Chemically active fibers as sorbant for industrial and weapon gaz capture

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Activated carbons are the sorbents used to fill gas mask cartridges. When they are not impregnated with active substances, these activated carbons do not have a high chemical selectivity. In addition, in the presence of high humidity or heat, their adsorption capacities decrease and desorption phenomena are possible. This is why many activated carbons are impregnated with chemical substances (polymers, organic compounds, metals) which reinforce their chemical selectivity and contribute to their better behavior in a humid and hot atmosphere. In partnership with AJELIS, a company that develops and markets sorbent fibers and textiles for water and air treatment applications, the CEA is developing fibrous sorbents that can be used in the CBRN field. The polymers that make up these fibers are chemically very similar to the impregnants in activated carbons. This is why the figure illustrates the possibility that textile sorbents can be an alternative to carbonaceous granular sorbents. Polymeric textile fibers with a diameter of 15 to 20 µm and a high expansion ratio give these sorbents high exposed surfaces but above all very easy and therefore fast access. The transition from granular to fibrous structure represents the first benefit. The second benefit is linked to the chemical compositions of these fibers that carry out trapping by chemisorption unlike the physisorption phenomena representative of activated carbons. Examples of breakthrough curves on ammonia (NH3) and hydrogen sulfide (H2S) comparing activated carbons and fibers are presented. Aspects related to relative humidity and temperature are discussed. It has been observed that increasing the relative humidity of the gas source or controlled humidification of the fibers improves the performance. This last point can be very important in specific conditions of use such as in humid tropical atmosphere. The aim of this study is first to obtain results on industrial gases (TICs), which can also be attack gases, and then to develop strategies for chemical trapping of combat gases (phosphorus, mustard, etc.). Catalytic properties are for example targeted.

Fig. 1: Chemical active fibers as an alternative to activated carbon for gas protection