Chemical Barrier Nonwoven Fabrics Containing Active Carbon Fibers

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In Japan, fabrics containing active carbon fibers find use in solvent recovery systems and air conditioners in higher priced automotives. Similar sorbent fabrics may be used to remove toxic aerosols and vapors, which are contaminants in laboratory, industry, consumer, and other environments, and may take the form of respirators and suits that can protect the wearer against chemical carcinogens, poisons, and irritants. A variety of such materials and end items are manufactured in several countries from active carbons that are available commercially in powder, granular, and fiber forms.

Fabrics containing active carbon fibers have the advantage of being able to be incorporated into textile systems without being poisoned by chemical binder additives. These inherently weak fibers may be supported by stronger textile fibers in such a way as to remain completely available for sorption, resulting in fabrics having high sorption efficiencies and capacities. The precursor options available for using fibrous active carbon in textile structures include wovens, needled felts, yards, and staple fibers from tow (continuous filaments).

Staple fiber (short lengths) is potentially the lowest cost form of fibrous active carbon because it is produced by cutting tow that need not be highly uniform and free from breaks. The staple fiber may be converted into active carbon-loaded webs by either of two processes:

1. suspending the fibers in a liquid carrying medium (such as water) which deposits them onto a moving forming screen (wet laid); and

2. suspending the fibers in a dry carrying medium (air) prior to web formation (air laid).

Fram Corporation, Clemson University, and US Army Natick Research and Development Center have collaborated on exploring air-laid webs containing active carbon fibers. It was the objective of this work to investigate the concept of using fully activated fragile carbon fibers to achieve sorbent nonwoven fabrics with textile-like hand and comfort properties. Successful results were demonstrated after Fram and Clemson developed a proprietary air-laid process for web formation from such fibers (US and foreign patents pending).

Different staple fibers blended in these fabrics perform the basic functions of sorption, carrying and bonding. The sorption properties of active carbon fibers are typical of powdered and granular forms. Fibers added as carriers act to promote the transport of shorter or less mechanically resistant fibers through a process. Bonding fibers are usually low temperature thermoplastic materials that consolidate a web by bonding at fiber crossover points when subjected to heat and pressure.

From initial work it was determined that carbon fiber tended to powder excessively when air laid with carrier and binder fibers on normal air lay equipment. Carbon fiber loss averaged almost 50-percent by weight as particle fly. This carbon dust was a health and equipment hazard, as it tended to be inhaled into the lungs and to short electrical circuitry. But when the process was modified to accommodate the new carbon fiber processing technique, carbon fiber fly was reduced dramatically to a loss of fiber below one-percent by weight. Also, the percentage of carbon fiber that could be loaded into a web and the resultant web uniformity were both greatly increased. This process enabled the textile properties of the carbon fiber to be combined with those of support and bonding fibers. The resultant webs retained the full sorption capabilities of the active carbon fiber.