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COMPARING THE ANTIMICROBIAL ACTIVITY OF THE SEMCO 3A TOTAL ENERGY WHEEL WITH OTHER SELECTED ANTIMICROBIAL SURFACE TREATMENTS

RESEARCH FINDINGS

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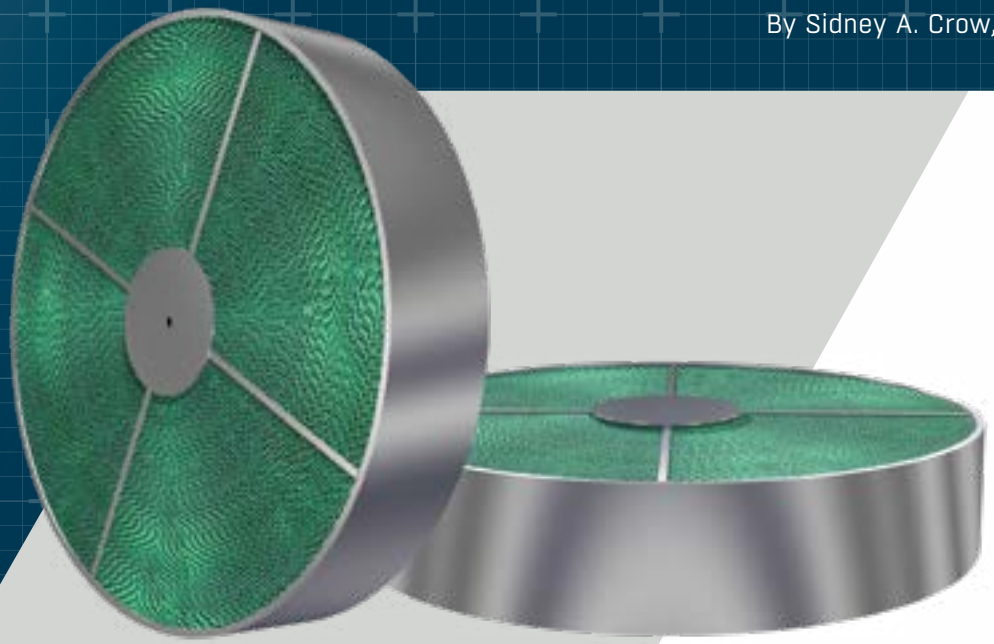


The surface of a proprietary coating developed by SEMCO Incorporated and used for its TE Series 3 angstrom molecular sieve coated total energy wheel was challenged with common bacterial culture *Pseudomonas aeruginosa* to determine its antimicrobial effectiveness.

Testing was also completed on two commercially available antimicrobial coatings approved for use in duct systems and air handling products. These samples were compared against an uncoated aluminum surface to quantify the effectiveness of any antimicrobial properties.

Since total energy recovery wheels commonly encounter saturated airstreams that also contain a large number of microbial spores, it is important that the wheel surface does not support the growth of these organisms. It is obviously a significant advantage if the surface also exhibits a high degree of antimicrobial effectiveness by preventing the growth of organisms that may come into contact with the wheel surface.

The results of the testing suggest that the SEMCO total energy wheel coating exhibits effective antimicrobial properties. The antimicrobial effectiveness was found to be in excess of 96% for the organism investigated.

OBJECTIVE

The primary objective of this research was to compare the antimicrobial activity of selected proprietary surface treatments, including that of the SEMCO total energy wheel.

This product uses a proprietary coating process, which integrates a 3-angstrom molecular sieve desiccant on an aluminum surface. Because of our experience with *Pseudomonas* (GSU-3), tests were completed to evaluate general activity this organism.

EXPERIMENTAL APPROACH

Cell suspension of *P. aeruginosa* GSU-3 was appropriately diluted in phosphate buffered saline with 0.05% Tween-80 (PBST) to achieve approximately 103 and 104 cells/ml, and 1.0 ml of this suspension was combined with 20 to 25 ml of PBST. The suspension was filtered through a 0.22 µm filter. Filter membranes containing cells were placed on the surface of metal coupons and were held for 4 h. These membranes then were transferred individually to a cellulose pad saturated with 1.8 ml growth medium in a Petri dish. Developing colonies from cells on the membranes were enumerated over a 24-hour incubation period at 35°C.

Materials

1) 2” x 2” metal coupons (SEMCO Inc, Columbia, MO)
2) Phosphate Buffered Saline w/ 0.05% Tween-80 (PBST, Cellgro®, #99-844-CM)
3) TSA (DifcoTM Tryptic Soy Agar, #236950, Lot #2190630)
4) TSB (DifcoTM Tryptic Soy Broth, #211825, Lot #2084558)
5) Pseudomonas aeruginosa GSU-3
6) Sterile Petri dishes (100×15 mm, polystyrene, FisherBrand® #08-757-12)
7) Sterile Petri dishes with 47mm sterile cellulose pads (Fisher, #09-753-53C)
8) Sterile 0.2 µm filters (Millipore, # GSWG 047 S1, mixed cellulose esters)
9) Nalgene 150-mL Analytical Filter Unit (Nalgen Company, #130-4020)
10) A vacuum pump (General Electric SKH33DN16)
11) Incubator (Innova 4230, New Brunswick Scientific, Edison, NJ)
12) Mixer – Titer Plate Shaker (LAB-LINE Instruments, Inc., Melrose Park, ILL)

TEST PROCEDURES

Bacterial Inoculum Preparations & Harvests

1) Culture *P. aeruginosa* GSU-3 on TSB at 35°C for 18-19 hours.

2) Harvest in Phosphate buffered saline with Tween-80 (PBST).

3) Adjust cell density and obtain optical density reading using a spectrophotometer. Approximate spectrophotometer readings for ~2x108 cfu/mL bacterial cultures are 0.10.

4) Dilute this suspension to 103 and 104 cfu/mL by transferring 0.1 mL suspension to tube A with 10 mL PBST, then transferring 0.1 mL suspension from tube A to tube B with 20 mL PBST (104 cfu/mL). Remove 1.0 mL from tube B to tube C with 9.0 mL PBST to obtain a cell density at 103 cfu/mL.

Filter bacteria onto membrane

5) Sterile 0.22 µm filters were placed in the filter holders.

a. 20 to 25 ml of sterile PBST was added to each unit.

b. ml of cell suspension was added to the buffer with the aid of a 1000 µl automatic pipette.

c. Turn on the vacuum and the sample was filtered.

Exposure and determination of recovery

6) Using sterile forceps, the membrane filters were transferred to the surface of metal coupons and held for 4 hours. 0.5 mL PBST was added to each filter to help attachment to metal surface.

Controls

Control A – recovery of inoculum: One membrane filter with bacteria was transferred to a 60 mm Petri dish with cellulose pad containing 1.8 ml of TSB.

Control B – recovery of inoculum after 4 h: One membrane filter with bacteria was transferred to a 100 mm Petri dish and held for 4 h, and then it was transferred to a 60 mm Petri dish with cellulose pad containing 1.8 ml of TSB.

Control C – coated agents released from metal surface: One membrane previously soaked with PBST was placed on a metal coupon for 4 h, another membrane filter with bacteria was transferred to a 100 mm Petri dish and held for 4h. Both membranes were transferred to a 60 mm Petri dish with cellulose pad containing 1.8 ml of TSB, with the membrane containing bacteria on the top.

7) At the end of 4-h exposure, the membrane filters were transferred to Petri dishes containing sterile pads, which had previously been dosed with 1.8 ml of TSB.

8) Dishes were then incubated at 35°C.

9) Dishes were examined over a 48-hour period to ascertain cell recovery.

10) Observations made are reported as follows.

FINDINGS AND RESULTS

Inocula (cells/coupon)	Approximate number of cells on surface after incubation	Anti microbial surface efficacy observed
Control A - plain aluminum	> 8,000 cells	Base
Antimicrobial binder	500	94%
Silver ion coating	0	100%
SEMCO wheel surface	350	96%

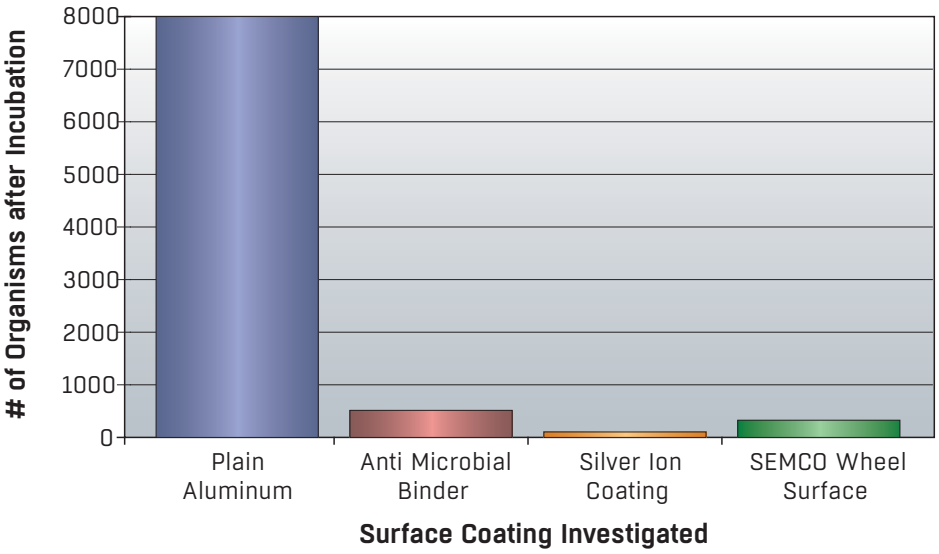
Notes:

1) Control A was a plain sheet of uncoated aluminum. After incubation, the cells had multiplied and were too numerous to count, well more than the 8,000 cells used for the challenge.

2) The silver ion coating is a product offered to the marketplace for coating ductwork and air handling systems.

3) The anti-microbial binder is a commercially available material approved for use in duct systems.

4) The SEMCO wheel surface tested was the standard material sold to the market place under the TE series product brand name and tested by the Georgia Tech Research Institute for contaminant carry-over (3-angstrom molecular sieve desiccant used in this coating).



RESEARCH CONCLUSIONS

The standard SEMCO total energy wheel coating was found to exhibit effective antimicrobial properties. The antimicrobial effectiveness was found to be in excess of 96% for the organism investigated. This feature is highly desirable for total energy wheels since they are in constant contact with the outdoor air stream being delivered to the occupied space and are often applied in environments like hospitals, nursing homes, laboratory and schools were avoiding the spread of microorganisms is essential. The uncoated aluminum control sample allowed the challenge organisms to quickly multiply well beyond the 8,000-cell challenge concentration. The organisms contained on this sample after incubation were far too many to count, simulating what can occur in HVAC system when antimicrobial coating are not utilized. This graph shows the final results of this investigation. The difference between the number of organisms shown for the plain aluminum and the various coatings depicts the antimicrobial effectiveness.

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