

## Liz Mittal, M.S.

SENIOR ENGINEER I

### CONTACT INFORMATION

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### PROFESSIONAL PROFILE

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Ms. Liz Mittal is a Senior Engineer I in ToxStrategies' Houston, Texas, office. She has more than 10 years of experience in human health risk assessment, environmental modeling, and computational analysis. Ms. Mittal has conducted numerous human health risk assessments (e.g., Superfund, consumer, occupational, and radiological), evaluating risk from various exposure pathways, both deterministically and probabilistically. She has managed and statistically analyzed extensive environmental and industrial hygiene data sets. She has developed indoor air models to assess risks from household consumer products, and she is also experienced in AERMOD dispersion modeling to predict ambient air concentrations resulting from releases to air. Ms. Mittal's expertise also includes conducting dose-response modeling to derive points of departure. She has used geographic information system (GIS) software to support quantitative assessments. Prior to her work in environmental engineering, she was a practicing chemical engineer in the semiconductor industry, designing and fabricating devices, and optimizing key manufacturing processes.

Ms. Mittal holds a master's degree from the University of Texas at Austin, in Environmental and Water Resources Engineering. Her graduate research focused on innovative approaches to characterizing and monitoring exposure to sediment contaminants during remediation. She has conducted field studies using passive sampling techniques to evaluate the effectiveness of remedy caps at Superfund sites. She has also conducted laboratory investigations to quantify the sorption of contaminants onto various amendments for capping remedies.

### EDUCATION AND DEGREES EARNED

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- 2010 M.S. in Environmental and Water Resources Engineering  
University of Texas at Austin
- 2003 B.S. in Chemical Engineering  
Texas A&M University

## SELECTED PROFESSIONAL EXPERIENCE

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### *Human Health Risk Assessments*

Conducted a human health risk assessment to establish remediation goals for dioxins and furans in soil for a former wood treating site in Canada that is to be repurposed to an urban residential development. Performed the 1-D probabilistic risk assessment using Oracle® Crystal Ball.

Determined maximum allowable concentrations for PFAS in containers—levels that are protective of consumer exposures. Considered acceptable margin-of-exposure (MOE) for residential application and post-application exposures, and also predicted various environmental media concentrations.

Compiled and statistically analyzed an extensive data set of workplace monitoring data from multiple companies in support of a TSCA risk evaluation. Conducted the analysis in R and incorporated Kaplan-Meier statistics, as well as conventional imputation techniques.

Conducted a spatial risk assessment of a 300-acre federal complex that used to manufacture airplanes and non-nuclear components for nuclear weapons. The project included managing and analyzing numerous environmental data sets from the 1980s through the present. Calculated carcinogenic risks and non-cancer hazard quotients for potential chemicals of concern for various receptors (e.g., outdoor, construction, and trench utility workers), and used ArcGIS to identify and graphically present areas of concern for remediation or risk management strategies.

Performed a human health risk assessment for recreational exposure to Lower Passaic River mudflat sediments containing a variety of contaminants such as PCDD/Fs, PCBs, metals, and other organics. This project involved establishing a screen for identifying the chemicals of concern, as well as reducing the large data set to determine descriptive statistics of exposure-point concentrations. Both deterministic and probabilistic risk assessments were developed to determine risk and hazard from the defined exposure scenarios. Additionally, advanced techniques were employed to quantitatively allocate the risk among potential sources.

Analyzed an extensive ambient air data set on particulate matter (PM) to evaluate whether air quality could adversely affect a residential community in the vicinity of several potential sources. Further, conducted statistical analysis of various wind directions in conjunction with PM data to determine whether the contribution from one potential source was elevated significantly.

Provided QA support for an Assembly Bill 2588 (AB2588) health risk assessment for residents in the vicinity of a metal-forging plant in California. Characterized emission rates from stack-test data and emission factor estimates for several processes at the plant. Linked the results of air dispersion modeling to the integrated risk assessment module HARP (Hotspots Analysis and Reporting Program). Additionally, evaluated the impact of implementing changes to baghouse stack heights.

Derived alternative preliminary remediation goals to be protective of fish and crab ingestion from the Lower Passaic River (LPR). The effort was a collaborative effort among three consulting firms to combine an empirical bioaccumulation model, LPR angler survey-derived ingestion rates, and a probabilistic risk platform. These alternative PRGs were presented as comments on the Focused Feasibility Study issued in 2014 by USEPA Region 2.

Conducted a margin-of-exposure assessment to determine whether the levels of a banned azo-dye detected in a textile could pose a health risk to consumers. This project included a detailed review of toxicity associated with the banned azo-dye. Additionally, derived exposure concentrations based on transfer factors that characterize the migration of the dye via leaching in sweat from the textile to the skin.

Developed a risk assessment platform that incorporated results from an indoor air quality dispersion model and determined inhalation risk for household consumer products. The platform was based on the output of an indoor air mass-balance model that had the ability to incorporate gas-phase reactions and sink depositions. The tool enables users to assess the chronic cancer risk based on product formulations and can be used to determine maximum allowable concentrations in product design.

Derived estimated daily intake (EDI) levels for a new ingredient's Generally Recognized as Safe (GRAS) notification. The EDI assessment involved analyzing National Health and Nutrition Examination Survey (NHANES) dietary data for various food categories and proposed uses with the R statistical program.

### ***Epidemiology***

Used geographic information system (GIS) software to identify census tracts of interest using distance-based methods and geospatial statistics-based methods for use in epidemiological analysis.

Conducted a meta-analysis to understand the impact of selecting alternative risk ratio values from peer-reviewed publications on risks for chromium-exposed cohorts.

Analyzed NHANES survey data to characterize thyroid hormone effects from environmental exposures to goitrogenic chemicals.

Maintained a database of occupational history and reconstructed exposure doses for workers at a chromate production plant operating from the 1940s into the 1970s. This evaluation expanded on a previously published dose-response analysis for this plant by expanding the original cohort to also include short-term workers.

### ***Evaluation of Chemical Characteristics and Toxicity***

Used QSAR to assess ready biodegradability in support of market claims for an extensive database of chemicals. Performed batch testing of ready biodegradability using EPA's EPI Suite BOWIN module, along with an R-tool developed in-house to assess applicable domain for the model predictions. Additionally, used OPERA as a secondary tool to provide additional predictions. For a subset of the database, compared predictions to empirical data to assess BOWIN's and OPERA's balanced accuracy and positive predictive value.

Provided QA support in developing an inhalation reference value for titanium dioxide by performing a complete reproduction of multi-path particle dosimetry modeling (MPPD) and dose-response modeling (using EPA's Benchmark Dose Modeling Software, BMDS).

Conducted a physico-chemical property search for an extensive list of chemicals under consideration for the Endocrine Disruptor Screening Program (EDSP), to determine whether chemical properties (e.g., solubility, hydrolysis, photolysis, volatility, etc.) conflict with specific assay testing requirements.

Conducted statistical analysis of an extensive database of toxicity data using various point-of-departure (POD) methods to help develop a standard approach to establishing PODs for genotoxic compounds. The points of departure included no-observed-genotoxic-effects level (NOGEL), bilinear modeling (for evaluating thresholds), and benchmark dose modeling.

Performed dose-response modeling for dioxin and dioxin-like compounds based on a peer-reviewed tiered modeling approach that uses EPA BMDS and GraphPad Prism. This study resulted in revised benchmark doses (BMDs) and half-maximal effective concentrations (EC<sub>50s</sub>), which were then used to calculate relative effect potencies (REPs). The impact of these revised REPs on the WHO<sub>2004</sub> REP database distribution is currently under evaluation.

### ***Development of Analytical Methods***

Conducted a field study at the McCormick and Baxter Superfund site to evaluate the effectiveness of the sediment cap remedy. This study used the polydimethylsiloxane (PDMS) profiler, a passive sampling technique, to quantify polyaromatic hydrocarbons in the porewater of the cap, and thereby to characterize chemical migration. The analysis included vertical profiling, statistical determination of areas of concern, and comparison of performance metrics between the PDMS sampler and the traditional analytical method.

Performed an extensive calibration of the PDMS fiber using water collected from the Pacific Sound Resources Superfund site. The study was designed to traverse a wide range of concentrations, to determine site-specific partitioning coefficients for the 16 EPA Priority PAHs for subsequent use in field applications. Additionally, characterized uptake kinetics and the volatilization of PAHs from the fiber.

### ***Process Engineering***

Conducted a series of experiments to evaluate a new low-temperature processing technique for contact etch. The study included optimizing gas flows to accommodate the lower temperature condition and the different chamber configuration. This new process was implemented into the manufacturing flow and provided increased throughput and improved flexibility.

Used SixSigma methods and Design of Experiments to identify key parameters contributing to semiconductor manufacturing process issues (i.e., edge-treatment arcing). In doing so, established standard operating procedure for determining process windows used in process control.

Used Fathom FFT to develop a simulation model of the distribution of utilities through the hexamethylene diisocyanate (HDI) unit at a plant in Baytown, Texas. The study involved incorporating actual piping configurations that were inconsistent with design piping and instrumentation diagrams into the Fathom model. Identified bottlenecks and alternative distribution patterns to improve efficiency in utilities usage.

## **COMPUTER & LANGUAGE SKILLS**

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RESRAD-onsite, AERMOD, R statistical language, ProUCL, ArcGIS, EPI Suite, OPERA, AIHA IH SkinPerm, AIHA IHMod, Hotspots Analysis and Reporting Program (HARP), Benchmark Dose Modeling (BMDS), Regional Deposited Dose Ratio (RDDR), Multiple-Path Particle Dosimetry Model (MPPD), RSEI-GM, SEERStat, ConsEXPO, U.S. EPA Tool kit for Indoor Air Quality and Inhalation Exposure Model (IAQX), Oracle Crystal Ball

## **PUBLICATIONS**

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**Mittal L**, Perry C, Blanchette AD, Proctor DM. 2024. Probabilistic risk assessment of residential exposure to electric arc furnace steel slag using Bayesian model of relative bioavailability and PBPK modeling of manganese. Risk Anal, [open access](#).

Panko J, **Mittal L**, Franke K, Maberti S, Zollers S, Millison K, et al. 2023. Industry-wide review of potential worker exposure to 1,3-butadiene during chemical manufacturing and processing as a reactant. J Occup Environ Hyg; doi: 10.1080/15459624.2023.2264329.

Verwiel A, Racz L, **Mittal L**, Rish W. 2022. CDC's national report on human exposure to environmental chemicals. SETAC Globe 23(6), [https://globe.setac.org/cdc\\_report\\_human\\_exposure\\_to\\_chemicals/](https://globe.setac.org/cdc_report_human_exposure_to_chemicals/).

- Suh M, Wikoff D, Lipworth L, Goodman M, Fitch S, **Mittal L**, Ring C, Proctor D. 2019. Hexavalent chromium and stomach cancer: A systematic review and meta-analysis. *Crit Rev Toxicol* [ePub ahead of print]: doi: 10.1080/10408444.2019.1578730.
- Thompson CM, Suh M, **Mittal L**, Wikoff D, Welsh B, Proctor DM. 2016. Development of linear and threshold no significant risk levels for inhalation exposure to titanium dioxide using systematic review and mode of action considerations. *Regul Toxicol Pharmacol* 80:60–70.
- Suh M, Thompson CM, Brorby GP, **Mittal L**, Proctor DM. 2016. Inhalation cancer risk assessment of cobalt metal. *Regul Toxicol Pharmacol* 79:74–82.
- Thompson CM, Seiter J, Chappell MA, Tappero RV, Proctor DM, Suh M, Wolf JC, Haws LC, Vitale R, **Mittal L**, Kirman CR, Hays SM, Harris MA. 2015. Synchrotron-based imaging of chromium and  $\gamma$ -H2AX immunostaining in the duodenum following repeated exposure to Cr(VI) in drinking water. *Toxicol Sci* 143(1):16–25.
- Proctor DM, Suh M, **Mittal L**, Hirsch S, Salgado RV, Bartlett C, Van Landingham C, Rohr A, Crump K. 2015. Inhalation cancer risk assessment of hexavalent chromium based on updated mortality for Painesville chromate production workers. *J Expo Sci Environ Epidemiol* 26(2):224–231; doi: 10.1038/jes.2015.77.
- Suh M, Thompson C, Kirman C, Carakostas M, Haws LC, Harris M, Proctor D, **Abraham L**, Hixon JG. 2014. High concentrations of hexavalent chromium in drinking water alter iron homeostasis in F344 rats and B6C3F1 mice. *Food Chem Toxicol* doi: 10.1016/j.fct.2014.01.009.
- Suh M, **Abraham L**, Hixon JG, Proctor D. 2014. The effects of perchlorate, nitrate, and thiocyanate on free thyroxine for potentially sensitive subpopulations of the 2001–2002 and 2007–2008 National Health and Nutrition Examination Surveys. *J Expos Sci Epidemiol* 2013:1–9.
- Bunch AG, Perry CS, **Abraham L**, Wikoff DS, Tachovsky JA, Hixon JG, Urban JD, Harris MA, Haws LC. 2014. Evaluation of impact of shale gas operations in the Barnett Shale region on volatile organic compounds in air and potential human health risks. *Sci Tot Environ* 468–469:832–842.
- Thompson CM, Fedorov Y, Brown DD, Suh M, Proctor DM, **Kuriakose L**, Haws LC, Harris MA. 2012. Assessment of Cr(VI)-induced cytotoxicity and genotoxicity using high content analysis. *PLoS ONE* 7(8):e42720.
- Qian YC, Zheng Y, **Abraham L**, Ramos K, Castiglioni E. 2005. Differential profiles of copper-induced ROS generation in human neuroblastoma and astrocytoma cells. *Molec Brain Res* 134(2):323–332.

## PRESENTATIONS

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- Racz L, **Mittal L**, Perry CS, Blanchette A, Proctor D. Assessing sustainable applications of electric arc furnace steel slag as construction aggregate: Applications of probabilistic risk assessment and physiologically-based pharmacokinetic modeling. Poster presentation at Society of Environmental Toxicology and Chemistry North America 44<sup>th</sup> Annual Meeting, Louisville, KY, November 2023.
- Proctor D, **Mittal L**, Vivanco S, Perry C, Blanchette A. Probabilistic health risk assessment for residential exposures to metals in electric arc furnace (EAF) steel slag. Presentation 5.15.P-Th123 to Society of Environmental Toxicology and Chemistry, Pittsburgh PA, November 2022.
- Proctor DM, **Mittal L**, Vivanco S, Antonijevic T. Probabilistic health risk assessment for residential exposures to metals in electric arc furnace (EAF) steel slag. Poster at Society of Environmental Toxicology and Chemistry (SETAC), Philadelphia, PA, November 2022.

Thompson CM, Chappell GA, **Mittal L**, Gorman B, Proctor DM, Haws LC, Harris MA. Use of targeted mode-of-action research to inform human health risk assessment of hexavalent chromium. Poster presented at Society of Toxicology Annual Meeting, San Diego, CA, March 2022

Perry C, Rish W, Ring C, **Mittal L**, Harris M. Use of probabilistic risk assessment and physiologically based pharmacokinetic modeling in supporting soil remedial objectives for dioxins and furans at a Canadian site. Poster for Society for Risk Analysis, Virtual Annual Meeting, 2020.

**Mittal L**, Leber P, Hillwalker W, Kowalczyk A, Panko J. QSAR tools to estimate ready biodegradability of chemicals: Critical evaluation for implementation in market decisions. Platform presentation at Society of Environmental Toxicology and Chemistry, Annual Meeting, November 2020.

Suh M, Harvey S, Wikoff D, **Mittal L**, Ring C, Goodmanson A, Proctor D. Meta-analysis of hexavalent chromium and stomach cancer. Poster presented at Society of Toxicology Annual Meeting, Baltimore, MD, March 2017.

**Abraham L**, Harris MA, Perry CS, Urban JD, Wikoff DS, Kinnell JC, Bingham M, Hickman S. Lower Passaic River RM0-8: An alternative preliminary remediation goal. Presented at the Battelle Sediments Conference, New Orleans, LA, January 2015.

Hixon JG, Thompson C, Bichteler A, **Abraham L**. Smoothing regression splines as the basis for dose-response modeling. Presented at the Society of Toxicology's 53rd Annual Meeting, Phoenix, AZ, March 2014.

Proctor DM, Suh M, Tachovsky JA, **Abraham L**, Hixon JG, Brorby GP, Campleman SL. Cumulative risk assessment of urban air toxics: A pilot study in San Antonio, Texas. Presented at the Society of Toxicology's 53rd Annual Meeting, Phoenix, AZ, March 2014.

Reible DD, **Kuriakose L**, Blischke H, Manzano S. Evaluating sediment cap performance with PDMS profilers: Field study of McCormick and Baxter Superfund site. Battelle Sixth International Conference on Remediation of Contaminated Sediments, New Orleans, LA, February 2011.

Blischke H, Reible DD, **Kuriakose L**, Manzano S. Evaluation of solid phase microextraction for long term sediment cap performance at the McCormick and Baxter Superfund site. SETAC North America 31st Annual Meeting, Portland, OR, November 2010.