

A Design for DECON

Sarah E. Katoski¹, John P. Davies¹, Brianna M. Leija², Shawn Funk¹

¹U.S. Army Combat Capabilities Development Command Chemical Biological Center, Aberdeen Proving Ground, MD, ²Precise Systems, Lexington Park, MD

ABSTRACT

Automated contamination mitigation capabilities will enable the Joint Force to improve sustainability of operations in a CBRN hazard environment and rapidly recover for a return to operational tempo after enemy employment of CBRN weapons or hazardous material. This program explores a critical area (e.g., for APODs/SPODs) autonomous decontamination capability that reduces troop-to-task logistics and risk to Warfighters with a 'design for Decon.' CBC is executing two efforts to address critical area contamination



- 1) Design and integrate a modular decontamination application payload for the Multi-Utility Tactical Transport eXpanded Mobility (MUTT-XM) that is suitable to demonstrate the concept of critical area decontamination.
- 2) Develop a decontaminant formulated from readily available commercial ingredients that can be mixed on site to address biological or chemical contamination. A formulation based on commercial ingredients aims to increase availability and lower cost.

OBJECTIVE

A Design of Experiments (DOE) was employed for the development, maturation, and evaluation of decontamination formulations to mitigate hazards associated with chem-bio agents. The DOE methodology is a systematic approach that uses statistically rigorous techniques to attenuate experimental noise thereby maximizing experimental efficiency.



The goal is to build a DOE Model capable of identifying the most promising formulations with minimal amount of experimental data.

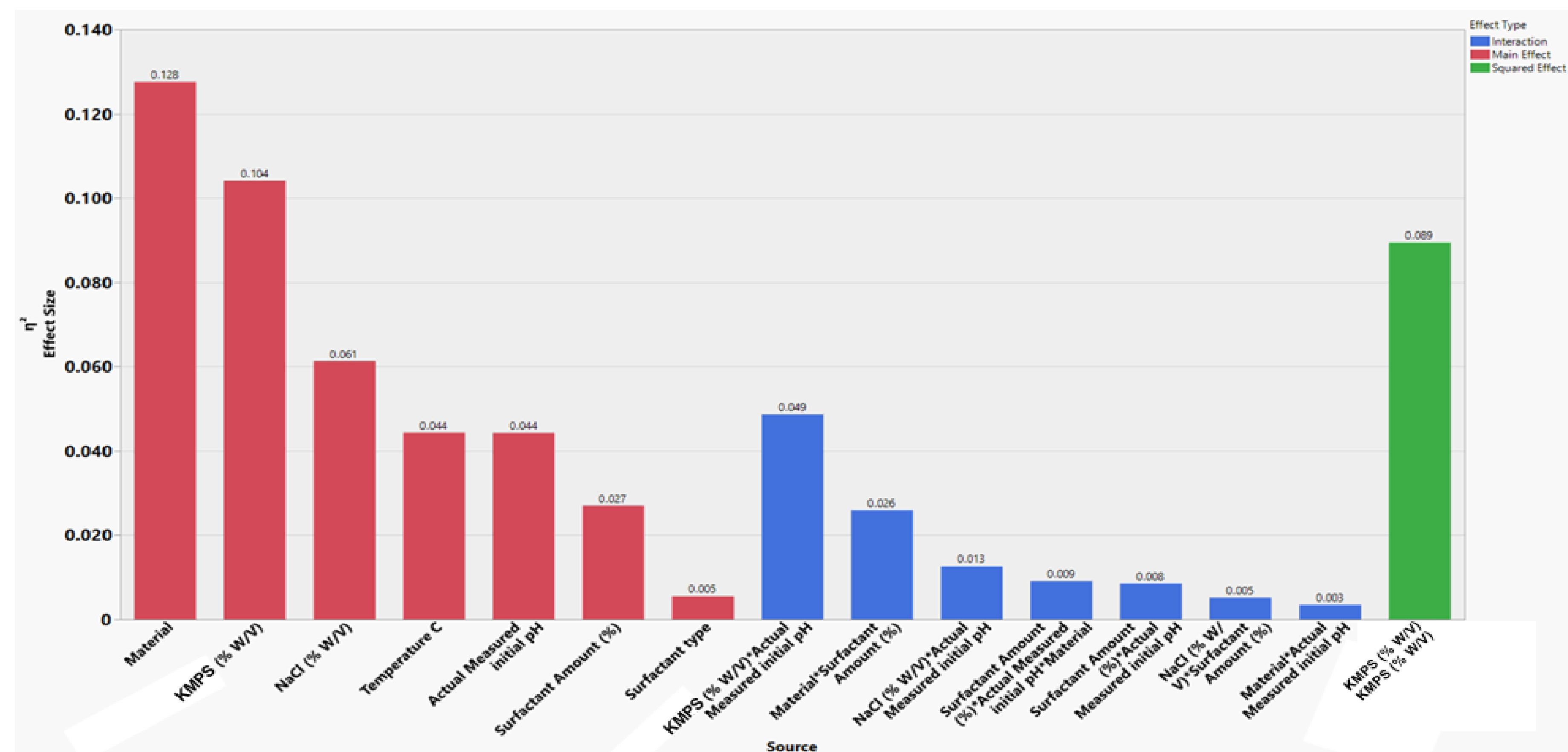


DEVCOM CBC @ DTRA CBD S&T Conference

Scan the QR Code to view all of CBC's
2024 DTRA CBD S&T Conference materials
<https://cbc.devcom.army.mil/cbdst-conference/>

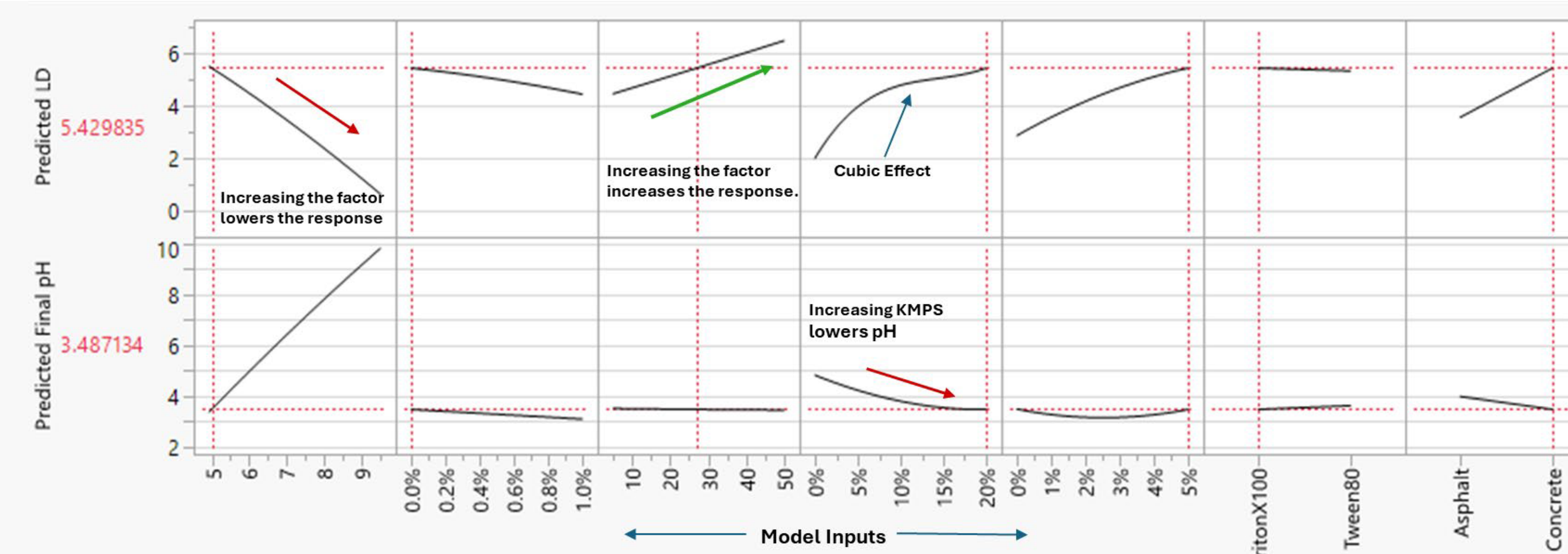
METHOD

An optimal DOE was generated with a 69-term cubic model that evaluated 95 unique sample configurations in duplicate. The model could predict main effects, squared effects and complex interactions between the seven variables. The response of interest was log reduction of agent.



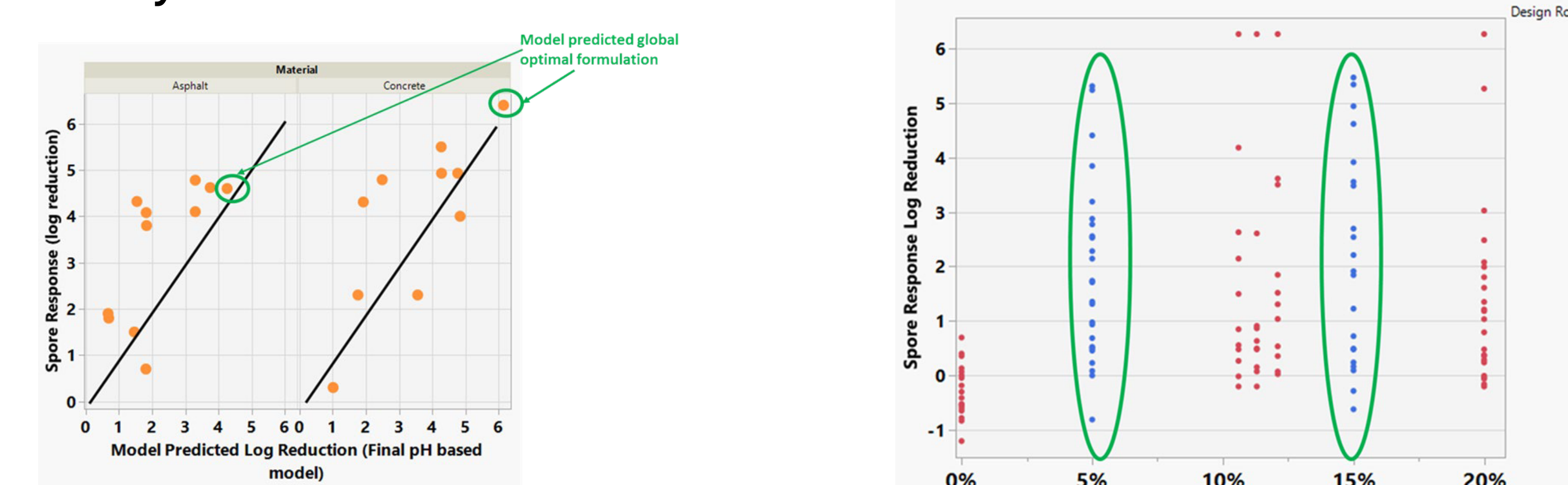
The model was used to predict three optimal formulations for maximum reduction of agent. It was determined that active ingredients were more efficient at a lower pH but the factors were sensitive to 3-way interactions.

Factor	Type	Levels
KMPS	Continuous	0% to 20% (%W/V)
NaCl	Continuous	0% to 5% (%W/V)
Surfactant	Continuous	0% to 1% (%W/V)
Temperature	Continuous	5°C to 50°C
pH	Continuous	5 to 9
Surfactant Type	Categorical	Tween80, TritonX100
Material	Categorical	Asphalt, Concrete



RESULTS

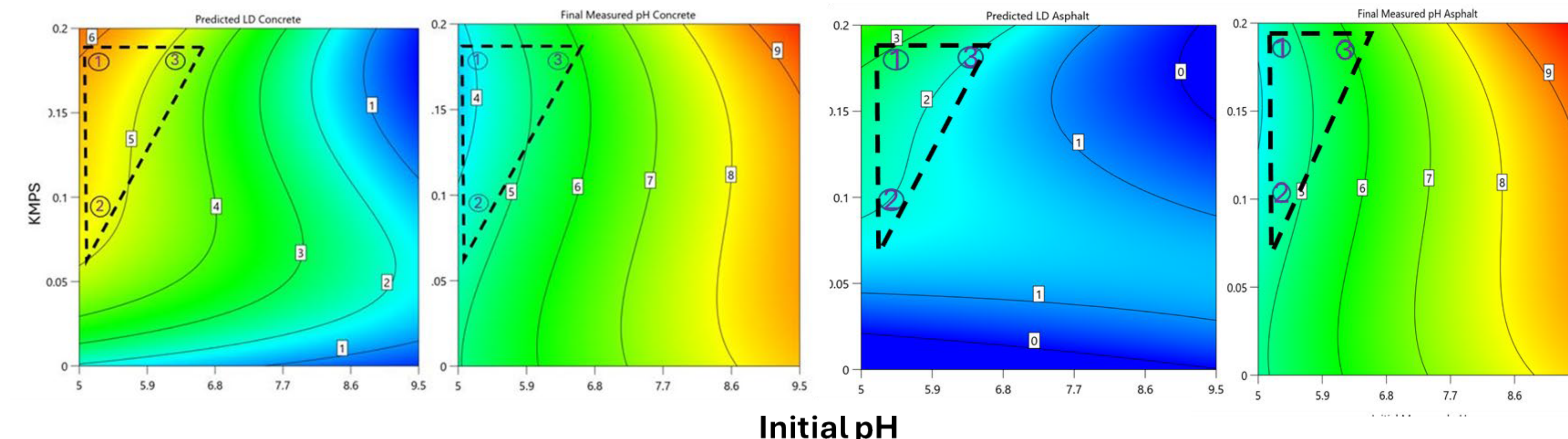
Due to operational limitations and the reactive species in the final formulations an augmented model was fit to assess trade-off scenarios: efficacy for more favorable interactions.



Formulation 1: Optimized for efficacy, is most expensive, hardest to stabilize, and extremely corrosive.

Formulation 2: Optimized with less active ingredient; increased stability, cost effective but less effective and mildly corrosive.

Formulation 3: Optimized for final pH, most stable and cost effective but least effective.



ACKNOWLEDGEMENTS

This research is funded by DTRA JSTO project CB11224, under William Buechter. The ABCAD Program includes important contributions from DEVCOM CBC Technology & Capability Demonstration (TCD) Branch, Decontamination Sciences Branch (DSB), the Advanced Design & Manufacturing (ADM) Product Realization Division and GVSC. The authors would like to express our thanks to Dr. Vipin Rastogi, Matthew Reber, Kevin Morrissey, and Janlyn Eikenberg. The views expressed in this abstract are those of the authors and do not necessarily reflect the official policy or position of the Department of Defense or the U.S. Government.