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Using Underwater Drones To Mitigate Waterborne Cbrn Threats

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The purpose of this paper is to explore the use of underwater drones to mitigate waterborne CBRN threats in oceans, rivers, underground stored water, and other compromised water systems. Contaminated water systems are an ongoing problem for warfighters, Joint Forces, human populations living in targeted areas, and ecosystems supporting life throughout the planet. Currently no solutions exist for waterborne CBRN environments. However, research shows water systems are increasingly vulnerable to emerging threat environments including CBRN attacks and WMDs. Emerging technologies provide opportunities to develop and test new means and methods for mitigating waterborne threats and contaminants that constitute a CBRN environment.

Research will show the impact of detection and filtration systems operating on underwater drones to neutralize threats in vital water resources for the warfighter, Joint Forces, and the surrounding human population and ecosystem. What makes this research and development possible are new technologies in the following areas: autonomous and remote operated vehicles, filters and water treatment processes incorporating nanotechnologies, smaller diagnostic devices including lab-on-chip devices, AI and ML, cloud computing, inexpensive software development tools and platforms, more efficient manufacturing opportunities, and advances in robotic fleet operations.

Filtration systems included in this experiment include the use of materials to treat chemical and biological threat agents applied to controlled test sites that will show the effectiveness of neutralizing threat agents. Measurements will forecast what size drone fleets will be needed in future for a range of concentration levels in impacted areas with predictions for clean-up time-frames. Drone test results include the use of the following materials: (a) filters housing ionized quartz nanotubes to remove heavy metals, (b) biocidal films, gels, and coatings aimed at waterborne disease agents and invasive species, (c) radiation such as ultraviolet filtration, and (d) nanoparticle based filters to treat radioactive water. Our means and methods will incorporate: (a) drone delivered treatments to infectious sites, (b) changes in temperature and pressure of contaminated water during treatment, and (c) the use of drones to mitigate the flow or drift of contaminants in emerging threat environments. Untethered and tethered drones will demonstrate the capability to intercept contaminants using simulated water currents to (a) perform containment of the primary threat environment from wider spread, (b) safeguard uninfected areas by positioning drones to intercept migrating contaminants, and (c) utilize the terrain to optimize the use of naturally occurring water currents and weather to predict intercept points.

The goal to treat contaminated water using drones is not identical to the goal of a fixed water treatment facility that produces quality drinking water; it's purpose instead is to perform water remediation in which the overall health and integrity of the marine ecosystem is restored or improved for the warfighter, Joint Forces, and inhabiting civilian population either during combat operations or post-conflict remediation efforts.

Keywords: CBRN, WMDs, waterborne threats, underwater drones, water treatment