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Development Of Novel Broad-spectrum Sorbent To Extend The Lifetime Of Collective Protection Filters

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The Department of Defense utilizes collective protection (COLPRO) filters such as the M98 to protect ships and buildings from CBRN threats. In addition to the broad-spectrum filtration requirements of military filters, these COLPRO systems operate full time, causing the filter sorbents to lose their chemical capacity due to the degrading effects of humidity or airborne contaminants. Extending the operational lifetime of COLPRO filters would lead to significant life-cycle cost savings and reduce logistical burden of filter replacement.

A novel process has been developed to make broad spectrum sorbents with increased resistance to aging. A mixture of metal oxides are co-precipitated onto a mixture of carbon and Zr(OH)4 powders, material notation %MO/(C, Zr). Due to the aqueous environment of the precipitation, the metal complexes deposited on the carbon and Zr(OH)4 powders are highly stable against humidity. The slurry is then mixed with a binder, extruded, dried, milled, and sieved to produce 12x30 granules. Accelerated aging is simulated by exposing the sorbent to humified air at 80° C and 80 RH for 1 week, or being exposed to discrete amounts of VOCs that simulate diesel fuel vapor, or exposed to SOx/NOx. The sorbents were then tested against 3 chemicals to probe for sorptive and reactive capacity. The ratio of MO: (C, Zr) as well as the ratio of C:Zr were varied to find an optimized formulation.

After a specific formulation was chosen, pilot scale batches were produced in 100 to 200 pound batches. The material shows good batch-to-batch consistency. With the additional material, varying degrees of weathering were performed to produce material aging curves. In FY24, the new material was placed at fixed-sites to collect data on aging in realistic environments.

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