

New Technology Reduces Carpet Drying Time While Maintaining Appearance and Cleanliness of Carpets

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"For building managers, particularly in 24/7 facilities, overall results - plus returning carpeted spaces to productive use - is an extremely important priority. Too often, we're forced to hold events with the carpet in a less-than-satisfactory condition, simply because we don't have time for cleaning and drying with current cleaning programs."

Jeff Bishop, building manager and industry consultant.

Introduction

Industry studies have shown that the top concerns of business owners and operators of carpet cleaning equipment are:

- Carpet appearance and cleanliness
- Shortening the carpet drying time after cleaning

The problem with current methods has been that "quality cleaning" and "short drying times" have been mutually exclusive.

A new technology developed and patented by Tennant Corporation called Soil Transfer Extraction (trademarked as "ReadySpace") has demonstrated the ability to reduce carpet-drying times, while maintaining the cleanliness and appearance of the carpets at high levels.

Current Carpet Cleaning Methods

Several different cleaning methods are employed by commercial carpet-cleaning professionals today:

- Vacuuming
- Bonnet cleaning
- Deep Extraction
- Light Extraction
- Encapsulation cleaning
- Chemicals

Vacuuming is recommended prior to any carpet cleaning, and can remove more than 50% of the loose dirt from commercial grade carpets.

Bonnet cleaning uses a cloth "bonnet" on a rotary floor-cleaning machine, and does a reasonably good job of improving carpet appearance on a short-term basis. But replacing the dirty bonnet is both time-consuming and expensive, and there is no clear indicator of when the bonnet should be replaced. Because the bonnet becomes dirty quickly, and is rarely replaced often enough, this method does little to improve the cleanliness of the carpet. Typically, bonnet cleaners are considered "dirt movers," and can damage the carpeting.

Reason for use: Dries faster than other methods, and improves carpet appearance by spreading out spots and "homogenizing" the carpet's color and pile.

Main Drawbacks: As commonly practiced bonnet cleaning does not really clean the carpet (does not remove a significant amount of soil). Also, many carpet mills will void their warranties if bonnet cleaners are used because of the potential for damage to the carpet.

Deep Extraction (also known as "Extraction") cleans a carpet down to the backing. It applies large volumes of water to the carpet under high pressure, which is then extracted by a vacuum hose, along with surface and deep dirt. Some water cannot be removed and remains in the carpet until it evaporates. Evaporation can typically take 12-16 hours.
Reason for use: Cleans thoroughly, down to the base of the carpet.

Main Drawbacks: Takes a long time for carpet to dry. Some re-staining of the carpet can occur due to wick-back. ("**Wick-back**" means that as the top layer of the carpet dries, water flows up the carpet fibers to the top of the carpet. The dry top surface of the carpet acts as a sponge, attracting water from lower layers. If any of the water is dirty, the dissolved dirt/soil/pigment will migrate to the top carpet layer along with the water, re-staining the carpet. Re-staining due to wick-back will occur whenever there are isolated stains and the carpet fibers or the carpet pad have been soaked to some depth.)

Light Extraction is a form of Extraction cleaning where less water is applied to the carpet, and the machine is moved across the carpet at a higher speed. Some water cannot be removed, and remains in the carpet until it evaporates. Water evaporation typically requires 3-8 hours.

Reason for use: Cleans moderately well, and dries faster than Deep Extraction.

Main Drawbacks: Takes quite a while to dry even though less water was used than in Deep Extraction. Some re-staining of the carpet can occur due to wick-back.

Encapsulation and Dry Compound: Encapsulation cleaning (also known as a "mist and agitation" method) involves the use of a special shampoo containing crystallizing polymers which is first applied to the entire carpet (much like a pre-spray) then worked in with a scrubbing machine. During the drying process, dirt is encapsulated forming "dirt crystals," which can then be vacuumed up after the carpet has dried. Dry compound is similar in that a chemical in a "damp medium" is spread across the entire carpet and then worked into the carpet fibers. As the medium and chemicals dry, the dirt attaches to it so that it can be vacuumed. With both processes, 2 vacuuming cycles are required: One before chemical application and one after drying.

Reason for use: Improves carpet appearance through homogenization, and dries quickly. Carpet re-staining through wick-back is essentially eliminated.

Main Drawbacks: Chemicals can be extremely expensive in the quantities required to get good cleaning. Very little soil removal occurs. Requires 2 vacuuming cycles to complete the cleaning cycle (labor intensive). Large amounts of residual chemicals can remain in the carpet using this process which can lead to rapid re-soiling and even indoor environmental quality (IEQ) issues.

Chemicals

Pre-sprays (or pre-treatment sprays) are usually applied to the carpet before agitation to loosen dirt and treat stains. The amount of time the treatment should remain on the carpet prior to machine cleaning is called "dwell time," and is typically 5-15 minutes.

Detergents are often added to the cleaning water to soften the water, emulsify oily dirt, and help remove soil from the carpet. There are dozens of detergents to choose from,

but most contain a *surfactant* for emulsifying the oil (it acts on the *surface* of the water), plus other ingredients such as solvents and fragrances. Some users add detergents to the water tank of an extractor machine, some will spray it on the carpet before cleaning (as a pre-spray), and some will do both.

Rinse Aids have many important functions. The two primary functions are: 1) They make the water "slipperier," assisting in the rinsing of carpet-cleaning brushes, and 2) They neutralize the effects of pre-sprays, keeping the colors in the carpet color-fast. Rinse Aids are strongly recommended when pre-sprays or detergents are used. When used, Rinse Aids are added to the clean-water tank of the machine.

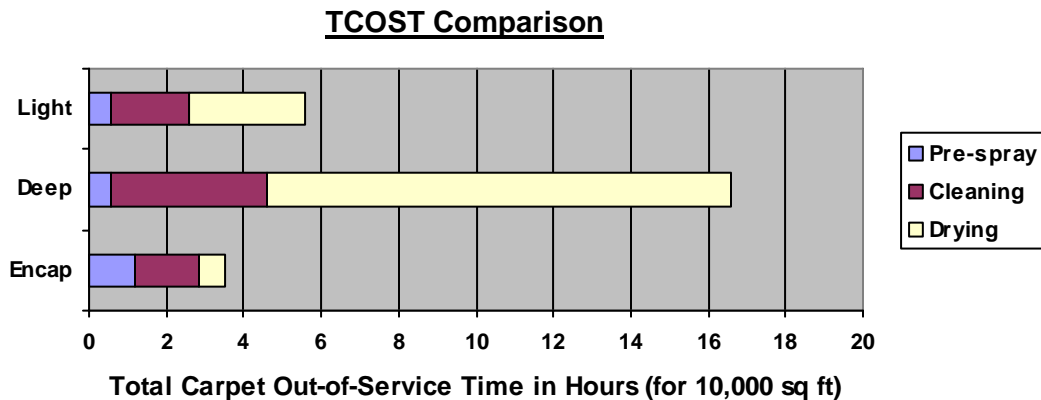
Total Carpet Out-of-Service Time

Carpeted spaces are either **in service** (usable by customers and employees) or **out of service** (unusable by customers and employees).

Spaces are out of service:

- During and after a pre-spray has been applied
- During the cleaning
- Waiting for the carpet to dry

The "Total Carpet Out-of-Service Time" (TCOST) is the length of time a carpeted area is out of service due to any of these conditions.



Total Carpet Out-of-Service Times in Hours for the cleaning of a 10,000 sq ft commercial carpet, assuming a pre-spray was used in all cases. (These are typical timings).

Deep Extraction takes the carpet out of service for the longest period of time, and leaves the carpet unusable for more than 16 hours.

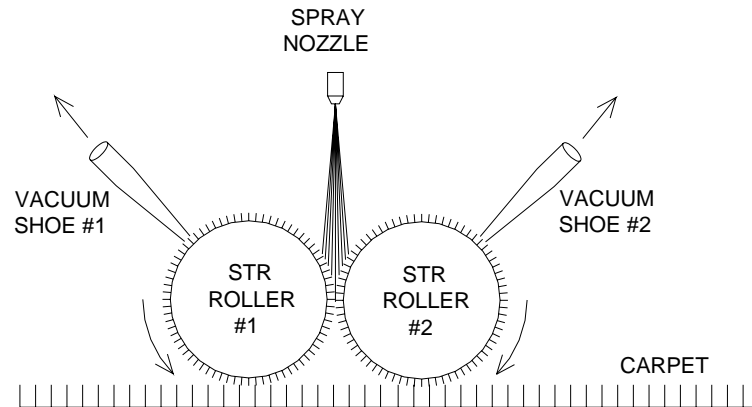
$TCOST = p + c + d$

p = pre-spray time plus dwell time, c = cleaning time, d = drying time

Note: Vacuuming time is not included in the out-of-service time because the carpet is dry, can be used by people, to some degree, and is not completely out of service.

Soil Transfer Extraction Technology (STE)

The Soil Transfer Extraction technology (STE) uses a different method for cleaning carpets, shown in the figure below:



Instead of spraying the carpet directly with water during cleaning, spray nozzles in the machine apply water to two counter-rotating rollers. After this, a vacuum shoe extracts water and soil from each roller. Very little water reaches the carpet because the water is never sprayed directly onto the carpet.

As the rollers continue to rotate, the rinsed and vacuumed part of the rollers contact the carpet, where they "seize" the soil. This soil is then flushed into suspension as water is sprayed on the rollers again and vacuumed away by the extraction tool on the next rotation. The rollers turn at 400 RPM, cleaning the carpet with each revolution. Rinsing and vacuuming of the rollers occurs 400 times/minute.

Many different materials were tested for use as the covering on the soil transfer rollers. Required material properties included a long wear life, good soil pickup, good rinsability, and low water transfer to the carpet, enabling a high water recovery rate from the brushes. Water recovery rates from the materials tested ranged from 50% to 94%, while cleaning ability showed an even wider range. Extensive testing slowly narrowed the choices down to the optimal fabric, which combines good cleaning characteristics with optimum life.

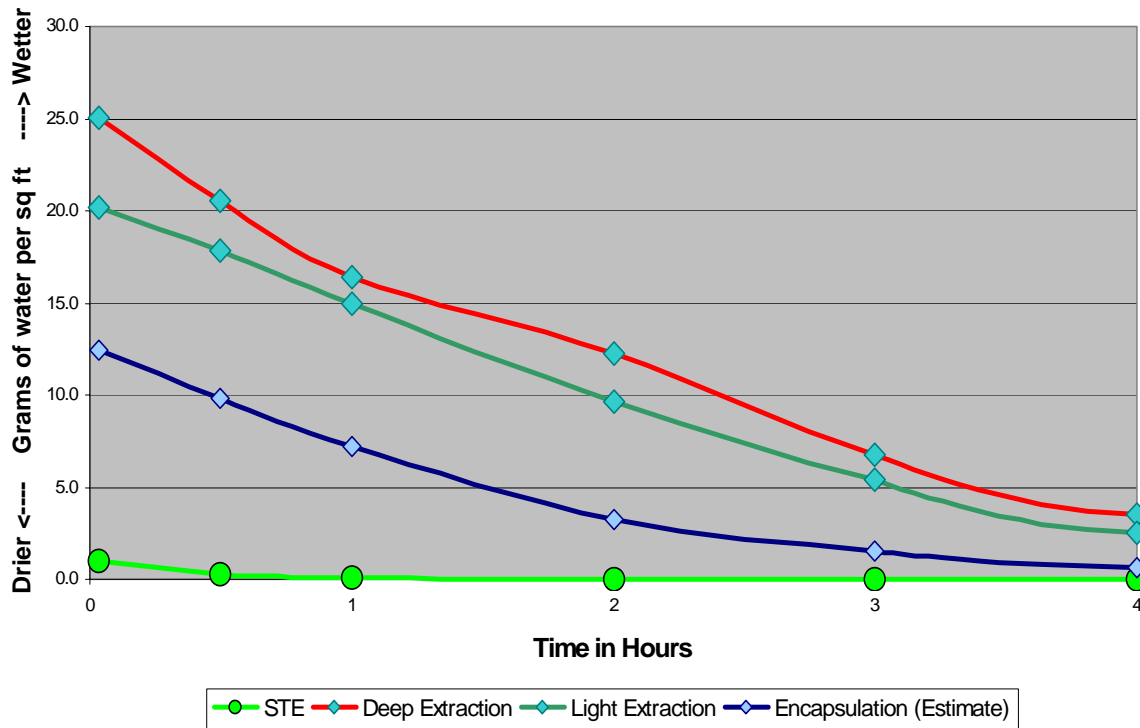
This cleaning method targets the soil that is embedded in the carpet fibers. Tests have shown that this technology is very effective at cleaning the carpet and dramatically improving carpet appearance. Most of the top layer soil is transferred to the rollers, and the carpet looks attractive after drying - even though the barest amount of liquid was used.

The key to ensuring carpet attractiveness and quick drying time is STE's **minimal use of water**. With so little water reaching the carpet, the carpet remains drier than Extraction methods, drying in less than 30 minutes.

Advantages of STE

- **Back in service:** The cleaned area can be returned to service sooner since the carpet dries in less than 30 minutes.
 - **Soil Removal:** STE removes significant quantities of soil from the carpet with each cleaning (unlike some other methods).
 - **Wick-back:** The low water usage of this method minimizes the potential for wick-back. With less wick-back to restrain the carpet, re-cleaning of such stains is reduced or eliminated. The carpet will usually look just as attractive after drying as it did after cleaning.
 - **Frequency of cleaning:** More frequent cleaning of carpets is possible with this method since there is no damage to the carpet, and the drying time is so low. If carpets are cleaned more often, they will look better, be cleaner, and last longer.
 - **Deep Extraction:** If carpets are cleaned more often using STE, Deep Extraction cleaning could also be done less frequently, further reducing "space downtime" and the costs of this effective, but very time-consuming, process.
 - **Air quality:** Wetter carpets often have an unpleasant odor. By reducing the amount of water used and the total carpet wet time, the carpet is kept drier, and the air quality is significantly improved. Additionally, this much drier process alleviates any of the mold issues (with their air quality problems) that can occur with methods that saturate the carpet.
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With its minimal use of water, STE is the **driest** process, as shown in the graph below.



Residual Moisture (Carpet Wetness) While Drying

Using the STE cleaning process (green line at the bottom), moisture can barely be detected in the carpet by the measuring instruments immediately after cleaning. After 30 minutes (or less), the carpet is dry to the touch and easily dry enough to walk on.

STE was by far the driest of the methods tested.

Note: Areas that were treated with a pre-spray will dry according to the amount of liquid used on the carpet. However, these areas can be artificially dried, as needed.

Machines and speeds used in testing:

Deep Extraction - Tennant model 1510 run at 50 ft/min (normal speed).

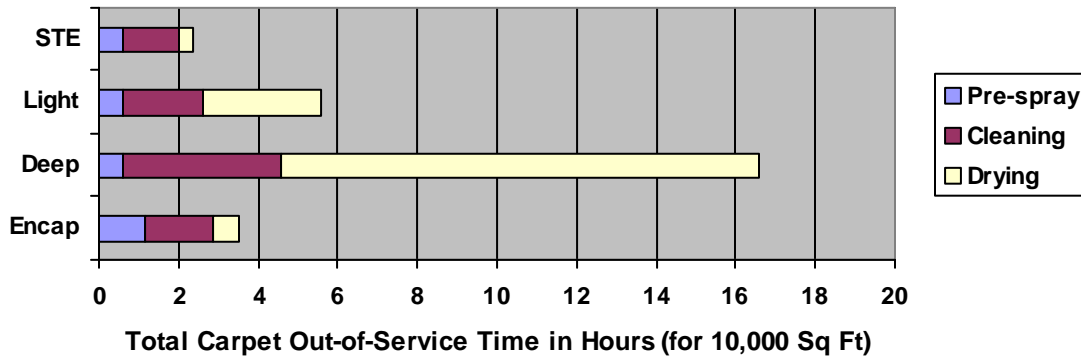
Light Extraction - Tennant model 1510 run at 100 ft/min (normal speed).

STE - Tennant model 1610 (ReadySpace) run at 100 ft/min (normal speed).

Source for STE, Light Extraction and Deep Extraction results: Professional Testing Laboratory, Inc., Dalton, GA. Data for Encapsulation Cleaning was estimated by Tennant Company.

TCOST Comparison of Four Cleaning Methods

For computing Total Carpet Out-of-Service Time (TCOST), Tennant's new STE machine was compared against 3 other cleaning methods using known, typical timings, and Tennant cleaning machines for Light and Deep Extraction. Encapsulation numbers are estimates supplied by Tennant Company. Pre-sprays were used in the calculations for all 4 methods. The results are shown in the graph below.



$$\text{TCOST} = p + c + d$$

p = pre-spray time plus dwell time

c = cleaning time

d = drying time

As the graph illustrates, STE has the lowest Total Carpet Out-of-Service Time, compared with the other methods, and is out of service for only 2.34 hours.

In other words (not counting the vacuuming time), the pre-spray, cleaning, and drying time for the STE method was only 2.34 hours for 10,000 square feet of carpet. The carpeted space was then ready to be put back in service.

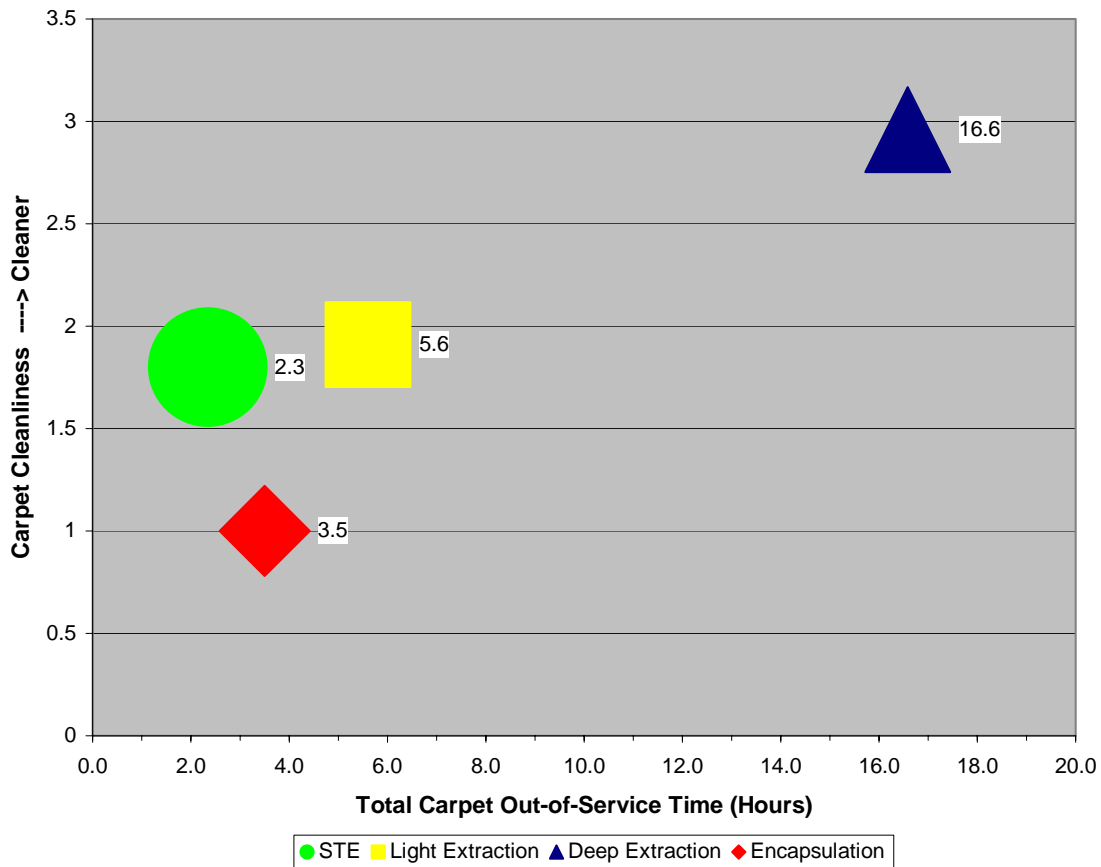
The TCOST times are:

STE: 2.34 hours

Encapsulation: 3.51 hours (estimate)

Light Extraction: 5.60

Deep Extraction: 16.58 hours



**Carpet Cleanliness vs. Total Carpet Out-of-Service Time
(for 10,000 Sq Ft)**

- **STE** cleans well - almost as well as Light Extraction, and keeps the total carpet out-of-service time down to a minimum (2.3 hours).
- **Light Extraction** cleans slightly better than STE, but takes the carpet out of service much longer (5.6 hours).
- **Encapsulation** cleaning takes longer than STE (3.5 hours), and doesn't clean as well. (Estimate)
- Only **Deep Extraction** cleans better than the other methods.

Interpretation: Clean carpets *and* quick turnaround times can be achieved with STE. (Deep Extraction should be used occasionally for deeper cleaning).

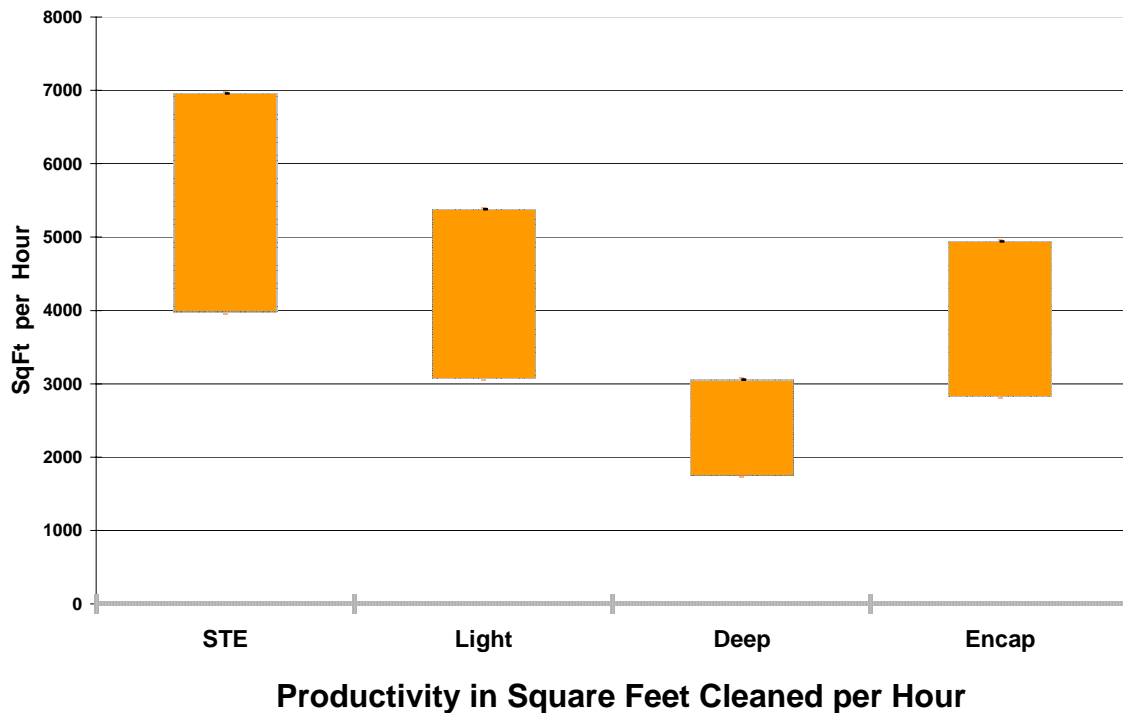
Carpet cleanliness was determined by measuring carpet color change, before cleaning and after drying, using a spectrophotometer, based on ASTM D6540-2000. 3 tests were run and averaged.

Source for STE, Light and Deep results: Professional Testing Laboratory, Inc., Dalton, GA.
Data for Encapsulation Cleaning was estimated by Tennant Company.

Other Advantages of STE

Besides cleaning effectively, drying quicker, and keeping the air quality at a higher level, STE:

- Does not damage carpets, unlike Bonnet cleaners.
- Does not require special chemicals.
- Reduces the slip/fall hazard when walking from a carpet to a hard floor surface.
- Cleans rapidly - 4,000 to 7,000 sq ft per hour.



Timings include prep time, pre-spray, cleaning, drying, and fill and dump times.

STE has the highest mean productivity rate at 5,500 sq ft cleaned per hour.

"The Soil Transfer Extraction method didn't just take 'less time,' but far less time. We've been using this equipment daily for almost two weeks now, and we're cleaning at a minimum rate of 6,000 square feet per hour."

Jeff Bishop, building manager and industry consultant.

Attribute	STE	Light Extraction	Deep Extraction	Encapsulation Cleaning
Water Application	Lowest	Medium	High	Low
Drying Times	Shortest < 30 mins	Medium 3-8 hrs	Long 12-16 hrs	Short
Carpet Appearance	Excellent Med-Hi uniformity Lifts pile No color degradation	OK Low uniformity Some pile lift No color degradation	Good-Excellent Med uniformity Lifts pile No color degradation	OK Hi Uniformity Lifts pile Some color degradation
Soil Removal	Medium	Medium	High	Very low
Potential for Wick-back	Very Low	Medium	High	Low
Potential for Resoiling	Low	Medium	Medium	High
Damages Carpet?	No	No	No	No
Pre-sprays	Best Practice	Best Practice	Best Practice	Best Practice
In-tank Solution	Warm or hot water. Rinse-aid is recommended.	Warm or hot water. Rinse-aid is recommended.	Warm or hot water. Rinse-aid is recommended.	Shampoo with crystallizing polymers in- tank or as a pre-spray
Safe for all commercial carpets?	Yes	Yes	Yes	Yes
Productivity (sq ft/hr)	High 6,000-10,000	High 6,000-10,000	Low - Medium 1,800 - 3,100	Medium - High 2,800 - 4,900
Frequency: Reasonable to use?				
Daily	Yes	No	No	Maybe
Weekly	Yes	Maybe	No	Yes
Monthly	Yes	Yes	Yes	Yes
Quarterly	Yes	Yes	Yes	Yes

Recommendations/Limitations for STE Operation

- As with all cleaning methods, the carpet should be vacuumed first for best results.
- The solution tank requires only warm or hot water. The use of Rinse-Aids is recommended. Rinse-Aids with a foaming tendency may require a defoamer in the recovery tank.
- For best results, a pre-spray is recommended for high-traffic areas, entryways, and spots. This can be any common pre-spray normally used on that carpet, or a pre-spray Tennant has developed for use with STE. Normal dwell times of 5-15 minutes should be used.
- As shown in the preceding graphs, STE is not considered to be a restorative cleaning process. STE is not intended to replace Deep Extraction, which will still be required occasionally to target the dirt at the base of the carpet.
- The Operator's Manual for the STE machine should be consulted for additional information on the proper operation and safe practices for the process.

Product Demos

Tennant is planning to offer product demonstrations to customers beginning in the 3rd quarter of 2004.

Conclusion

Tennant's new Soil Transfer Extraction technology (STE) is a significant, evolutionary development in the field of carpet care, offering fast drying times while maintaining high standards of carpet cleanliness and appearance.

Its compatibility with existing pre-sprays and the simplicity of machine operation should make the transition to STE an easy one for owners, operators, and purchasing agents.

Additionally, significant productivity gains can be achieved as a direct result of the operating speed of this new process and its rapid carpet drying time.

STE sets a new standard for delivering exceptional cleaning performance in time-sensitive situations.

"ReadySpace" is a trademark of Tennant Company.

The Soil Transfer Extraction technology is patented under US Patent Office number 6,662,402 B2

Other Patents pending.

Professional Testing Laboratories, Inc (PTL), Dalton, Georgia, is an independent laboratory for testing carpeting and related products.

The Tennant Company's website is located at: www.tennantco.com.