



BARC Questionnaire

BARC would like to thank all those who took the time to complete the questionnaire that was circulated along with the first BARC newsletter after the Workshop on Bioaccessibility held in Toronto in late 2006. The questionnaire returned a 64-percent response rate and, from the information gathered, it is clear that a wide range of research is being undertaken. A full examination of the information is under way; however the initial data indicate that both physiological and chemical extraction methods are being used for the determination of the bioaccessible chemicals of potential concern (CoPCs) in a variety of soil-particle sizes (ranging from $<38\mu\text{m}$ to $<250\mu\text{m}$).



Methods currently used to measure bioaccessibility as an input in risk estimation include the physiologically based extraction test (PBET); the in-vitro gastrointestinal (IVG) method; the Simulator of the Human Intestinal Microbial Ecosystem (SHIME) method and the SBRC/Solubility Bioaccessibility Research Consortium method. Data from the questionnaire indicate that a variety of CoPCs are gaining attention from both industry and research facilities. In addition to arsenic and lead, which are assumed to be validated against in-vivo data for a number of methods for certain soil types, the bioaccessibility of barium, cadmium, chromium, cobalt, copper, mercury, nickel, selenium and zinc have been investigated. However compared with in-vivo models, the validation of the model of choice for these elements is not necessarily complete.

This highlights a number of questions that need to be addressed: i) how well do the in-vitro models predict bioaccessibility for elements with no in-vivo or validation data available; ii) should un-validated in-vitro models be used to generate data for input into the risk calculation; iii) is validation being undertaken or is it proposed for these elements; and iv) is there a need to validate the models using in-vivo data, or are there options to show that the methods are applicable. The final question, raised in the Health Canada workshop in December, 2006, by Bruce Conard and discussed further here, is food for thought for all those involved in measuring bioaccessibility for use in risk assessments.

Bioaccessibility Workshop

In December, 2006, as part of its task under the Federal Contaminated Sites Action Plan, Health Canada sponsored a bioaccessibility/bioavailability workshop held in Toronto at the Marriot Hotel. The aim was to seek an industry-based perspective on issues regarding this area of research, so that future research efforts would be relevant. Representatives from more than 15 different industry and academic institutions were present at the two-day workshop. The workshop was co-chaired by Drs. Beverley Hale of the University of Guelph and Ken Reimer from the Royal Military College of Canada. The proceedings of the workshop are available at www.cntc.ca.



Several conclusions were reached in the workshop, with proposed short-, medium- and long-term goals for the future of Health Canada-sponsored bioaccessibility research in Canada. It was agreed that the immediate research priority is to conduct a number of in-vivo feeding studies using inorganic materials with elevated total metal concentrations. These should be available in sufficient quantities so that more studies can be carried out by researchers at will.

The medium-term research goal was to test several methods in different laboratories but using the same materials (ideally those investigated in the short-term research objective, above), to identify the tests that best predict or correlate with the in-vivo data, as gathered above. This exercise will establish performance standards and standard operating procedures (SOPs) for the preferred methods. Such guidance documents are absolutely essential.

The long-term research objective is to build a mechanistic understanding of the factors that control bioaccessibility of contaminants in environmental media that are ingested or inhaled. The other part of accomplishing this goal is to undertake a meta-analysis of data that exist now. This will mine data in both the peer-reviewed literature and the "grey" literature that many proponents involved in land contamination possess.

One of the main conclusions drawn from the workshop was that bioaccessibility estimates are not acceptable without in-vivo validation, and an Ontario Ministry of the Environment (MOE) representative stated that only validated methods would be considered. A view was put forward suggesting that in-vivo validation was not critical, and that the common goal should be to improve the assessment of risk at a location. In order to achieve this, a better

understanding of the source contaminant is required, and the measured bioaccessibility does not (and need not) equal bioavailability. Furthermore, considering that as long as the bioaccessibility test and the method by which the RfD is determined are similar, one can obtain meaningful information (i.e. a better, but still conservative, appreciation of risk) in the near term. This approach, if accepted, could hasten the application of bioaccessibility testing to a larger number of substances, and thereby address a Health Canada concern.

The Way Forward

Soil bioaccessibility data provided by Canadian laboratories are currently accepted at face value. They are considered to be reliable and directly comparable with data provided by other laboratories. However, because of the evolution of methodologies and a requirement for good laboratory practice, quality assurance/quality control studies must be conducted using a commercially available reference material.

Recently, concerns have been raised over access to commercially available reference soils for bioaccessibility and bioavailability research and commercial data collection. The worldwide availability of two widely used reference soils, NIST 2710 and 2711 are beginning to run out, and alternatives must be found. To this end, the BARC Group is in talks with Health Canada regarding a BARC round robin study and the possible creation of one or more Canadian reference soils. The potential creation of Canadian reference soils is in the early stages, and as such there is a need for the participation of the research and industrial communities who utilize bioaccessibility tests. The BARC group would like contributions from the bioaccessibility community (academia and industry) regarding several aspects of the decision-making process, including the contaminants of current interest (and potential future contaminants that may come under the spotlight) and possible locations where these may be present either through natural or anthropogenic processes and the contaminated soil is available in large enough quantities (i.e. 1 metric tonne) to be collected and prepared for the required purposes.

The round robin study proposed by BARC and Health Canada will investigate the scale of bioaccessibility testing in laboratories across Canada, to consider the range of methods used and the spread of data reported by those methods. Such a study would assess the performance of individual laboratories to ensure that data are reliable and comparable, despite minor methodological differences. It is proposed that all participating laboratories provide i) bioaccessibility data for a BARC-chosen soil generated by their own in-house method, as well as a sub-sample for analysis by an independent laboratory accredited by the Canadian Association for Environmental Analytical Laboratories (CAEAL); and ii) bioaccessibility data for a BARC-chosen soil, using a BARC-chosen method as well as a sub-sample for analysis by an independent CAEAL-accredited laboratory. It is hoped that the resulting data will provide the backbone for all future BARC research efforts and a peer-reviewed paper for the group.

A startup meeting will be held in Toronto in late August or early September, 2007, to plan the round robin and solicit input from interested parties regarding, among other things, possibilities for the reference materials. It is expected that the project will begin immediately afterward. A further technical group meeting is proposed for February/March, 2008, to discuss the initial results, prior to the presentation of findings at a conference related to Federal contaminated sites.

Further BARC meetings/workshops to encourage both academic and industrial participation to be held in various Canadian cities are proposed throughout the life of the round-robin study and subsequent BARC projects.

To facilitate the process of advancing bioaccessibility as a useful tool for the assessment of risk at contaminated sites, a desk study will be undertaken that will include a questionnaire. This study will identify data gaps between regulatory requirements (and what information the risk-assessment community requests from laboratories) and what data and information laboratories that carry out bioaccessibility testing routinely provide. This questionnaire will guide the decisions made for the technical aspects of the round-robin study as well as provide an initial benchmark indication of current laboratories undertaking bioaccessibility testing.

Bioaccessibility/Bioavailability Discussion Forum



The BARGE group is in the process of setting up an on-line discussion forum. This is intended to be a place where both the research and risk assessment communities involved with bioaccessibility can come together and discuss issues. Further details will be posted shortly on the BARGE website at www.bgs.ac.uk/barge.