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Extended Life Filter For Chemical Biological Radiological And Nuclear (cbrn) Protection

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Broad spectrum filtration is of critical importance for protection of the warfighter. This application requires materials with both high porosity for physical sorption and metal sites for chemical reactions. While these challenges have been well met, aging due to exposure to humidity or battlefield contaminants limit the fieldable lifespan. The objective of this effort is to develop improved filtration media and to incorporate the media into scaled filter designs that maximize service life.

A novel process is used to make beaded granules of blended powder materials. The powders include carbons with different porosities, precipitated metal oxides, and zeolites. In addition to the base materials, co-precipitated media with metals deposited onto the carbon powder can be made and then built up into beaded granules. Beaded granules with different ratios of powders are made and then loaded with triethylenediamine (TEDA). Physical properties of the filtration media are evaluated to determine porosity, density, particle size distribution, and ball pan hardness.

The beaded granules are then subjected to accelerated aging. Humid aging was performed by delivering air at 80 °C and 80% RH to media at flow rates representative of collective protection filters. Under these conditions, 5 simulated years of aging can be achieved in 2 weeks. To simulate battlefield contaminant exposure, discrete loadings of a simulated fuel mixture was loaded onto the beaded granules. Following aging, materials were tested for filtration performance against cyanogen chloride (CK), hydrogen cyanide (AC), dimethyl methylphosphonate (DMMP), CH3Br, and H2S, with results compared to those of the baseline material.

A co-precipitated Zn/Carbon beaded granule was prepared and evaluated for filtration performance prior to and following accelerated aging. For all blended media with carbon, TEDA retention and utilization is good as measured by CH3Br breakthrough. However, CK performance is greatly reduced for blended beaded granules of carbon and metal oxides. This is due to separation of TEDA in the carbon pores and the reactive metal sites needed to keep the TEDA from being poisoned. When co-precipitated Zn/Carbons are employed, CK performance remains essentially unaltered after aging. This is due to stabilization of active metals sites within the carbon pores near the retained TEDA. In addition to CK, there is no impact of either fuel or humid aging on the AC performance of Zn/Carbon co-precipitated materials. The durability of the beaded granules versus AC is attributed to the stabilization of the metal phase.

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