

INSPIRATION

Sustainability is comprised of three aspects: environment, economy, and society. In 2013, the environmental and economic components were proven to be achieved by a high-velocity hand dryer (Dyson Airblade™). The inspiration of this year's project was to determine the implications of high-velocity hand dryers for society and human health. After prior survey results showed only 35% acceptance from users, different slogans were analyzed to help increase the use of high-velocity hand dryers. Many users expressed concern about high-velocity hand dryers increasing the amount of microorganisms on washed hands. This concern inspired the idea of bacterial studies in high-traffic and low-traffic restrooms. The ultimate goal of this work was to prove or disprove that high-velocity hand dryers achieve all three components of sustainability and to realize all of the benefits of this technology.

SLOGAN SURVEY METHODS

- Carbon emissions from the 2013 lifecycle analysis (LCA) were converted to more easily relatable units using the EPA Greenhouse Gas Equivalencies Calculator.
- Gender-specific surveys were conducted to determine the most effective slogan for each bathroom.
- The selected slogans for each gender were designed graphically.

SLOGAN SURVEY RESULTS

Survey results showed that females were influenced most by comparing the carbon emissions saved by high-velocity hand dryers to the uptake of carbon from trees. Males indicated that realizing they could emit 80% less CO₂ by using high-velocity hand dryers would be the most effective to increase usage (Figure 1).

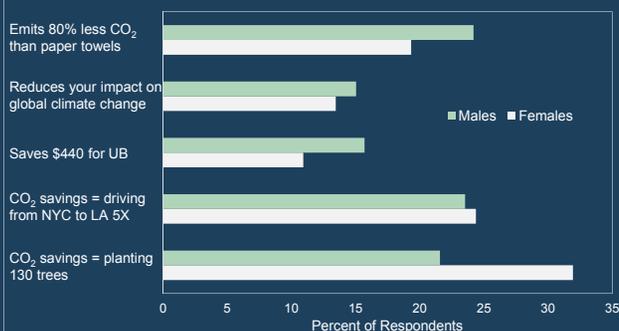


Figure 1. Slogan Survey Results

BACTERIAL STUDY METHODS

Sample Collection

Sampling was conducted in the male and female bathrooms on the first floor of a low-traffic bathroom, and two different sets of restrooms in a high-traffic building according to the following method:

- LB agar plates were prepared previously and stored at 4°C.
- A propane torch was used as an open flame near the sampling locations to prevent ambient bacteria in the air from contaminating cotton swabs or LB agar plates.
- Sterile cotton swabs were extracted from their packaging and immediately used to swipe the contact point in one smooth streak.
- The swab was streaked in a zigzag pattern across the LB agar media.
- Sampling locations included the front and back inner portions of the Dyson Airblade™ hand dryer, door handle, light switch, paper towel, and paper towel lever.
- Petri dishes were incubated at 37°C for 23.5 hours and stored at room temperature for an additional 22 hours prior to analyzing bacterial growth.

Bacterial Growth Analysis

- Plates were analyzed 45.5 hours after samples were first put into the incubator.
- Colony-forming units (CFUs) were counted to quantitatively compare the abundance of bacteria on surfaces relative to each other.
- Visible CFUs were defined as small and opaque formations with discrete round morphologies (Figure 2). Larger colonies with blurry edges were assumed to be fungi or mold species and were not included in the CFU counts (Figure 3).

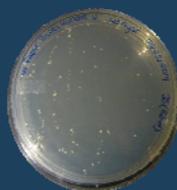


Figure 2. Example of CFUs



Figure 3. Example of mold and fungi species

ACKNOWLEDGEMENTS

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BACTERIAL STUDY RESULTS

Based on the results obtained, there were generally fewer bacteria present on the high-velocity hand dryer contact points than the paper towel dispensers. The number of bacteria on the door handle and light switch samples were consistently small.

Table 1. CFUs in High-Traffic Restrooms (Values for a Second Set of Restrooms)

Sample	Men's Bacteria Count (CFUs)	Women's Bacteria Count (CFUs)
Door Handle	2	2
Light Switch	0	0
Dyson - Front	20	1
Dyson - Back	21	9
Paper Towel Handle - Wall	31	N/A (222)
Paper Towel Handle - Sink	108 (142)	139 (91)
Paper Towel - Wall	0	N/A
Paper Towel - Sink	0	4

Table 2. CFUs in Low-Traffic Restrooms

Sample	Men's Bacteria Count (CFUs)	Women's Bacteria Count (CFUs)
Door Handle	0	0
Light Switch	0	0
Dyson - Front	5	1
Dyson - Back	1	0
Paper Towel Sensor	8	0
Paper Towel	2	0

CONCLUSIONS

Previously, an LCA and cost analysis were conducted on Dyson Airblade™ high-velocity hand dryers. The current study examined the social, health and safety aspect of sustainability by performing a slogan survey and a bacteria study. Based on these studies, the following conclusions were drawn:

- The slogan survey proved users were most motivated by a comparison of CO₂ savings to tree uptake (females) and CO₂ emissions of paper towels (males).
- High-velocity hand dryer surfaces had fewer bacteria than paper towel dispensers.
- Opening a door or turning off the light were not important sources of bacteria that could be back-transferred to hands after the drying process.

FUTURE WORK

The next phase in the signage study will be implementation of the signs and evaluating the change in usage of the high-velocity hand dryers. To further evaluate the health risks each surface with bacteria poses on humans, this project will be expanded to determine if bacteria on each sample are pathogenic or nonpathogenic species.