

## **Analysis of mold growth in specific areas of finished shoes**

### **I - Introduction**

The air is teeming with mold spores. When these spores land or adhere to objects and find themselves in specific temperature, humidity, and nutritional conditions, molds can easily proliferate and continue to spread through various pathways, such as air currents, people, and animals. Common contaminants are numerous, whether they are found in food, construction materials, leather, textiles, wood, plastic, rubber, metals, and more. As long as environmental conditions are conducive to mold growth, these materials are susceptible to contamination.

Footwear is also a common object prone to mold growth, with materials including mesh, nylon, genuine leather, suede, canvas, synthetic leather, elastic fibers, and more. All of these materials provide a favorable environment for mold growth. Based on YCM Mold Research Center's (MRC) past experiences, mold tends to colonize and grow in areas such as the shoe upper, sole, seams, adhesive points, and shoe collar. If stored in poorly ventilated or high-humidity spaces for an extended period, it becomes even more

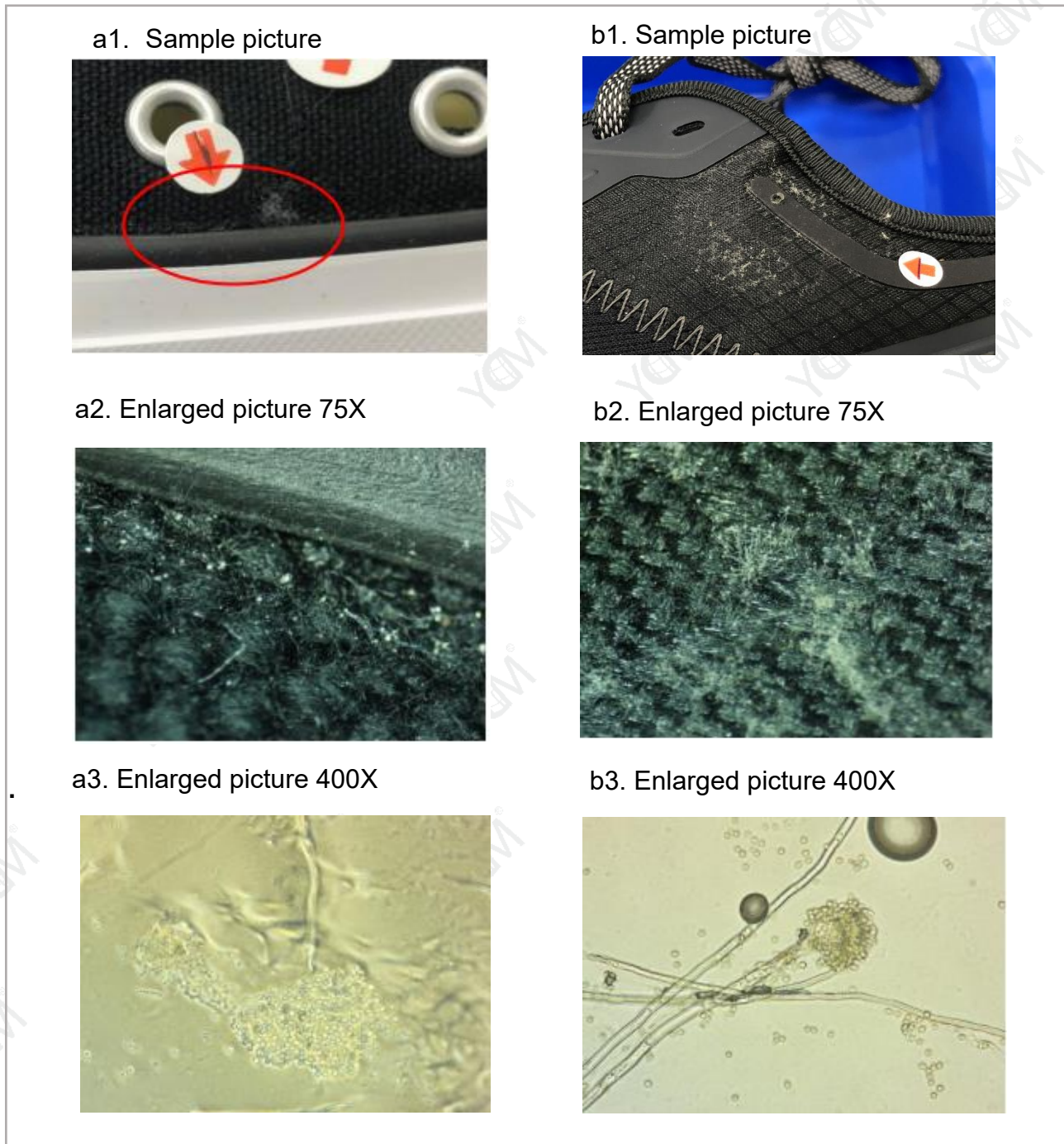
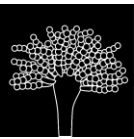
conducive to the growth and proliferation of mold spores. Mold can utilize dust, dirt, grease, sweat, and other contaminants accumulated on the shoe material or surface as a source of nutrients, leading to mold growth and subsequently affecting the appearance and quality of the product.

In the past, both Brand C and Brand A had suspected mold issues with their finished shoes. Consequently, they commissioned YCM MRC to conduct tests to determine if the issues were indeed due to mold and to speculate on the reasons behind the mold growth. This information would serve as a reference for subsequent product handling and improvement measures.

---

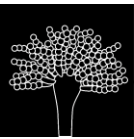
### **II - Results**

The finished shoes from Brand C and Brand A submitted for testing, as shown in Figure 1, exhibited visible patchy contamination. Following testing by the YCM Mold Research Center, the results confirmed the presence of mold growth structures.



**Figure 1. The finished shoes submitted for testing from Brand C and Brand A.**

a1-a3. After examining the finished shoes from Brand C and b1-b3. from Brand A under a microscope at various magnifications, mold growth structures were identified in all of them.



### III · Conclusion

The finished shoes from both Brand C and Brand A, which were suspected to have mold issues, underwent testing at the YCM Mold Research Center (MRC). Mold structures were observed in both cases, confirming the presence of mold growth. In the case of Brand C, the white spots on the sample surface were primarily concentrated at the seams. In contrast, the samples from Brand A had mold spots predominantly concentrated at the collar. After analysis, it was confirmed that the mold was caused by *Penicillium oxalicum* and *Aspergillus niger*. The spores of these two molds are often carried in the air or dust and are common high-risk molds found on textile and leather products. Combining the test results and comparing with the YCM Mold Big Data database, it is speculated that the contamination of both may originate from the production processes, with mold spores attaching to the finished products. Subsequently, exposure to high-temperature and high-humidity conditions during transportation or

storage led to the growth of mold from the spores, causing mold issues.

Adhesive seams, stitching areas, and the vicinity of the collar on footwear samples are common areas susceptible to mold contamination. They are prone to contamination because they can easily come into contact with mold spores during the manufacturing process. Once contaminated, it is not visible to the naked eye and is difficult to clean. If these contaminated areas encounter an environment conducive to mold growth, it can lead to irreversible contamination and product quality deterioration.

Based on the test results from the YCM Mold Research Center (MRC), recommendations for improvement and practical mold prevention measures are provided. In situations where mold spore contamination is difficult to detect and mold growth cannot be effectively controlled, these measures can help inhibit mold and maintain the product's integrity.