PROTECTION THAT LIVES ON
MICROBAN®

Antimicrobials in Durable Foam Applications

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Many products that we use every day are some forms of foam or have foam in them: from the comfy cushion of your couch to the shoes on your feet, from the insulation in your home to the yoga mat on the floor…all of these materials are not designed to be washed but exposed to moisture regularly during usage. Shoes take up the sweat from your feet. Insulation absorbs condensed moisture. Couches witness spillages now and then. Exercise equipment undoubtedly see their fair share of sweat. The moist and nutrition rich environment in foam is a favorite place for bacteria and fungi to grow. As these organisms metabolize, they can break down the foam, causing premature failure of the products. Moreover, they can create stain, odors and allergens as the by-products, potentially causing allergic reactions or even illness for users.

If you think about it, you spend most of your life in direct or indirect contact with a foam product: 10-16 hours in shoes, 6-8 hours a day on a mattress and pillow, 1-2 hours in a car, etc. Most people credit the bad smell from shoes or apparel to sweat. However, few people notice that sweat, which is composed of water, salts and organic matters, actually doesn't stink. The odor mainly comes from various fatty acids with the strongest one being isovaleric acid, aka. foot odor. The acids are generated from the metabolizing process of Staphylococcus epidermidis, Propionibacterium acnes and genus Bacillus (Ara, Hama et al. 2006), the often found bacteria on human skin flora. They play a key role in breaking down amino acids to odorous compounds and should be blamed for your stinky shoes. In bed, a person may produce more than 8 oz. of sweat every night [100 liters every year], which with body heat, becomes an ideal condition for bacterial and fungal growth. Professor Woodcock, Clinical Director for Respiratory Medicine at University Hospital of South Manchester, and his colleagues, showed that a "typical used pillow contains a substantial load of many species of fungi" (Woodcock, Steel et al. 2006). In building materials, especially foam insulations, mold is always a concern for home owners and builders. As a subset of fungi, mold grows and forms a network of transparent filaments called hyphae. When their presence is visible to the naked eye, mold colonization is already extensive, and damage is often irreversible. While most prevention strategies focus on moisture control, overlooks and mishaps happen. Remediation is usually difficult and costly since molds can go into a dormant state and survive harsh conditions.

Close associations between fungi exposure and asthma have been documented since late the 1600s. Sensitivity to fungal allergens is common in asthma patients and closely related to severity and death (Denning, O'Driscoll et al. 2006). Reviewing the relationship between asthma and fungal exposure, Dr. Denning and his team had noted that:

"One key difference is that other allergens, such as house dust mites, cat dander or grass pollen are sources of allergenic protein, but fungi have the additional ability to actively germinate and infect the host skin or attempt to colonise the respiratory tract. Thus, it is possible that fungi have a much greater impact on an individual in terms of triggering host defences against pathogens and producing nonallergen toxins and enzymes that may play an accessory role in triggering allergy.

Fungi are well known to colonise and cause diseases in skin, nails, sinuses or airways. Many of these low-level infections, such as thrush or athlete's foot, are long term and recurrent; thus, exposure to these fungi, while not as directly damaging as respiratory infection, may provide a chronic source of allergen exposure"

While your stinky shoes may cause embarrassment and awkwardness sometimes, the volatile organic compounds (VOCs) generated from microorganisms, especially fungi, in your home may also create potential health issues. The problem is that most people don't realize it until it is too late.

Antimicrobials incorporated into foam materials can provide continuous protection against bacteria and fungi. Introduced during the foam manufacturing process, the antimicrobials become part of the foam materials and last the life-span of the products. However, there is not a one size fit all solution for all applications. Depending on the foam materials, production processes and final usages, the antimicrobial of choice must be carefully selected.

How is foam created?

Foam is a generic term to call any material that traps air or gas bubbles. For durable goods, foam is usually made from polymeric materials, either thermosets like polyurethane (PU) or thermoplastic like poly (ethylene-vinyl acetate) (EVA), polystyrene (PS). Depending on the formulation and the manufacturing process, the final properties of the foam can vary greatly.

For example, PU foam is formed by reaction between isocyanates and polyols in the presence of catalyst(s) and other foaming additives. All reactants and additives are in liquid form, and are kept separated until mixed together. The flexibility of the formulation allows PU foam to be available with a range of density, softness and strength for applications ranging from mattresses and cushions, to shoes and insulations.

Foams based on thermoplastic resins are often created by the breaking down of a blowing agent with or without other additives. The chemical reaction is triggered by temperature and a gas is released, creating bubbles in the material. Representatives of this process include EVA, poly (vinyl chloride) (PVC), polyethylene (PE) foams. EVA foams are dominant in floor mats, shock absorbers, shoes, insulations, etc. PVC foams are often used for exercise mats or leatherette fabrics. PE foams are found mostly in flotation devices.

Another typical method to introduce air (gas) in polymers is relied on the physical properties of such gas. In this case, the "gas" is mixed with the polymeric material under carefully control pressures and temperatures. The "gas" may even be in liquid state during this process. When the pressure is reduced, the "gas" expands and form bubbles in the polymer matrix. A common gas is pentane, used in making expanded polystyrene.

With the diversified processes and evolving technologies, there is certainly not a one-size-fit-all antimicrobial solution. Any new additive introduced to the system may interfere with the formula and negatively impact the foam properties.

Microban® Antimicrobial Technologies for Foam

With over 20 different antimicrobial actives in house, Microban engineers have the ability to choose and customize antimicrobial solutions for your specific foam formula. Depending on your process and final use pattern of the products, Microban, with the knowledge and experience of our engineering team, works with your manufacturers to provide protection to your products. Exploring new processes? Trying new material? We are excited to work with you on your innovation projects and create unique benefits to your customers.

Microban antimicrobials are inert until they are exposed to a moist environment in which bacteria and fungi can proliferate. Only then will they release and make the environment inhospitable to the organisms. Incorporated during the manufacturing process, the antimicrobial becomes part of the foam material and delivers continuous protection against damaging, odor-causing and allergen-creating bacteria and fungi throughout the product’s lifetime.

Our technologies are registered with the U.S. Environmental Protection Agency (EPA) as safe to use in a variety of foam applications. None of our actives are considered nanotechnology, of which pros and cons are still not fully understood.

How it is implemented?

The Microban engineering team works individually with polymer manufacturers to make the antimicrobial incorporation as simple and seamless as possible without disruption to your existing manufacturing processes. Our engineers develop and test customized formulations of antimicrobials for each individual product and/or process. Each test method is suitable for certain materials. Working with microbiologists, we can recommend the suitable microbiological test method for your foam. We can also work with you to design a test that can differentiate your antimicrobial-protected product versus an unprotected one.

These custom formulations are tested at your manufacturer for process-ability and to ensure that the antimicrobial solutions will not degrade or decrease the aesthetics or function of any part of the product. By providing the antimicrobials to manufacturers in customized solutions and training manufacturing staff on their proper use, the Microban engineering team makes it very easy to properly insert the antimicrobials into the foam products. Our regular and ongoing testing ensures that our antimicrobial solutions continue to work over time, and our marketing services help manufacturers leverage the Microban brand, providing differentiation in the marketplace for your products.

The Microban Commitment to Safety and the Environment

Microban is committed to consumer safety and environmental stewardship. Microban scientists work closely with manufacturers to ensure the safety of the antimicrobial technology across the supply chain, from delivery, receipt and storage, to insertion in the production process, and on into actual use. Microban patented technology is derived from natural elements and is retained within the foam products even as it prevents the reproduction of bacteria for the product’s lifetime. Microban technologies for foam products are registered in both the US (EPA) and the EU (BPR).

Why Microban?

Microban International is the global leader for built-in antimicrobial protection – with strong brand awareness in the marketplace, more than twice all other antimicrobial companies polled. With the broadest set of antimicrobial products on the market today, we are committed to partnering with manufacturers to understand their products, problems and needs to develop the ideal solution for each product.

Microban cutting-edge foam technologies, combined with our wide range of services, help foam makers differentiate their products with distinct advantages over competitors.

Research & Development - Engineers in our state-of-the-art research facility will work with you to understand your product and develop customized, safe, effective and durable solutions to enhance your foam products. We not only know what will work, but why it works.

Safety - You can be confident that Microban-labeled antimicrobials are safe to use as directed. We will train your manufacturing staff on the proper use of our foam product antimicrobials to ensure that they, and the people who use your products, are at no risk from our products.

Analytics - Our world-class analytics labs test the antimicrobial effectiveness of your products from the initial proof-of-concept phase and through the manufacturing and commercialization stage to ensure that you deliver on your product's promise of safe, effective antimicrobial protection.

Quality Control - Scientists at Microban Company headquarters in Huntersville, North Carolina, and staff in local offices in South America, Asia, Europe and North America partner with your manufacturing team to deliver training, regulatory support and other resources targeted to ensure the highest quality.

Marketing and Compliance - We'll consult with you to ensure that your marketing materials comply with all local regulations and effectively communicate the benefits of Microban antimicrobial coverage to your customers.

Environmental Stewardship - Microban is committed to the highest levels of sustainability and consumer protection. Our use of recycled materials helps to reduce landfill burden and the need to source brand-new materials.

From durability requirements to marketing support and patent counsel, Microban supplies our partners with thorough and advanced services to help seamlessly deploy and leverage new antimicrobial technologies. Microban provides you with turnkey support including technical development, regulatory assistance, patent counsel, training, and technical and marketing support to get your product to market quickly and effectively.

More than 250 smart companies are leveraging the Microban brand as an important differentiator to help grow their businesses. For more information about how Microban can help you achieve a more powerful footing in the market, including case studies, testimonials, learnings and best practices, contact us today.

References:

Ara, K., et al. (2006). “Foot odor due to microbial metabolism and its control.” Canadian Journal of Microbiology 52(4): 357-364.

To characterize foot odor, we analyzed its components by sensory tests, isolated microorganisms that produce it, and evaluated the mechanism of the occurrence of foot odor. As a result, foot odor was found to be derived from isovaleric acid, which is produced when Staphylococcus epidermidis, a resident species of the normal cutaneous microbial flora, degrades leucine present in sweat. In addition, Bacillus subtilis was detected in the plantar skin of subjects with strong foot odor, and this species was shown to be closely associated with increased foot odor. Therefore, we screened various naturally occurring substances and fragrant agents that inhibit microbial production of foot odor without disturbing the normal microbial flora of the human skin. As a result, we identified citral, citronellal, and geraniol as fragrant agents that inhibit the generation of isovaleric acid at low concentrations.

Denning, D. W., et al. (2006). “The link between fungi and severe asthma: a summary of the evidence.” European Respiratory Journal 27: 615-626.

There is current evidence to demonstrate a close association between fungal sensitisation and asthma severity. Whether such an association is causal remains to be confirmed, but this is explored by means of a detailed literature review. There is evidence from two randomised controlled trials that, in the example of allergic bronchopulmonary aspergillosis (ABPA), treatment with systemic antifungal therapy can offer a therapeutic benefit to 60% of patients. ABPA is only diagnosed if a combination of clinical and immunological criteria is achieved. It is not known whether such cases are a discrete clinical entity or part of a spectrum of the pulmonary allergic response to fungi or fungal products. This paper describes the epidemiological evidence that associates severity of asthma with fungi and discusses possible pathogenetic mechanisms. Many airborne fungi are involved, including species of Alternaria, Aspergillus, Cladosporium and Penicillium, and exposure may be indoors, outdoors or both. The potential for a therapeutic role of antifungal agents for patients with severe asthma and fungal sensitisation is also explored. Not only are many patients with severe asthma desperately disabled by their disease, but, in the UK alone, asthma accounts for 1,500 deaths per yr. The healthcare costs of these patients are enormous and any treatment option merits close scrutiny. Within this report, the case for the consideration of a new term related to this association is put forward. The current authors propose the term “severe asthma with fungal sensitisation”. However, it is recognised that enhanced and precise definition of fungal sensitisation will require improvements in diagnostic testing.

Woodcock, A. A., et al. (2006). “Fungal contamination of bedding.” Allergy 61(1): 140-142.

Background: It is currently believed that most fungal exposure occurs external to the home. Aims: To enumerate the fungal flora of used synthetic and feather pillows and the dust vacuumed from them, in the UK. Methods: 10 pillows aged between 1.5 and >20 years in regular use were collected and quantitatively cultured for fungi. Swatches were taken from nine sections of the pillow and dust was also collected by vacuum from five pillows. Pillow vacuuming was carried out prior to pillow culture. All were cultured at room temperature, 30 and 37°C for 7 days in broth before plating, and a subset were also cultured for 24 h in broth and then plated. Fungi were identified by standard morphological methods. Results: The commonest three species isolated were Aspergillus fumigatus (n = 10), Aureobasidium pullulans (n = 6) and Rhodotorula mucilaginosa (n = 6). Another 47 species were isolated from pillows and vacuum dust. The number of species isolated per pillow varied from 4 to 16, with a higher number from synthetic pillows. Compared with the nonallergenic A. pullulans, more A. fumigatus was found in synthetic than feather pillows. Conclusions: We have examined pillows for fungal contamination, and show that the typical used pillow contains a substantial load of many species of fungi, particularly A. fumigatus. Given the time spent sleeping, and the proximity of the pillow to the airway, synthetic and feather pillows could be the primary source of fungi and fungal products. This has important implications for patients with respiratory disease, and especially asthma and sinusitis.