Comparison of US and European Methods For Determining Site Cleanup Levels

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INTRODUCTION

In the past two years, there has been significant evolution in the ways in which different countries determine cleanup levels for hazardous waste sites. Among the more innovative approaches is that established by ECETOC, the European Centre for Ecotoxicology and Toxicology of Chemicals, through the use of their HESP model (Human Exposure to Soil Pollutants), Version 2.0.

This short paper compares how site cleanup levels are determined under HESP versus standard US Environmental Protection Agency risk assessment methodology, known as Multipathway Health Risk Assessment, and provides guidance as to relative advantages, disadvantages, and costs of each approach under different conditions. EPA guidance can be found in its publications Risk Assessment Guidance for Superfund and other documents available from regional EPA offices.

COMPARISON OF US VS. EUROPEAN METHODS

The attached chart provides a detailed comparison of the two approaches, which are significantly different.

To summarize their differences, HESP is a software-based program which is easy to use. It develops exposure concentrations, which it then compares to exposure criteria. It does not differentiate among types of adverse effects, such as carcinogens vs. non-carcinogens, and it does not calculate risk. HESP only addresses the risks of contaminants in soil, but assesses exposure from soil contamination via several routes of exposure. European criteria form the basis of comparison with estimated exposure concentrations.

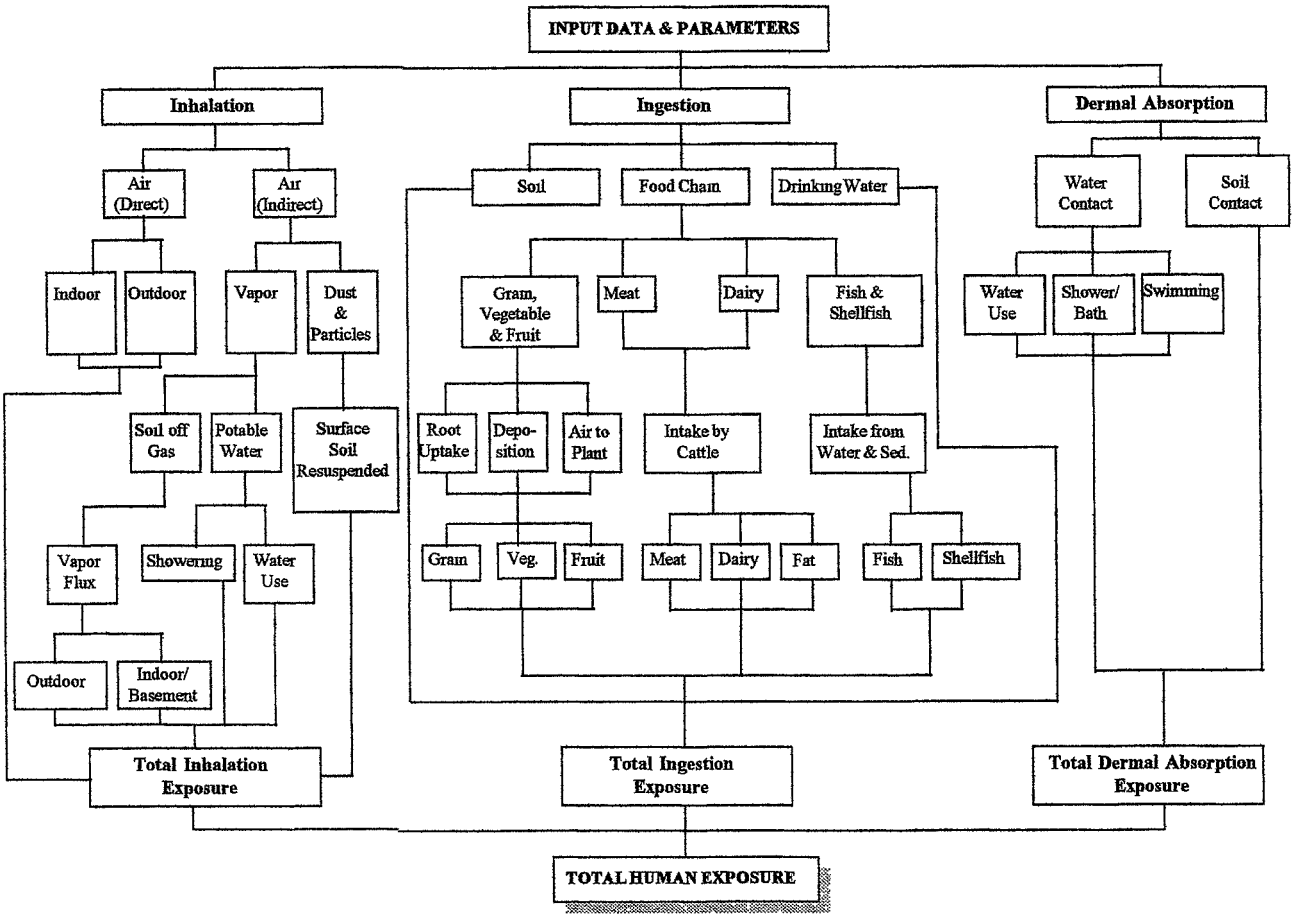
EPA's risk assessment guidance can be used with a broader type of sources, and is not limited to soil contamination. The guidance is extensive, although not complete, and is cumbersome to use. EPA does not provide software to conduct risk assessments following its guidance, which is regularly updated and may vary by region. US criteria are used The EPA MPHRA approach is far costlier to follow that the HESP approach.

What they have in common is the following: each uses a multipathway approach to developing scientifically defensible cleanup levels An example of multipathway exposure assessment is given in Figure 1.

UPDATE TO THE HESP MODEL

As this article went to press, word was received of a new upgrade to the HESP model, version 2.1. It reportedly includes the following additions, none of which significantly alter the descriptions in the attached chart. New features include:

FIGURE 1. MULTIPATHWAY EXPOSURE ASSESSMENT



- A new exposure route has been added to the program, allowing the modeling of exposure through consumption of poultry and poultry products.

- A database with all relevant chemicals as used by the Dutch authorities to set soil and groundwater criteria (Dutch Soil Protection Act of 1994) has been incorporated.

- A number of parameters for the chemical parameter set have been added (acid dissociation constant, bioconcentration factors for stem and root).

- The user can now define groundwater as a direct source of drinking water in the run definition.

For information about obtaining the program, the updated User Guide, the Reference Manual, and costs of the program, contact Dr. W Veerkamp, Environmental Affairs, Health, Safety and Environment Division, Shell Internationale Petroleum Maatschappij B V., Postbus 162, 2501 The Hague, Netherlands, telephone 011-31-70-377-2810.

WAYS IN WHICH HESP CAN BE USED IN THE US

In reviewing the model, two immediate uses arise for the HESP model at US facilities.

1. Multinational corporations with facilities in the US and Europe are generally required to use the cleanup approach preferred by the country in which the facility is located. However, different approaches can result in vastly different outcomes, thus posing internal management policy questions regarding consistency of corporate approach throughout a company's international operations.

2. Within the US, companies or agencies with several sites can use HESP to prioritize remediation efforts at multiple sites using this streamlined approach. Although the results may not be directly comparable to risk estimates generated by EPA, HESP nonetheless will provide a scientific basis for a general ranking. The more sites to rank, the more attractive this option becomes.

Updates will be published as new information becomes available.

CONTENT	ECETOC – HESP	US EPA	COMPARISON
A. GENERAL METHODOLOGY			
Name of method	Hazard assessment. Calculates exposure, not risk, & compares to max. tolerated exp	Risk assessment	Different
Major steps	Release estimation, preliminary assess , definitive hazard assess., effects assess.	Emission estimation, screening analysis, exposure assess., toxicity assess., risk characterization	Similar
Key variables	PEC (Predicted Environmental Conc'n)	ADD (Av Daily Dose), LADD (Lifetime Dose, for carcinogens)	Different
Key criteria	PNEC (Predicted No Effect Conc'n)	RfD, RfC, CSF -- more developed	Different, EPA is more complete
Carcinogenic/noncarc	Nonspecified	Specified	Different
Applicable sources	Soil	Multiple sources	Quite different
Applicable environ. media	Air, water, soil, sediment, biomass	Air, water, soil, sediment, food chain	Same
B. MODEL DESCRIPTION			
Name	Human Exposure to Soil Pollutants (HESP)	Multipathway Health Risk Assessment (MPHRA)	
Model style	Integrated software program; 108 equations, ca. 90 fixed parameters	Extensive documentation and guidance	HESP is better organized, easier
Basic structure	Site-specific and default data-> Preliminary exp & hazard assess.-> Definitive exposure & hazard assess -> Risk assessment (not completed)	Site-specific and default data-> Dispersion modeling-> Exposure assessment-> Toxicity assessment-> Risk characterization	MPHRA is more complete, HESP is mainly for exposure assessment

COMPARISON OF EUROPEAN AND US METHODS FOR DETERMINING SITE CLEANUP LEVELS

CONTENT	ECETOC -- HESP	US EPA	COMPARISON
B. MODEL DESCR. (CONT.)			
Focus point	Soil contamination	Air, surface water and soil contaminations	MPHRA is more complete
Applicable category	Contaminated soil sites	Waste incineration, cement kiln, waste-to-fuel facilities	MPHRA can be used for more applications
Scientific background	Solid	Solid	Comparable, each has its specific advantages, both provide calculations
Ease of use	Very good	Moderate to difficult	HESP is much easier to use
C. SITE INFORMATION			
Sampling procedures	Presented	Presented	HESP is more detailed+D89
Characteriz'n of contam'ts	Requirements specified	Requirements specified	Same
Characterization of media	Soil only	All the media	Same soil characterization requirements
Characterization of fate of contamin'ts in envir. media	Soil only	Soil and surface water	Same contaminant fate study in soil
Analytical method for sample analysis	Specified	Specified	Similar requirements, methods
D. EXPOSURE ASSESSMENT			
Inhalation pathways	Inhalation of: vapor in indoor and basement air vapor during showering vapor and particles in outdoor air	Inhalation of: vapor and particles in outdoor air	HESP has much more complete & sophisticated considerations in calcul'n of indoor & outdoor air concentration HESP incl. 2 more pathways.

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D. EXP. ASSESSMENT (CONT.)			
Ingestion pathways	Ingestion of: soil crops meat and dairy products fish drinking water	Ingestion of: soil plants meat and dairy products fish drinking water surface water during swimming breast milk	Methodologies in calcul'n of exposure point conc'ns for HESP and MPHRA differ MPHRA has more complete considerations and more sophisticated methodology. MPHRA has 2 more pathways.
Dermal absorption pathways	Dermal absorption from: contact of soil and dust contact of surf. water -- swimming contact of water -- bathing/showering	Dermal absorption from contact of soil and dust contact of surf water -- swimming	Calcul'ns of exposure concentrations in HESP and MPHRA are similar HESP incl. 1 more pathway.
Dose estimation	Absorbed dose	Average daily dose Lifetime daily average dose	Methods in HESP & MPHRA are similar; but HESP does not distingush between carc & noncarc doses.
Output	Total est. human exp. by contaminant & equilibrium conc'n of contam.between various environmental compartments	Total risks by contaminant	
E. PRELIMINARY ASSESSMENT (SCREEN)	Specified	Specified	Similar req'ts, methods
F. TOXICITY ASSESSMENT	Not included	Included	MPHRA is more complete
G. RISK CHARACTERIZATION	Not included	Included	MPHRA is more complete. Incl. statisical analyses.
H. COST/TIME TO COMPLETE	Low-moderate.	High	