Assessment of short-term radioactive contamination of river water resulting from the Chernobyl Accident

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A model is being developed at the Environmental Radioactivity Laboratory for the assessment of short-term consequences of direct contamination of rivers through deposition of radioactive material on the surface of the water. Using measurement data, the contribution of the Danube River as a source of contamination for the North-Western Black Sea in the first 2 weeks following the Chernobyl accident will be evaluated.

The model attempts to describe the time evolution of specific activity in river water, by taking into account contamination resulting from fall-out deposited on the river surface. It is a one-dimensional dispersion model which includes a correction for vertical diffusion (HALASZ, 1992). It is based on the following assumptions:

-The deposition rate is time-dependent and uniform along a given length of the river. Measured deposition data corresponding to the period of interest, are fitted to give a smooth deposition function, required as input.
-Water velocity, river depth, diffusion coefficients and sampling depth (depth up to which the inlet of the sampling recipient extends) are considered constant and required as input data.
-A mixture of up to 15 radionuclides is considered. For most of the daily samples only gross beta activities are available. Using the relative concentrations of radionuclides in deposition samples (resulting from gamma spectrometrical analyses), required as input data, calculations are made for the radionuclidic composition on time subintervals 80 that the corresponding gross beta activity approximates the measured values.

The model has been tested using sets of data obtined through measurement of fall-out and river water samples performed up to May 10, 1986, following the Chernobyl accident, as illustrated in Fig. 1 for the case of River Buzau.

Fall-out and river water samples have been collected with a frequency depending on the type of the sample, but at least once a day, at the stations of the National Environmental Radioactivity Surveillance Network. Immediate gross beta measurements have been performed on all the samples. For the fallout samples and for some of the water samples gamma emmiter concentrations have been determined also.

At the present stage of development, the model, applied to the existing data sets, gives a reasonable agreement with the observed delay between the peak values in deposition rate and specific activity in water. In most cases the calculated amplitude of water specific activity approximates well the measured values, but the corresponding decrease is slower than the observed one.

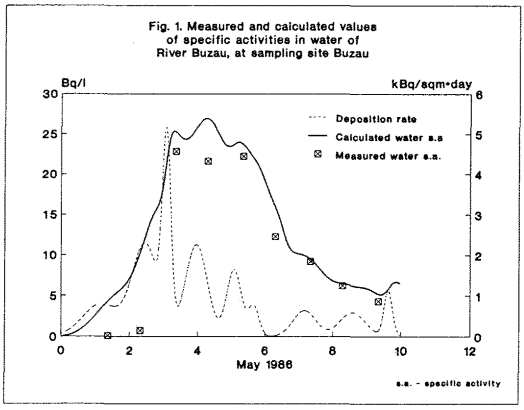

Fig. 1. Measured and calculated values of specific activities in water of River Buzau, at sampling site Buzau

The main processes governing the shape of the peak in water specific activity are radionuclide accumulation vs. decay and longitudinal transport.
The effect of the longitudinal diffusion is small for the given ranges of parameters. The influence of vertical diffussion is important for the range used for the vertical diffusion coefficient.
There are cases in which the assumption that deposition is uniform over a large surface is not appropriate.

The model is to be developed by taking into consideration suspended and bed sediments as well as input coming from the drainage area. A finer resolution deposition map will be produced and hydrological characterization of each case will be completed in order to improve the input data. Such data are presently prepared for a case study of the Danube River, much more complex due to the contribution of tributaries, which will permit an evaluation of the input of radioactivity into the Black Sea, resulting from the direct contamination of the river.

REFERENCES

HALASZ M.-A., 1992.- Model for dispersion of radioactive contaminants in rivers, to be published.