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An evaluation of polymeric flooring and its effectiveness in controlling airborne particles and microbes

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A study was carried out to examine the ability of Dycem polymeric flooring to remove particles and microbes from the air in controlled and uncontrolled environments. Test results indicated that the polymeric flooring investigated is most effective in environments containing high numbers of airborne particles and microbes, reducing these potential contaminants by as much as 60%.

Introduction

The study investigated and evaluated polymeric flooring and its effectiveness at controlling airborne and microbe particulates from reaching critical operational height, which is of particular relevance to the life sciences and pharmaceutical industry.

The objective was, firstly, to establish whether air-borne particulates and microbes of various sizes rose to critical operational height with standard movements of a person in a cleanroom; and, secondly, to establish whether the use of polymeric flooring in the critical environment would have a significant positive impact in lowering particulate and microbe counts, thus controlling air-borne contamination.

Test Methodology

For the purposes of the tests, a body box was utilised which met Class 10 conditions at the outset, and prior to each test the floor of the body box was cleaned with polypropylene wipers presaturated with 70% IPA/DI water. Polymeric flooring from Dycem Ltd. was used throughout the investigation. Standard tests were carried out in accordance to IEST-RP-CC003.2[1] over a period of two days.

In the standard tests, four conditions were evaluated:

1 Without Polymeric Flooring
2 With Polymeric Flooring
3 With Polymeric Flooring and Laminar Airflow
4 Without Polymeric Flooring and with Laminar Airflow

In each test, an operative wearing a Tyvek gown, bouffant hair cover and polypropylene shoe covers entered the body box and performed a series of activities, including five minutes of touching shoulders and reaching, five minutes marching in place and slapping the chest, and five deep knee bends in one minute. These activities were designed to create vortices similar to those created by the movement of personnel and equipment in everyday cleanroom environments, which result in a spiral effect, lifting contamination above critical operating heights.

The research team measured various particle sizes ranging from less than 0.3 microns, to less than 10 microns. However, for the purposes of this report, the results shown relate to particles of less than 0.5 micron and less than 5 microns. These particle sizes were chosen to denote the different needs of the electronics and life sciences industries; the former represented very small contaminants, with particles above this size potentially harbouring microbes.

During the tests, air-borne particle counts were measured using a Met One Laser Particle Counter. Airborne microbes were captured on TSA fall-out plates located on the front and rear ledges of the body box. These plates were incubated for seven days following the test and the number of colony-forming units (cfu) counted. The total number of airborne particles and microbes at or above 1.067m height were counted for all four standard tests.

Results

The results of the tests are summarised below. Graphical representations of the data may be found in **Figures 1–3**.

Standard test 1 (the datum); without polymeric flooring

a Airborne count at or above 1.067 m; particles <0.5 micron
Total count = 1,674,812 particles
b Airborne count at or above 1.067 m; particles <5 micron
Total count = 105,545 particles
c Microbe colony at or above 1.067m.
Total count = 11 cfu

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Standard test 2 – with polymeric flooring

a Airborne count at or above 1.067m; particles <0.5 micron
Total count = 1,154,790
This represents a reduction of 520,022 particles, or 31%.

b Airborne count at or above 1.067m; particles <5 micron
Total count = 41,504
This represents a reduction of 64,041 particles, or 60%.

c Microbe colony count at or above 1.067m
Total count = 4.5 cfu
This represents a reduction of 6.5 cfu, or 60%.

Standard test 3- With polymeric flooring and with laminar airflow

a Airborne counts at or above 1.067m; particles <0.5 micron
Total count = 12,440
This represents a reduction of 1,662,372 particles, or 99.25%.

b Airborne count at or above 1.067m; particles <5 micron
Total count = 2,914
This represents a reduction of 102,631 particles, or 97.24%.

c Microbe count at or above 1.067m
Total count = 0 cfu
This represents a reduction of 11 cfu, or 100%.

Standard test 4-Without polymeric flooring and with laminar airflow

a Airborne count at or above 1.067m; particles <0.5 micron
Total count = 14,419
This represents a reduction of 1,660,393 particles, or 99.13%.

b Airborne count at or above 1.067m; particles <5 micron
Total count = 3002
This represents a reduction of 102,543 particles, or 97.15%.

c Microbe count at or above 1.067m
Total count =0.5 cfu
This represents a reduction of 10.5 cfu, or 95.45%.

Conclusions

The principal conclusions to be drawn from the study were that the polymeric flooring reduced microbial contamination at levels critical to operational height by 60%, while the use of polymeric flooring in conjunction with laminar airflow reduced microbial contamination levels to 0%.

Furthermore, the use of polymeric flooring alone reduced airborne particle contamination levels at critical operational height by 31 % for particles less than 0.5 micron, and by 60% for particles less than 5 microns. It should be noted that these measurements are per single person. The use of polymeric flooring in conjunction with laminar airflow reduced airborne particle contamination at critical operational height by 99.25% for particles less than 0.5 micron, and by 97.24% for particles less than 5 microns.

Wherever there is a need to reduce the amount of contamination entering a controlled environment, a specific polymeric flooring should be used to prevent these contaminants from getting into products and processes.

Independent tests have confirmed not only that polymeric flooring is the most effective contamination control flooring for critical environments, preventing up to 99.8% of all foot-borne contamination and 99.4% of wheel-borne contamination from entering a critical environment, but also that this type of flooring is highly effective at reducing airborne particulate as well.

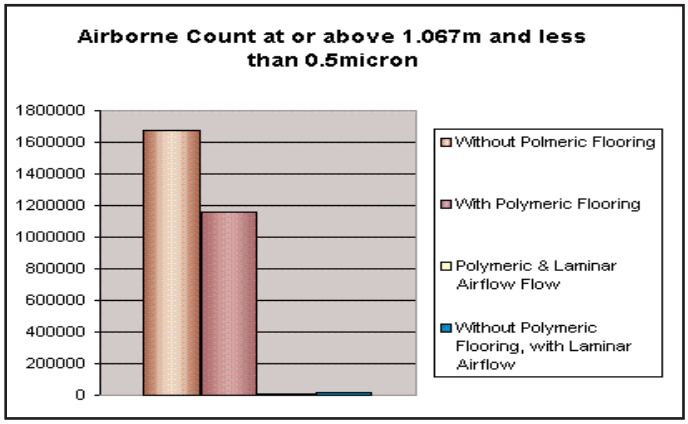

Figure 1. Airborne particle (<0.5 microns) counts recorded under different test conditions (see text)

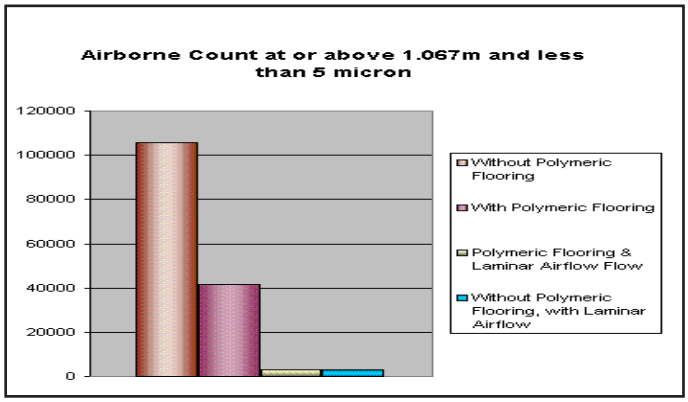

Figure 2. Airborne particle (<5 microns) counts recorded under different test conditions.

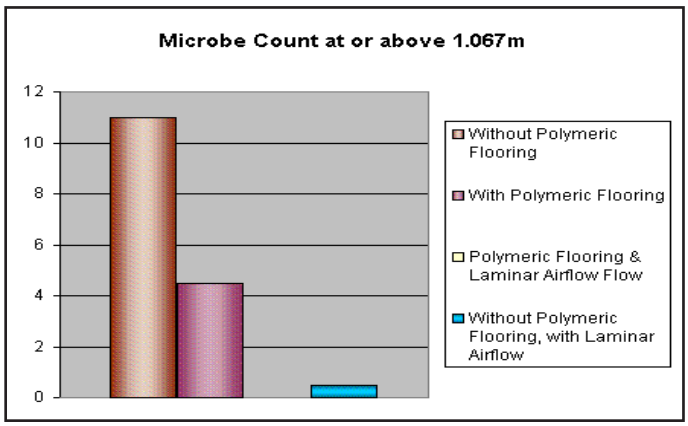

Figure 3. Microbe counts recorded under different test conditions

References

1. IEST-RP-CC003.2, Garment System Considerations for Cleanrooms and Other Controlled Environments
2. IEST –RP-CC023.2, Microorganisms in Cleanrooms

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