence this uptake by administrative measures of air pollution control. For example contamination of vegetables in gardens close to the vicinity of a single PCDD/PCDF-source is principally easy to change, since this contamination depends on the source strength and other parameters of dispersion which are liable to public surveillance. On the other hand for food which is imported from totally different regions, like sea fish as an extreme, this influence is nearly non-existant.

Concerning the tranfer factors describing the quantitative relationships between the media air, soil, forage as well as food and the acceptor man as

another important prerequisite for the derivation of air quality standards besides the TDI's, some very interesting informations could be reached within the immediate past. These informations can not be presented in detail in this abstract. As an example Fig. 3 shows that a strict relationship exists between

Fig. 3: Relationship between PCDD/PCDF-content in standardized grass culture and deposition. In series 1 a) values below detection limit taken as measured, in series 2 b) set to 1/2 detection limit.



the deposition of PCDD/PCDF and uptake of PCDD/PCDF in standardized grass cultures. This grass cultures growing in an uncontaminated soil substrate in 1.50 m height above ground are used as bioindicators. Equally good relationships can be demonstrated between uptake of PCDD/PCDF in grass cultures and vegetables, which demonstrates the overwhelming influence of PCDD/PCDF in air in comparison to the PCDD/PCDF-content in soil for the contamination of forage and food.

Summarizing all the aspects of this paper the proposal of 15 pg m^{-2} d^{-1} as a standard for deposition which was mentioned already on occasion of DIOXIN '90[1] can obviously be confirmed. For the concentration an air quality standard of 150 fg m^{-3} is under discussion at present.

1 Prinz, B., Krause, G.H.M., Radermacher, L.: Criteria for the evaluation of dioxins in the environment. *Chemosphere* 1991;23:1743-1760
2 WHO Regional Office for Europe: *Consultation on Tolerable Daily Intake from food* of PCDDs and PCDFs. Bilthoven, Netherlands, 4-7 Desember 1990. Unedited draft.