On Site Aerosolization-A Risk Management Tool

Presenter: Mr. Kelly Houston, Aerosolization Equity Investments, LLC

Science Panel Advisor:

1. **Provide a few sentences summarizing the method or process illustrated by the case study.**

   - System and method of on-site ***Aerosolization*** of all "permitted and final discharges" to Waters of the United States (WOTUS), or "land applications" as an "all natural, medically understood and very high volume zero liquid discharge voluntary program" for all public and private sector leachate or wastewater permit holders. The case study parameters would encompass 3 phases:

     - **Phase 1**- Safely, effectively, efficiently, predictably, continually, and voluntarily ***aerosolize*** the "annual permitted discharge volume" while it is still on the site of its generation as a voluntary "last step" to effect a "zero liquid discharge" outcome. **1) Insert- "Aero Diagram"---2) Insert- DHS Hyperlinks---3) Insert- Dr. Col Houston's abridged CV---4) Insert- video of "controlled fallout"---5) Insert- video of "atmospheric uptake"**

     - **Phase 2**- Choose Standardized design parameters for chemical and biological "Aerosolization Alleys" with safety and monthly disposal volume requirements paramount. **6) Insert-"Basic Aerosolization Alley" (100K GPD design)---7) Insert-"Super Aerosolization Alley" (600K GPD design)---8) Insert- video of "Aerosolization Alley" in use---9) Insert- DHS testing and monitoring equipment slides.**

     - **Phase 3**- Choose Standardized design and layout parameters for mass testing and experimentation for families of chemicals and families of biological's as well as choose, test and monitor beneficial flocculants and amendments to enhance coalescence. **10) Insert- "25 Aerosolization Alleys" (Monitoring/Experimentation Grid)**

2. **Describe the problem formulation(s) the case study is designed to address. How is the method or process described in the case useful for addressing the problem formulation?**

   - Existing federal, state and local leachate and wastewater treatment and final disposal compliance laws, regulations, rules and their public and private sector on-site interpretation are costly, confusing and susceptible to extensive legal challenges and public misunderstanding. Additionally, off-site treatment facilities seeking to remove chemical and biological contaminants from entering our waterways, have also struggled with compliance,

improvement and costs. Both public and private sector compliance administrators, their staffs and their consultants, are conflicted by past compliance requirements and further may have an academic and professional background in the engineering professions or related fields rather than in the medical sciences. ***Aerosolization*** is a long proven medical technology that is now transferred to the leachate and wastewater de-watering and final discharge disposal fields.

- ***Aerosolization*** utilizes all natural processes: individual particle electro-static charges, varying waterborne environmental conditions, waterborne oxidation, airborne oxidation, additional and much more powerful electrostatic charges, gravity and atmospheric disposal of the water component to provide five separate encapsulation processes to safely, quickly, efficiently, predictability and economically provide for on-site dewatering of all types of leachate and wastewater permitted discharges. All of these natural processes, when taken together, are called ***Aerosolization*** as air (or oxidation) is being added to a solution and now in very high flow and disposal rates. The now encapsulated biological and chemical contaminants (5 separate and natural encapsulation processes) are then delivered to a particular and chosen on-site and lined retention area, for eventual and appropriate solids disposal, while immediately releasing the water component of the formerly defined leachate or wastewater as now cleaned water vapor. ***Aerosolization*** would effectively deliver on-site dewatering with efficient and predictable contaminant encapsulation, coalescence and volume reduction. This natural process, system and method can be continuously operated in various on-site applications and overlay existing operations and processes. There has been some confusion between Atomization and ***Aerosolization*** when explaining the long known technology to wastewater administrators and their regulators. ***Aerosolization*** is the opposite scientific process or method of the mechanical engineering process generally referred to as Atomization. ***Aerosolization*** also starts in a liquid medium and is also the opposite of dissemination, which starts in a prepared or processed extremely dried form that would resemble talcum powder. ***Aerosolization*** will be considerably safer and cheaper to employ and operate than existing compliance and permitting measures, on their own.

- ***Aerosolization*** would eventually enhance or eliminate existing treatments, systems or methods of leachate or wastewater disposal as a final disposal option. As most treatment or final disposal systems or methods have the leachate or wastewater leave the site of generation; on-site ***Aerosolization*** will reduce the cost, immediate liability exposure and also the downstream cost and liability exposure. Past methods of treatment or final leachate or wastewater disposal operated under the assumption that “dilution is the solution to pollution” whereas ***Aerosolization*** greatly encapsulates, concentrates, and precipitates the contaminants from the discharge, and allows for ease of management, as each site’s permit allows, under a customized and site chosen and continuous operational structure. As “permitted” leachate or wastewater daily discharge has been a limitation to any facilities’ productive output, ***Aerosolization*** would additionally offer a way to drastically increase total productive output from existing public and private sector facilities.

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3. **Comment on whether the method or process is general enough to be used directly, or if it can be extrapolated, for application to other chemicals and/or problem formulations. Please explain why or why not.**

- **Phase 1-** The process, mechanical system and method of Aerosolization are easily customizable to overlay existing federal, state and local laws, safety policies or compliance measures for all chemical and biological leachates or wastewaters. The environmental conditions associated with wind, rain and site specific humidity are just evapotranspiration rate limiting factors easily overcome by additional machines or longer operations.

- **Phase 2-** Adding and continually testing various flocculants and amendments along with a standardized "Aerosolization Alley" design would additionally provide the leachate or wastewater permit holder a method of "trial and error" to further insure safety and environmental control and compliance. Example: An "Aerosolization Alley" is built to safely and easily handle 1M gallons per day of chemical contaminants can be made even safer and more efficient by adding biologicals or flocculants into the wastewater itself or the mechanical system. In this way, various questions would be answered, such as: Which biologicals or flocculants are best for which chemicals and for the maximum amount of encapsulation? What is the desired "throw distance"? How often are the encapsulated solids removed from the lined area? Where should they go and how should they be handled?

- **Phase 3-** Public and private sector grouped monitoring and testing of various families of chemicals or biologicals can also be standardized and analyzed for best grouped outcomes going forward under new rule making and before site deployment or new national compliance guidelines are issued.

4. **Discuss the overall benefits and challenges of the method or process.**

- **Benefits-** Aerosolization has long been known to be safe, effective, efficient, predictable, immediately available, modular, customizable, and economical. Additionally on-site ***Aerosolization*** easily overlays existing systems and methods.

- **Challenges-** On-site ***Aerosolization*** is a curious method to most existing public and private sector wastewater managers and their regulators. On-site ***Aerosolization*** will require constant monitoring and testing for safety, effectiveness and proper solids handling and final disposal of the encapsulated contaminants.

5. **Outline the minimum data requirements and describe the types of data sets that are needed.**

- Ambient site specific soil and air conditions for a minimum of 1 month before testing and monitoring with new "Aerosolization Alley" designs built to establish the baseline before Phase 1, 2, 3 operations.

- Last leachate or wastewater testing for constituents of concern monitoring and future testing guidance.

In addition to these 5 areas, please also answer the following questions, if they are relevant. Feel free to adapt these questions to add additional understanding to your method/process. Does your case study:

A) Describe the dose-response relationship in the dose range relevant to human exposure?

All public and private sector sites should follow all federal, state and local laws as well as any facility specific safety policies and procedures for personal and environmental safety and compliance. As the Aerosolization system and method (and operations contained within the "Aerosolization Alley") will be initiated and shut down via remote control and from an enclosed (and perhaps even off site) control center it is assumed that all additional safety measures would be suggested from new federal and or site specific administration considerations. Facility personnel seeking to further consolidate, further dewater or remove the encapsulated solids for appropriate handling and final disposal may wish to follow additional and voluntary personal protection measures.

B) Address human variability and sensitive populations?

Any and all public and private sector employees dealing with the Aerosolization system, method, operations, testing, monitoring and/or "Aerosolization Alley" maintenance should undergo routine physicals and increased safety considerations should always be improved.

C) Address background exposures or responses?

All historical and site specific soil, air and water testing monitoring and operational safety and compliance measures undertaken should be considered for any and all additional safety and compliance guidelines.

D) Address incorporation of existing biological understanding of the likely mode of action?

All biological contaminants, in a liquid medium, oxidize and clump very easily and readily. The "throw distance" of the aerosolization process will be shorter and accumulated solids will be larger in volume. To aid in more thorough and complete encapsulation of all chemical contaminants, adding various types and volumes of specific biologicals and or flocculants and under various environmental conditions is suggested. Example: If a chemical producing facility would like to add additional layers of encapsulation in their aerosolization process then animal processing water or agricultural processing water or "grey water" would be helpful. Here testing monitoring and experimentation would seem to have endless permutations.

E) Address other extrapolations, if relevant – insufficient data, including duration extrapolations, interspecies extrapolation?

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Here physically measuring scientists using physical testing in real time observation and the scientific method will be able to add effectiveness, efficiency, predictability and additional safety and confidence to the system and method.

F) Address uncertainty?

Any uncertainty is understood with any new application of a long known science and technology in another area of academic or professional field. Past uncertainty was easily overcome through a focused discussion of physical science laws, method observation and testing results after operations. Uncertainty in the future can be easily overcome through repetition of these same confidence-building steps.

G) Allow the calculation of risk (probability of response for the endpoint of interest) in the exposed human population?

With adherence to all federal, state and local laws and public and private sector site specific policy and procedures as well as any new and additional safety and compliance guidelines, risk and exposure to any human population, is minimized and is considered far better and safer than existing systems and methods-on their own. The end system and method should be the remote operations of on-site "Aerosolization Alleys" from enclosed testing and monitoring centers that are either on or off the site where the ***Aerosolization*** system and method is in continual operation.

H) Work practically? If the method still requires development, how close is it to practical implementation?

The system and method of on-site ***Aerosolization*** operations (across all 3 phases of this case study) is practical, effective, efficient, predictable, economical and ready for national implementation. The questions left to answer would surround locating the "Aerosolization Alleys" and their design, and the total number of machines required to deliver a "zero liquid discharge" outcome to every public and private sector leachate or wastewater generating site.

Additional References:

1) **Biological Warfare: Pathogen Perspectives**, Jen, Houston, Duffus, Durojaiye, 2015, 2016.
2) **Medical Aspects of Chemical and Biological Warfare, Textbook of Military Medicine**, Part 1, US Army, 1997 and 2008.
3) **A History of Chemical and Biological Warfare Agents**, Edward M. Spiers, 2010.
4) **Emergency Action for Chemical and Biological Warfare**, Hank Ellison, 1999 and 2016.
5) **War of Nerves: Chemical Warfare from WWI to Al-Qaeda**, Jonathan Tucker, 2007.
6) **Medical Aspects of Chemical Warfare, Textbooks of Military Medicine**, Borden Institute, Walter Reed Army Medical Center, 2009.
7) **Handbook of Toxicology of Chemical Warfare Agents,** Ramesh C Gupta, 2015.
8) **A Laboratory History of Chemical Warfare Agents**: Laboratory Tutorial and References, Jared Ledgard, 2017.

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Addendum: Background Details (Items listed as "printout" will be available at the conference for panel/audience review)

1. "Aerosolization" is a long known and very thoroughly physically tested medical science with internationally accepted testing protocols. http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=1&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=0&f=S&l=50&TERM1=aerosolization&FIELD1=&co1=AND&TERM2=&FIELD2=&d=PTXT
2. Testing with raw leachate started under VADEQ and NCDENR in 2011. After a year and a half of monitored, daily dawn to dusk data collection, there were zero contaminant detects. (printout)
3. NCDEQ operational approval came in May of 2013. Full Approval in August of 2013. The engineering firm and NCDENR called the process a "Leachate Evaporation System" which is not correct but was titled at the time without my input. (printout)
4. VADEQ operational approval for Republic Services was issued in July 2015. (printout)
5. The 2015 NC Budget asked NCDEQ to study many leachate treatment and disposing technologies (printout).
6. Republic Services presentation to the ERC in support of Aerosolization (printout)
7. NCDEQ specific operational approval with stepped up enforcement for Republic Services, Certainty of operational enforcement protocols has been an issue for the industry long before aerosolization was even tested. 2016 (printout)
8. NCDEQ ERC report of findings 2016 (printout)
9. NCDEQ PowerPoint presentation 2016 (printout)
10. NCDEQ approval for a 90-day pilot for Charah to use Aerosolization for Coal Ash Leachate, 2016 (printout).
11. NC Governor Coopers veto https://www.ncleg.net/Sessions/2017/h576Veto/letter.pdf