

CONCURRENT SESSION 5 – CHEMICAL AGENT DECONTAMINATION RESEARCH

Questions and Answers

- **U.S. EPA:** Question for Michael Polkabila: Can you comment on how the established clearance goal was established? Was it based on fentanyl related health data or an extrapolation from meth? How did you extrapolate from the carfentanyl from the fentanyl?
 - **Michael Polkabila, BioMax Environmental, Inc.:** The clearance criteria was established during the case study by utilizing various astute toxicologists. With them, they had the benefit to review the modeling performed by EPA relative to methamphetamine. And it was determined since we started this process, we all knew from the get-go that fentanyl was very lethal, and we would have to have clearance criteria to reference. However, there was nothing established at that time. So, the reference doses compared to various opioids and the two toxicologists we worked with provided that consultation with us and did some EPA modeling. I can forward that to anyone who is interested, contact me directly. It is elaborate modeling that in essence determined what a health base standard should be. I did see that one of the other questions mentioned the ratios between the lethality of fentanyl versus carfentanyl were not the same ratios associated with the clearance criteria, and that was simply because of the current analytical limit of detection. We were not able to get lower than 0.01 micrograms per sample so it was important for us to do the best we could and that was the lower limit of detection.
- **Anonymous:** Question for Michael Polkabila: The plan included great steps to control inhalation and dermal hazards. How important are these routes compared to usual routes of exposure, i.e., ingestion and injection?
 - **Michael Polkabila, BioMax Environmental, Inc.:** We considered all of those from an uncontrolled site standpoint. We examined inhalation hazard of powders and the residues. It was enlightening that the residues were prevalent throughout the houses. We extrapolated residue from the top of the ceiling fan in the dining room – that told us it was airborne and was very alarming and eye-opening. We considered all routes of exposure. We have learned since then that inhalation exposure is the predominant exposure, whether it is first responders on the street, law enforcement, or people reoccupying or walking into one of these uncontrolled residences or contaminated sites. To keep the generation of airborne particles as low as possible is critical. We designed our decontamination protocols to address that.
- **U.S. EPA:** Question for Shawn: Are there skin compatibility studies for the zirconium hydroxide containing product?
 - **Shawn Stevenson, Chemical Biological Center:** Yes, we have done a few things to look into this. We obtained a skin toxicity clearance memo from the Army Public Health Center (it is something they do, and you can reach out to them and find out if a chemical is toxic or not), and we reached out and received the toxicity memo that said it was relatively safe. The University of Hertfordshire did a direct peptide reactivity assay which basically outlined dissolve the zirconium hydroxide and see if it interacts with any of the peptides on the skin. What they found was that the zirconium hydroxide was impossible to dissolve, and we were not able to get an interaction with the peptides. It is an inconclusive test but it did show there is a good chance it is not

interacting with the skin; it is staying on top and not going into the skin. Right now, we are also testing neutral red uptake assay to see if that has an interaction. We are looking at the skin toxicity of the compound.

- **(2 questions asked at once) HHS/CDC:** Question for Shawn: How much coverage of the powder is needed? How does it compare to RSDL? **And Defence Research & Development Canada:** Question for Shawn: How to remove the powdered zirconium hydroxide from a contaminated skin?
 - **Shawn Stevenson, Chemical Biological Center:** What we have done so far is work with a loose powder, and we have removed it with a cotton ball and just wiped off the skin. We know if there is ever a mature product from this, it is not going to be a loose powder; it is likely going to be in some form of wipe or mitt, or something along those lines. We do not want there to be any shedding. Ideally you will not ever have to worry about removing the zirconium hydroxide. Everything should be soaked up into the material. We have done limited studies using weight to weight to get full absorption. We were able to look down to 2 microliters of agent to 0.2 grams of zirconium hydroxide. We could probably go lower, but we had trouble measuring out the small amounts of agent and powder.
- **U.S. EPA:** Question for Michael Pirhalla: Can these models also predict a dense gas release (e.g., chlorine) or is the model independent of the physical/chemical properties of the released gas?
 - **Michael Pirhalla, U.S. EPA:** The short answer is maybe. For the laboratory experiments that we did in the fluid modeling facility, we used an ethane neutrally buoyant tracer which is meant to help us understand how a chemical or a particle would be dispersed within the air flow. There have been experiments done in the fluid modeling facility with a dense gas that was done many years ago, but the chief challenge with that is the building is enclosed and there is minimal ventilation, so you do not want to release a potentially harmful substance in there even though the release is so low. In addition, getting the boundary layer in the wind tunnel to correspond to the actual atmosphere is challenging in such a scaled environment. So, it is possible but we typically do neutrally buoyant analyses in the wind tunnel. As for the models, the CFD model can handle any kind of release, but we chose to do a neutrally buoyant analysis because it corresponded with our wind tunnel comparisons.
- **Anonymous:** Question for Michael Pirhalla: Can the model be used in a way to account for environmental reactions of the contaminant, e.g., with sunlight or interactions with atmospheric gases or particles found in urban areas?
 - **Michael Pirhalla, U.S. EPA:** I believe AirMod, the dispersion model that we used, has limited capabilities with some of the criteria pollutants. I do not believe they simulate conversions of NO_x and SO_x – a more applicable model would be a 3D air quality model. It would be great to have that ability in the future. I am not sure if a CFD model can accommodate that at this point.
- **Anonymous:** Question for Vivian: Is skin decontamination with RSDL affected by sweat, lotion, or other substances that might be found on the skin in practice?
 - **Vivian Lau, Defence Research and Development Canada:** I do not think that has been explicitly tested for. There have been some tests done with it in the presence of insect repellent, and in terms of whether or not weird reactions happened, they are compatible. However, whether that affects the decontamination efficacy, I do not think we know that yet. Just from

knowledge of how RSDL works, skin will help to dilute the potency of the lotion, so in that sense it is likely that it would.

- **U.S. Army DEVCOM Chemical Biological Center:** Question for Vivian: Did you look at any other extraction methods for VX from skin, or only acetonitrile?
 - **Vivian Lau, Defence Research and Development Canada:** We went ad hoc and went with acetonitrile because that was most accessible to us at the time.
 - **HHS/CDC:** Question for Michael Polkabila: What protocols did you use for decontamination of entry personnel and controlling cross contamination?
 - **Michael Polkabila, BioMax Environmental, Inc.:** Yes, we utilized disposable PPE. That was critical for the potential for the particulates to land on the PPE itself. It is important on any opioid site not to use an alcohol-based hand sanitizer or wipes because the alcohol will solubilize the opioid and it could enter through the dermal layer. Once we removed the disposal PPE, we had the personnel use a detergent mixed (e.g., Dawn soap) with a water solution.
 - **Defence Research and Development Canada:** Question for Michael Polkabila: Was any opioid contamination found in adjacent apartment units?
 - **Michael Polkabila, BioMax Environmental, Inc.:** I wish we could have looked. During this time, we were focused on the unit of concern. We did not have the availability to sample next door. We did ask and they refused. What was significant was the opioids were also found within the mailbox. This was enlightening and alarming at the same time. The opioids had come to the site through the U.S. mail. There must have been some particulates of the opioid on the exterior because they transferred to adjacent mail sites as well.
 - **Defence Research and Development Canada:** Question for Michael Polkabila: Can you comment on how 1-4h wet decontamination contact time was achieved, i.e., how often reapplication of decontamination solution was required, amount of effluent generated, etc.?
 - **Michael Polkabila, BioMax Environmental, Inc.:** It is a challenge to keep a surface wet so that there is adequate dwell time. We did it through re-application. The unit itself was within a critical barrier. We also sprayed the materials wet on the surface and kept reapplying. These were hydrogen peroxide-based solutions. That was, at the time, the best technology we had available. There is current research ongoing that has evolving technology.
 - **U.S. EPA:** Question for Shawn: Considering the cost and properties why zirconium hydroxide (4 OH') aluminum hydroxide (3 OH') may be cheaper and environmentally benign. If you have compared, how did zirconium hydroxide compare with other agents?
 - **Shawn Stevenson, Chemical Biological Center:** I specifically have not. I know a lot of other work has been done examining the chemical reactivity of other oxides. I do think aluminum oxide or something like that has been in previous personal decontaminates. There might be utility for that oxide if it soaks up the agent. That is what zirconium hydroxide is doing very well, is it is soaking up the agent onto it, and the bonus is the reactivity. I personally do not have any experience with the others, but it may be something to explore.
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