# Tennant Ec-H2O vs. Chemical Scrubbers

April, 2010

**Testing conducted by Elliott Affiliates, Ltd. www.ealtd.com**

Tennant contacted us to conduct testing of the ec-H2O 5680 model floor scrubber, which uses electrolyzed water to clean rather than chemicals. The scrubber has been tested in controlled lab environments, but how would it perform under real-world conditions? Would it be just as effective as a scrubber that uses chemicals to clean?

We wanted to find a challenging floor care environment, one that's been using a chemical scrubber to clean floors. A soft drink bottling plant/warehouse in Baltimore, MD was the answer, a 24-7 operation with bottling conveyor belts running nonstop, pallets loaded with cases of soft drinks everywhere, and forklifts racing around all day long to keep up with 6 active loading docks. The resulting floor conditions include lots of sugary syrup residue around from spills and leaks, petroleum-based stains and residue from forklift wheels and track-in from busy roads and parking areas, grease spots and residue from the equipment and conveyor belts located throughout the building.

The questions we asked were:

1. Does the activated water scrubber deliver an acceptably "clean" floor in this environment?
2. Is there a difference over time between the results delivered by each machine?
3. Are there advantages of using the ec-H2O over the current system of chemical scrubbing?

To try and answer those questions, we used the following measures:

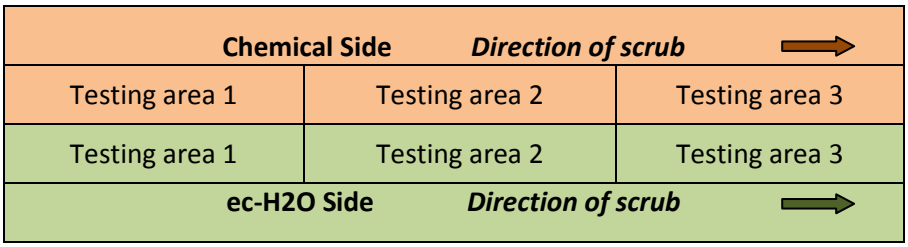
- Appearance – Are the floors noticeably cleaner (or acceptably clean) after scrubbing?
- Organic Load – Is organic matter (the food for bacteria) removed sufficiently by each cleaning method?
- Bacteria Load – Are bacteria removed from the floors in significant amounts?
- Sustainability – Which process is more sustainable, or "green"?

We identified five (5) different study areas in the plant, and conducted testing and scrubbing in the same exact area over a period of three (3) days:

- Pallet Area (unfinished concrete floor)
- Corridor (unfinished concrete floor)
- Loading Dock (unfinished concrete floor)
- Bottling Area (unfinished concrete floor)
- Cafeteria/Break Room (VCT floor)

All areas were split in half – one half was scrubbed with the current chemical scrubber, also a Tennant model. The other area was scrubbed with the Tennant ec-H2O machine. On both sides of each area, the cleaning was done using one pass ONLY with each machine.

Three (3) different test sections were identified on both sides of the area to be cleaned, as the diagram below shows:




Both areas were tested before any cleaning was done, and again after one (1) pass with the appropriate scrubber on each side.

Testing protocol and measures were as follows:

1. To monitor **appearance**, pictures were taken of the testing area.
2. For **organic load**, Hygenia SystemSure II ATP devices and swabs were used following device instructions in each of the 3 testing sections. An approximately 4”x4” square area was swabbed on the floor.

   *The presence of ATP (adenosine triphosphate) on a surface indicates the presence of contamination, such as food residue, allergens, and/or bacteria, implying a potential for the surface to harbor and support bacterial growth. Therefore, low ATP levels are desirable. The manufacturer notes that ATP levels of 0-30 are acceptable on food preparation surfaces, and levels below 100 are considered “clean”.*
3. For **bacteria**, swab samples were taken adjacent to the ATP swab sample areas in each of the 3 test sections, again following manufacturer directions. 3M Aerobic plates were then inoculated, incubated, and interpreted to determine bacteria count.

   *Low levels of bacteria are desirable*.
4. **Sustainability** generally considers many things, such as electric and water usage, impact on the environment, impact on people, and cost.

## Appearance

The testers and employees of the plant were very impressed by the performance of the ec-H2O scrubber. Given the nature of the residue on the floors, everyone was a little skeptical that water, even electrolyzed water, would be able to remove any soiling as effectively as a chemical. It was immediately apparent that those fears were unfounded – ec-H2O removed even the toughest greasy dirt quickly, leaving the concrete floors dry and residue-free.

Bottling Area **before** cleaning

These are pictures of the bottling area, on the first day, before and after four passes with the Tennant ec-H2O machine.

Bottling area after four passes with ec-H20 machine.

The effect was not as dramatic on all floors, especially in the cafeteria, where the VCT tile was not as visibly soiled as the other areas.

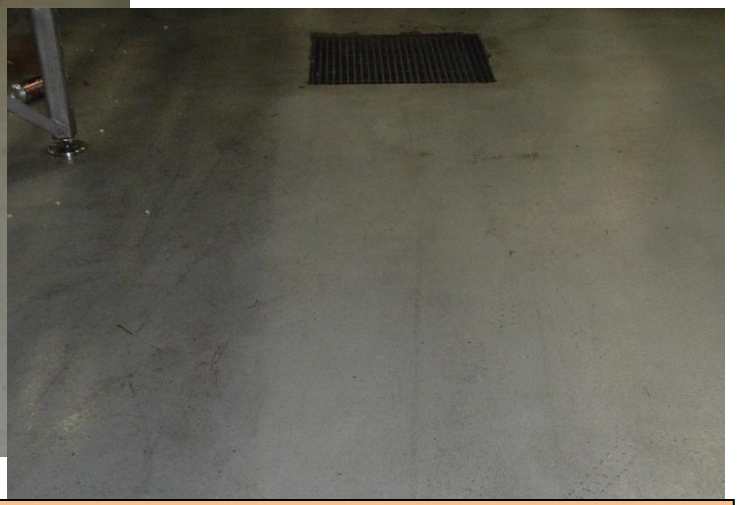
Contrast that with the scrubbing method using chemicals. The floor pictured is in the bottling area, right next to the floor done with the ec-H2O scrubber.

Bottling area **before** cleaning with chemical scrubber on day 1

Bottling area **after** four passes with the chemical scrubber on day 1

By the 3rd day, the bottling area floor has been scrubbed six times, but it appears that the chemically cleaned area is still not as clean as the ec-H2O area was after the first day's cleaning.

Bottling area on day 2 after one pass with the chemical scrubber



Bottling area after one pass with chemical scrubber, day 3

Again, the effect was not the same on all floors, especially the cafeteria VCT floor. However, the ec-H2O machine's performance in removing visible soil was equal to or superior to the chemical scrubber on all floors.

## Organic Load

For removing ATP, the ec-H20 machine delivered superior results overall, reducing ATP by 90.1% average. The chemical scrubber reduced the ATP load 84.2% average.

**ec-H2O Scrubbing** Overall Average Reduction: **90.1%**

| | *Percent Reduction in ATP* | | | | |
|---|---|---|---|---|---|
| | **Bottling Area** | **Corridor** | **Loading Dock** | **Pallet Area** | **Cafeteria** |
| **Day 1** | 95.1% | 97.7% | 94.8% | 99.6% | 92.4% |
| **Day 2** | 83.0% | 99.3% | 68.1% | 97.3% | 95.1% |
| **Day 3** | 99.1% | 99.8% | 56.1% | 96.8% | 77.2% |
| **Average:** | **92.4%** | **98.9%** | **73.0%** | **97.9%** | **88.2%** |

**Chemical Scrubbing** Overall Average Reduction: **84.2%**

| | *Percent Reduction in ATP* | | | | |
|---|---|---|---|---|---|
| | **Bottling Area** | **Corridor** | **Loading Dock** | **Pallet Area** | **Cafeteria** |
| **Day 1** | 86.7% | 99.3% | 98.8% | 79.0% | 99.5% |
| **Day 2** | 72.9% | 98.2% | 60.2% | 78.7% | 86.1% |
| **Day 3** | 97.8% | 96.9% | 81.3% | 99.3% | 28.4% |
| **Average:** | **85.8%** | **98.1%** | **80.1%** | **85.7%** | **71.3%** |

For each of the rooms tested, the ec-H2O machine ATP reduction was higher overall than the chemical scrubber, except in the loading dock, where performance was slightly lower than the chemical method. There was no consistent pattern of increased performance over time (the span of the three day period) for either of the methods.

On the 3rd day, when we arrived in the pallet area, it was obvious someone had spent time cleaning the floor, since a hose and mop were still out and the space appeared much cleaner. However, based on ATP and bacteria testing, the floor was actually much more contaminated than on previous days. Visual inspection of the mop and bucket showed that the water was extremely dirty, so it was apparently the cause of the increased contamination in the "before" test areas on the third day. This is a great example of why it's so important to use testing to validate whether cleaning methods are working properly or cross contaminating an area.

## Bacteria Removal

In removing bacteria, the ec-H2O scrubber also out-performed the chemical scrubber, reducing the presence of aerobic bacteria by an average of 95.1%. The chemical scrubber also removed a significant amount of bacteria from the floor, at an average of 89.7%.

**ec-H2O Scrubbing** Overall Average Reduction: **95.1%**

| | *Percent Reduction in Bacteria* | | | | |
|---|---|---|---|---|---|
| | **Bottling Area** | **Corridor** | **Loading Dock** | **Pallet Area** | **Cafeteria** |
| **Day 1** | 98.2% | 96.7% | 87.4% | 99.9% | 85.9% |
| **Day 2** | 99.6% | 99.8% | 99.3% | 99.7% | 95.3% |
| **Day 3** | 91.0% | 95.7% | 96.9% | 85.0% | 95.5% |
| **Average:** | **96.2%** | **97.4%** | **94.5%** | **94.9%** | **92.2%** |

**Chemical Scrubbing** Overall Average Reduction: **89.7%**

| | *Percent Reduction in Bacteria* | | | | |
|---|---|---|---|---|---|
| | **Bottling Area** | **Corridor** | **Loading Dock** | **Pallet Area** | **Cafeteria** |
| **Day 1** | 98.8% | 100.0% | 99.7% | 99.5% | 68.6% |
| **Day 2** | 95.6% | 97.0% | 100.0% | 100.0% | 89.9% |
| **Day 3** | 63.0% | 84.8% | 93.7% | 93.7% | 75.0% |
| **Average:** | **85.8%** | **93.9%** | **97.7%** | **97.7%** | **77.9%** |

It is interesting to note that the ec-H2O system seemed to perform more consistently in all areas than the chemical scrubber. It also outperformed the chemical scrubber by a large margin in the cafeteria area, the only room that had a VCT floor instead of a concrete floor, reducing bacteria by 92.2% instead of the 77.9% reduction by the chemical scrubber.

While there is no consistent pattern of improved bacteria removal by either system from Day 1 through Day 3, it is apparent that the ec-H2O system delivered more consistent soil and contamination load removal over the course of the study.

## Sustainability

"Green" is defined by Presidential Executive Order 13101 as "products or services that have a lesser or reduced effect on the health and environment when compared with competing products or services that serve the same purpose." As such, it is imperative to consider both environmental impacts AND human health issues when considering a change in products or equipment.

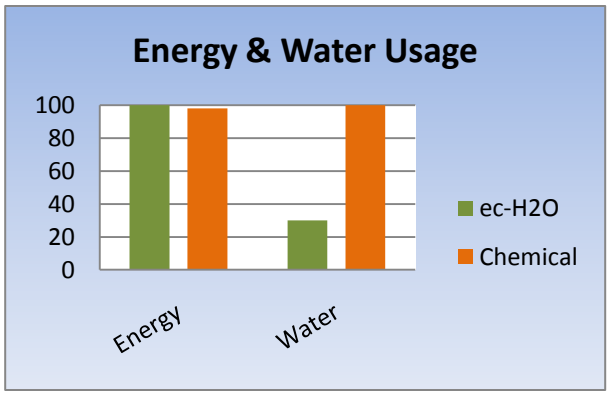
Another factor to consider when it comes to "green" or sustainably preferred processes is the "triple bottom line", or:

- "Profit" - Economic bottom line.
- "Planet" - Environmental bottom line , reducing or removing pollutants from the environment, use of less raw materials, energy, water, decreasing materials disposed of in the landfill, and the impact of transportation of the product.
- "People" - Social bottom line, the impact on people, both those who use a product and those who come in contact with it or the results of its use.

There are several factors to compare between the two machines to determine which has a more positive triple bottom line. We did not evaluate ALL possible factors, just the ones most apparent in the study.

| Category | Impact Measure | ec-H2O scrubber | Chemical scrubber |
|---|---|---|---|
| **Profit** | Cost of machine | $$$ | Slightly less expensive |
| | Added resources needed | No | $ Cost of chemicals |
| | Total Cost of ownership and use of equipment | $$$ | $$$$ |
| **Planet** | Energy Usage (see chart below) | 100% | 98% |
| | Water Usage (see chart below) | Up to 70% less water | 100% |
| | Cleaning chemicals in waste water | No | Yes |
| | Transportation of chemicals | No | Yes |
| | Disposal of packaging for chemicals | No | Yes |
| | Raw materials used for manufacture of chemicals | No | Yes |
| **People** | Potential health hazards by handling chemicals | No | Yes |
| | Chemical residue left behind after cleaning | No | Yes |

If the "green" product or equipment performs the same or better than the current method, and there are environmental, economic, and social benefits, then the choice is simple. For all of these reasons, the ec-H2O machine outperforms the chemical scrubber.




## Overall Study Conclusions

The Tennant ec-H2O floor scrubber delivered greater ATP and Bacteria reduction and higher appearance and sustainability than the floor scrubber using a designated chemical cleaner.

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