INDUSTRY

DHI SOLUTION

LEACHING EXPERT SYSTEM

LeachXS: A database/expert Decision Support System (DSS) coupled with geochemical modelling

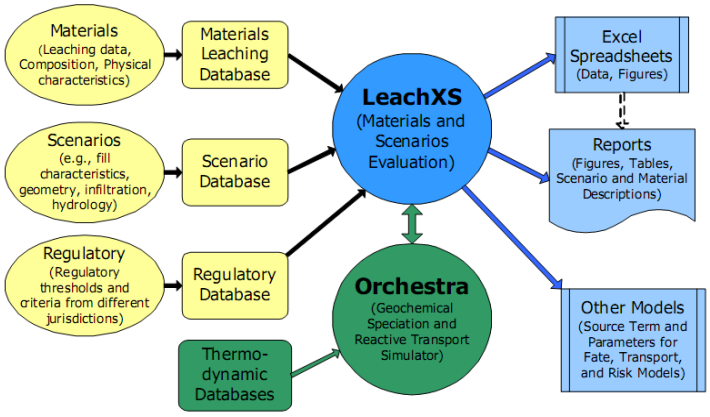
LeachXS is a database/expert Decision Support System (DSS) for characterisation and Environmental Impact Assessments (EIAs). It is based on contaminant release as derived from leaching tests, including, batch, column, and tank tests as well as pH-static leaching tests. LeachXS may be applied to soils, sludge, sediments, combustion residues, municipal waste, industrial and hazardous wastes, mining waste, construction and demolition (C&D) waste, treated or stabilised waste, and numerous other wastes and materials. It is continuously being developed by the Energy Research Centre of the Netherlands (ECN), Vanderbilt University (United States) and DHI Denmark.

A WASTE MANAGEMENT DATABASE/EXPERT DSS

LeachXS contains laboratory leaching and lysimeter tests results as well as field and composition data. It supports the interpretation of leaching data to provide estimates of short- and long-term release of the contaminants of interest, which comprises:

- all common inorganic constituents
- a selection of organic components
- radionuclides

This makes LeachXS a unique tool to study the release behaviour of different materials when used, recycled or landfilled.



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SUMMARY

CLIENT

- Waste producers (for example, incineration, mining and construction companies)
- Waste management industries
- Consultants and contractors
- Public authorities

CHALLENGE

- Difficulty systematically interpreting and managing large quantities of analytical data
- Difficulty comparing leaching data obtained by different methods
- Complicated process involved in simultaneously assessing the equilibrium between numerous interacting types of chemical substances (species)
- Differences in compliance criteria for specific waste management options between countries

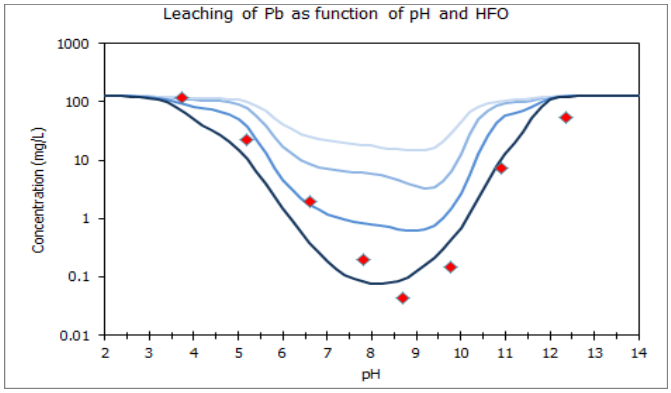
SOLUTION

- A database Decision Support System (DSS) allowing for standardised formatting and graphical presentation of data for virtually all elements of interest
- Geochemical modelling option implemented in order to support/explain the observed release trends and test proposed solutions

VALUE

- Cost-efficient data management and reporting
- Standardised formatting and graphical presentation including Quality Control and check for consistency
- Enabling comparison of data against criteria for specific utilisation or disposal options
- Facilitation of efforts to comply with environmental regulations for recycling, waste management, contaminated soil and sediment assessment, fertiliser use and construction product use

A regulatory database in LeachXS allows for the comparison of test data against criteria for specific utilisation or disposal conditions. The regulatory database may be tailored to different countries and applications. Geochemical speciation and chemical reaction/transport modelling capabilities are integrated into LeachXS by using the modelling environment ORCHESTRA. Geochemical modelling includes mineral solubility, sorption on aluminium/iron/manganese oxides, sorption on clay, and complexation with dissolved organic carbon and particulate organic carbon.



Example of optimisation of leaching of lead (Pb) by addition of reactive iron surfaces (HFO) at pH 3-13. Points represent laboratory data from CEN/TS 14997 pH-static leaching test while lines represent model predictions of dissolved Pb at different HFO levels. © DHI

THE FUNCTIONS OF THE SYSTEM

Evaluation guidance:

- problem definition
- selection of characterisation needs and methods
- detailed methodologies
- provision of existing information on characteristics and behaviour of materials similar to those in question

Laboratory guidance:

- lysimeter and field data collection (including experimental design and quality control considerations) of statistical data evaluation
- exploits existing information from similar pilot and field evaluations

Data management:

- standardised formatting and graphical presentation (including consistency and quality control checking) of statistical data evaluation
- data mining
- pH and redox dependency of aqueous concentrations, geochemical speciation, acid/base neutralisation capacity, leaching potential (availability) from batch testing
- release of contaminants as a function of time for granular and monolithic materials from sequential data sets including chemical speciation and mass transfer parameter estimation
- quality control based on the use of simplified testing in comparison with earlier, more detailed characterisations of the same or comparable materials

Source term descriptions:

- estimation of substance release as a function of time for default or user-defined applications or management scenarios, including:
- selection of appropriate source term models
- evaluating the effects of potential external influences (for example, mixing, carbonation, oxidation, reduction, and acidification)
- uncertainty analysis

Impact evaluation:

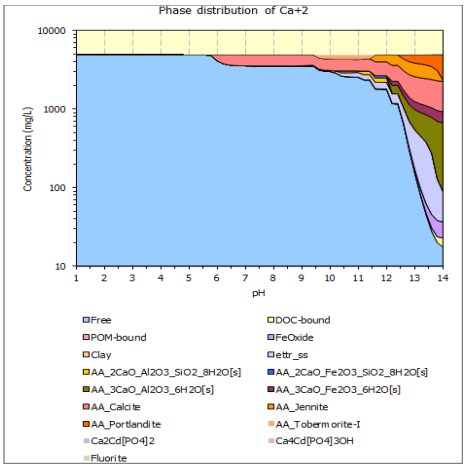
- potential impact on soil, groundwater or surface water and risk estimation, including the application of default or user-defined transport and fate scenarios

Decision algorithms:

- comparison of evaluation results and decision-making based on regulatory criteria from different jurisdictions
- recommendations on reduced-testing quality control programmes
- recommendations on approaches to reduce substances release and environmental impacts

A FLEXIBLE SOLUTION

LeachXS is a very flexible tool and it can be adjusted to the client's needs. It can be used for, among other things, data-handling, reporting and statistical analysis of data as well as process optimisation and impact assessments (using the geochemical modelling). LeachXS contains data conversion tools based on Microsoft Excel and a data import tool for a Microsoft Access database. This way, the user may insert his/her own data into LeachXS and obtain the desired answer or result.



Example of calculated distribution of calcium (Ca) between mineral phases controlling its release from recycled concrete aggregate at different pH values. © ECN

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