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Removing Soil:
A Comparison of Cleaning Methods

kaivac cleaning systems™
Complete Cleaning For Healthy Results™

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Table of Contents

Executive Overview	**2**
Introduction	**3**
The Soil Removal Comparison Studies	**4**
Experiment # 1: Removal of Urine Residue by Various Cleaning Methods	**4**
Experiment # 2: Urine Residue Levels Pre- and Post- Cleaning – for Two Different Cleaning Programs – Conducted by a National FSP	**6**
Why Urine?	**8**
Why Test in Front of Toilets and Urinals?	**8**
The Significance of Grout	**8**
Why was No-Touch Cleaning More Effective?	**9**
Urine Detection Kit	**9**
Going Forward	**10**
Conduct Your Own Research	**10**

Executive Overview

Kaivac has long believed that clean can be defined as the absence of soils, and has accordingly designed its no-touch cleaning systems from the start for maximum soil removal.

Although much anecdotal evidence had been collected over the years that seemed to confirm that no-touch cleaning actually does remove soils that other methods leave behind, Kaivac desired to validate and measure its beliefs and claims with more scientific evidence.

Consequently, in early 2006, Kaivac designed a series of tests to compare the soil removal capabilities of no-touch cleaning with the two most common methods of restroom cleaning: string mopping and flat mopping.

According to the test results contained on the following pages, no-touch cleaning, at least with a Kaivac system, is far more effective than string or flat mopping at removing urine, a primary source of restroom odor, from a grouted tile restroom floor – both from the tile surface and from the all-important grout line. Some of the findings include:

- Kaivac's no-touch cleaning process removed 98 percent of urine residue on both smooth hard surfaces and grout lines.
- Both string and flat mops left 30 times more urine residue than Kaivac's system on grouted surfaces and 12-13 times more on smooth tile surfaces.
- Both flat and string mop methods did a poorer job removing urine residue from grout lines than they did from tile surfaces.
- Facilities that are cleaned with only a mop had nearly as much urine present after cleaning as those that incorporate no-touch cleaning had prior to cleaning, even when performed only every other week.

Kaivac believes that these results are the result of the inherent capabilities of the no-touch cleaning methodology and system that are non-existent in mopping processes. For example, the no-touch cleaning process includes built-in dwell time, which is typically minimized during mopping, to loosen and lift soils. But perhaps most important, the suctioning of soils and liquid through the system's built-in wet vacuum ensures that all contaminants are removed from all surfaces, including the vulnerable grout lines.

Introduction

Kaivac has long believed that clean can be defined as the absence of soils. And Kaivac is not alone in this position. For example, Michael A. Berry, Ph.D., the Director of the Scientific Advisory Council for the Cleaning Industry Research Institute (CIRI), recently defined clean as being "a condition free of unwanted matter that has the potential to cause an adverse or undesirable effect". (May 11, 2006 CIRI online seminar.)

Consequently, from the beginning, a key design consideration for Kaivac when developing or enhancing its systems has been the ability to thoroughly remove and contain soils.

Over the years, feedback from the field has indicated that we are indeed achieving this goal. For example, Kaivac often hears from customers that, prior to their adoption of no-touch cleaning, they had significant lingering odor problems in their restrooms. However, after cleaning their restrooms a time or two with their Kaivac no-touch cleaning machines, they noticed that the lingering malodor would go away. In addition, soils that had accumulated in grout lines and other surfaces began to disappear and grout lines would often actually whiten. Interestingly, this was usually accomplished without the use of disinfectants or disinfectant cleaners.

In another recent instance, a Phoenix, Arizona television news crew examined three upscale school districts for the presence of urine on restroom surfaces. They swabbed a variety of restroom surfaces while the schools were in session. The swabs were then taken to a laboratory for evaluation. They reported finding evidence of urine on virtually every surface in two of the three districts. While some splatter is inevitable in a school restroom, the samples for these schools were taken in the morning – prior to heavy use.

The third district fared much better in the test, with urine present only on the floor around the toilet and on door handles. Incidentally, the third district's restrooms were tested in the afternoon, not in the morning. This was significant because it was expected that the restroom surfaces would be even more soiled, more contaminated, and show more evidence of urine after continued use. In searching for the reasons why these restrooms showed less evidence of urine than the other two districts, the television crew discovered that this district has incorporated no-touch cleaning into its program, while the other districts cleaned using conventional methods. (Kaivac had no knowledge of this news story until after it was aired.)

Encouraged by such anecdotal evidence that no-touch cleaning may actually remove soils that other methods leave behind, Kaivac wanted to dig deeper into the reason – or reasons – for these consistently positive results. We wanted to validate and measure our beliefs and claims with more scientific evidence.

The Soil Removal Comparison Studies

In early 2006, Kaivac began to design a series of tests to measure the soil removal capabilities of various cleaning methods and tools. Initial tests were conducted in a "live" restroom at Kaivac headquarters to help confirm and fine tune our measurement procedures. Then, working with independent, non-Kaivac personnel, testing was expanded to include a variety of field locations representing a number of facility types. This section describes each test suite as well as the resulting measurements.

Experiment # 1: Removal of Urine Residue by Various Cleaning Methods

Purpose

We designed this test to compare the effectiveness of string mopping, flat mopping and no-touch cleaning in removing urine residue (i.e., dried urine) from the grout line and from the tile surface of a restroom floor.

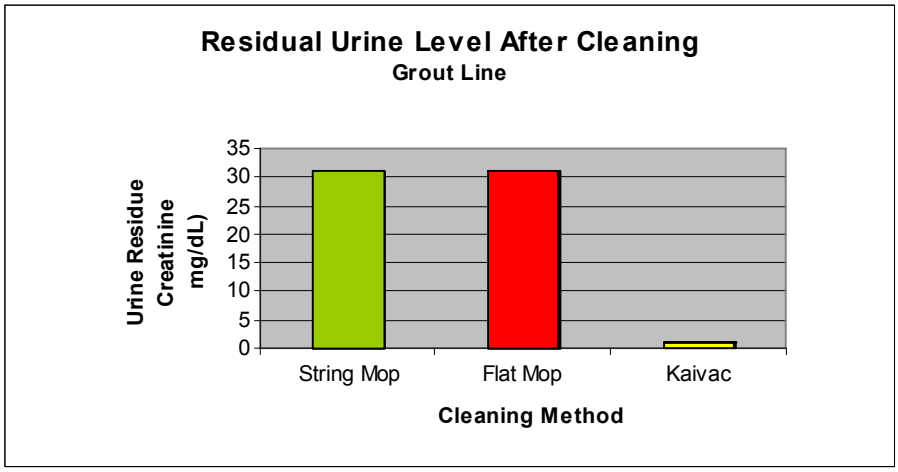
Methods

This experiment was performed using the grouted ceramic-tile floor of one of the restrooms in Kaivac's corporate offices. The restroom floor was sectioned off into test areas – one area for each of the three cleaning methods being evaluated. Each area was identical in size, and included two grout line intersections. In addition, each area was remote from the other two, so that there would be no flow of liquids or solutions from one area to another. Each test area was soiled with fresh urine by holding a fine-mist spray bottle about 12 inches above the first grout line intersection, aiming the bottle toward the intersection, and spraying about 1 gram of urine downward onto the floor. This same procedure was repeated at the second grout line intersection. The urine then was allowed to dry. The urine application was repeated until a sufficient level of urine residue build up produced a 50 mg/dL creatinine reading as described later.

The test areas were cleaned using plain water from the cold tap. No cleaning compositions were used, so as to avoid any possibility of a cleaning composition influencing the results. For the string-mop area, a cotton string mop was thoroughly wetted with water, and the mop head was wrung out in a mop-bucket wringer, resulting in a damp mop. For the flat-mop area, a polyester microfiber pad was thoroughly wetted with water, and the pad was wrung in the same wringer, resulting in a damp pad. The pad was attached to the frame of a flat mop. For each of these mops and corresponding floor areas, the area was cleaned by making a first pass of the mop across the area, and then by making a second pass in the opposite direction. For each pass across the floor, a slight downward pressure was applied to the mop via the mop handle. For the no-touch cleaning area, one of Kaivac's KaiZen machines was used. This area was cleaned by sprinkling water from the spray gun, with the nozzle in low-pressure mode. The water was allowed to dwell for about five minutes; and then the solution was vacuumed up using the vac tool assembly.

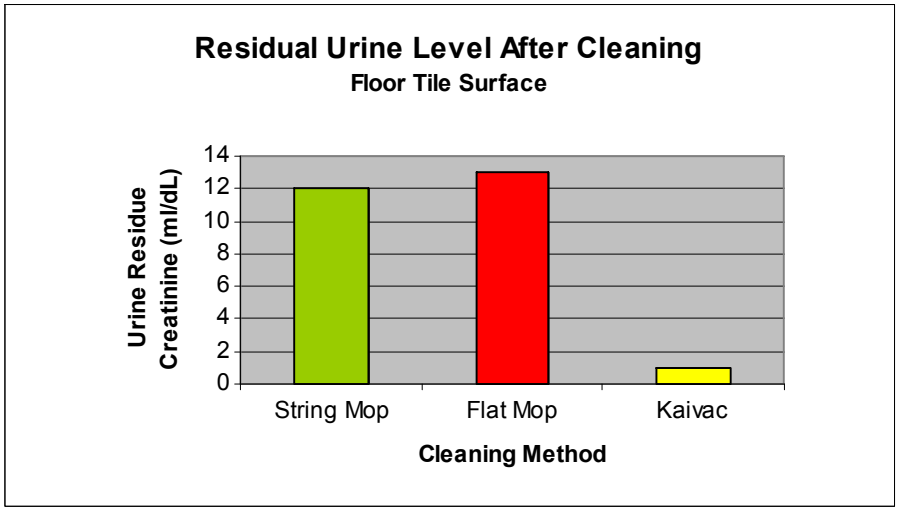
Once the test areas had been cleaned, they were tested for the presence of residual urine using Kaivac urine detection strips. For each area, both a particular grout line intersection and a particular location on the surface of one of the ceramic tiles were tested. Detection with the strips was performed as follows. The test site was wetted with a single drop of tap water, and the drop was agitated on the site for about ten seconds. Then the pad portion of the test strip was placed on the test site for about ten seconds, and the strip was removed from the site and allowed to develop for about 60 seconds – at which time the detection result was read and recorded. A fresh strip was used to test each area.

Results



Graph 1

Graph 1 shows the amount of urine residue detected on the grout line test site of each of the areas after cleaning. These are average figures based on a minimum of 11 test runs. The vertical axis shows the amount of urine residue remaining after cleaning, as determined by the concentration of creatinine present at the test site. The creatinine concentration is expressed as milligrams per deciliter (mg/dL). The horizontal axis shows the three cleaning methods tested – string mopping, flat mopping, and no-touch cleaning with a Kaivac machine. As may be seen in the graph, the average creatinine concentration detected at the grout-line test sites was 31 mg/dL for both string- and flat-mop cleaning, and 1 mg/dL for no-touch cleaning with a Kaivac machine.



Graph 2

Graph 2 shows the amount of urine residue detected on the tile-surface test site of each of the areas, after cleaning. As with Graph 1, the vertical axis shows the amount of urine residue remaining after cleaning, as determined by the concentration of creatinine present at the test site. The creatinine concentration is expressed as milligrams per deciliter (mg/dL). The horizontal axis shows the three cleaning methods tested – string mopping, flat mopping, and no-touch cleaning with a Kaivac machine. As may be seen in the graph, the average creatinine concentration detected on the floor tile surface test sites was: 12 mg/dL for string mop cleaning; 13 mg/dL for flat mop cleaning; and 1 mg/dL for no-touch cleaning with a Kaivac machine.

Interpretation

Based on the results of this experiment, Kaivac's no-touch cleaning process removes 98% of urine residue on both smooth hard surfaces and grout lines. The string and flat mops left 30 times more urine residue than on grouted surfaces and 12-13 times more on the smooth tile surface. It is also obvious that the flat and string mop methods do a poorer job removing urine residue from grout lines than on tile surfaces.

Experiment # 2: Urine Residue Levels Pre- and Post- Cleaning—for Two Different Cleaning Programs—Conducted by a National FSP

Purpose

We designed this experiment to find out how much urine residue is present at the grout line, on the restroom floors of a wide variety of public, commercial and industrial facilities. In particular, we wanted to see how much residue was present before and after cleaning using two different types of cleaning programs. The first program involved traditional periodic in-house string mopping of the restroom floors. The second program is one in which a national FSP used Kaivac no-touch cleaning systems to clean their clients' restrooms, including the floors, every other week. In between those FSP visits, the client organizations usually performed their own periodic string mopping.

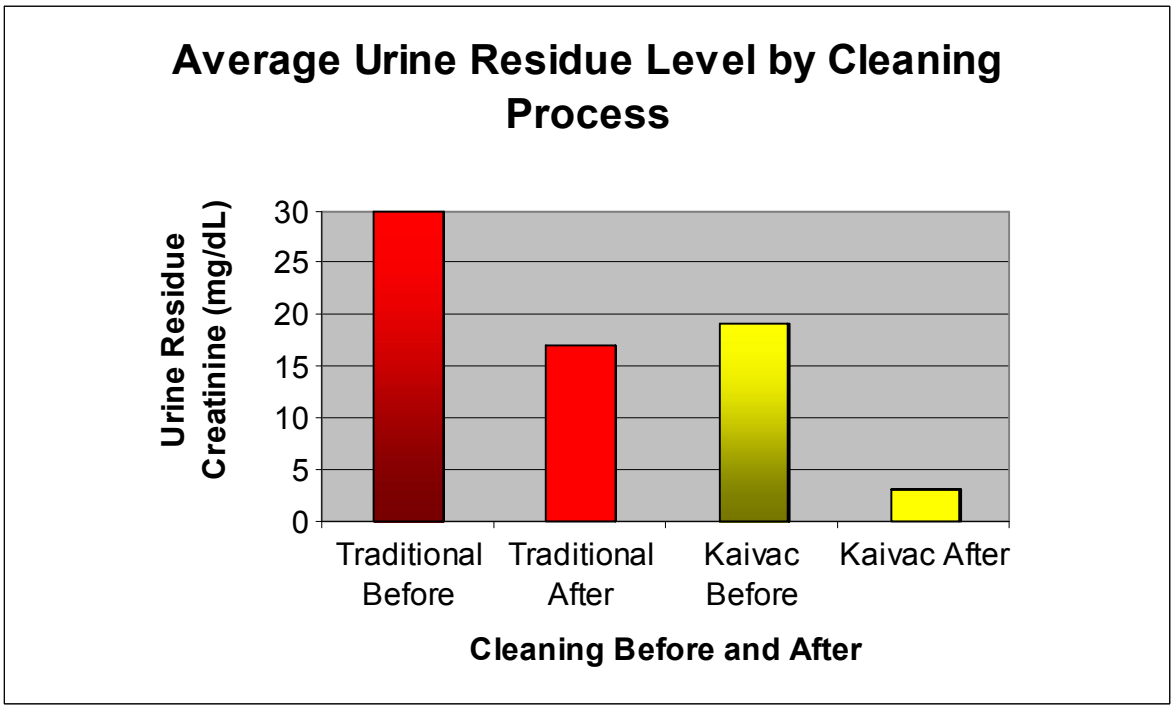
Methods

Using Kaivac urine detection strips, we obtained pre- and post- cleaning data from the group of facilities that performed their own in-house cleaning using mops.

For facilities using the second program, a few of the FSP's cleaning professionals were trained to perform urine detection testing with Kaivac's test strips. They then went to a variety of customer sites and tested a grout-line location prior to cleaning. After that, they performed the every-other-week no-touch cleaning service followed by a second test at the same grout line location.

The urine detection testing was performed in a manner substantially similar to that described in Experiment # 1.

Results



Graph 3

Graph 3 shows the amount of urine residue detected at the grout line, for both cleaning programs – both pre- and post- cleaning. The vertical axis shows the amount of urine residue, as determined by the concentration of creatinine present at the test site. The creatinine concentration is expressed as milligrams per deciliter (mg/dL). The horizontal axis shows the pre- and post- cleaning methods for each of the two cleaning programs – periodic string mopping (first program), and every-other-week no-touch cleaning with a Kaivac machine by a trained FSP, with periodic string mopping by the customer in between service visits (second program). As can be seen in the graph, the average creatinine concentration detected at the grout-line test sites, pre-cleaning, was 30 mg/dL for the first program, and 19 mg/dL for the second program, which incorporated no-touch cleaning every other week. Post-cleaning, the results were 17 mg/dL and 3 mg/dL for the first and second programs, respectively.

Interpretation

Based on the results of this experiment, a program that incorporates Kaivac's no-touch cleaning system is not only far more effective at removing urine from the restroom floor than a program that relies on mopping, but also, there is far less urine build-up on the floor with the program that incorporates no-touch cleaning. In fact, facilities that are cleaned only with a mop have nearly as much urine present after cleaning as those that incorporate no-touch cleaning have prior to cleaning. And these results are achieved in facilities that incorporate no-touch cleaning as infrequently as every other week. It stands to reason, then, that facilities incorporating no-touch cleaning on a more frequent basis, such as daily or weekly, would experience even better results.

Rationale and Conclusions

Why Urine?

In this research, Kaivac tested for urine for several reasons. First of all, urine is a type of soil and is common to restrooms. Therefore, Kaivac believes that urine satisfies the basic requirement for research that measures the removal of soil. Second, the presence of urine can also indicate the presence of other harmful soils and contaminants.

Third, Kaivac's research indicates that foul restroom odors come from urine residue that remains when cleaning is only partially effective. This is a prevalent problem that continues to plague our industry. While fresh urine from a healthy individual is usually considered to be sterile, it contains urea, on which bacteria thrive. In fact, urea is a powerful fertilizer that has surpassed and nearly replaced ammonium nitrate as a fertilizer. Attracted to this rich food source, bacteria soon begin to break down the urea, giving off ammonia and unpleasant odors. Over time, the residual urine that is not removed--along with the related colonies of bacteria--produces the stubborn foul odor associated with unclean restrooms.

Why Test in Front of Toilets and Urinals?

Clearly, one would expect to find urine in front of urinals and toilets, so why test these locations?

Kaivac wanted to measure the results of various cleaning methods and tools so we believed that it was important to choose a site that consistently contained measurable amounts of soil. Also, our tests measured the presence of urine both before and *after* cleaning.

In addition, these will typically be the spots with the highest concentration of accumulated urine and will, therefore, likely be the trouble spots for the bulk of odor development. Kaivac made the assumption that if a cleaning method is able to remove urine from these high concentration areas, it can be assumed that it will remove urine and other soils from additional locations as well.

The Significance of Grout

When we began our quest to learn about the importance and impact of removing urine from the restroom floor, we performed an experiment in which we monitored the odor of urine over time. We used two identical plastic containers; we added washed limestone gravel to the bottom of one (to simulate grout), and kept the other free of gravel (to simulate a non-porous tile surface). We then added a small amount of fresh urine (2 mL) to each container on a routine basis, over a 20-day period, allowing each amount of urine to dry before the next amount of fresh urine was added.

Through day 13, the contents of both containers gave off only a very mild odor. By day 14, however, the odor profile had changed dramatically. While the contents of the non-gravel container still gave off only a very mild odor, the contents of the gravel container gave off a moderately pungent odor. Then, on day 18, the non-gravel container began to emit a moderately pungent odor. At the same time, the gravel container odor had intensified to strongly pungent.

From this work, we learned that urine residue (e.g., dried urine) leads to a malodor problem on both non-porous and porous surfaces. Perhaps even more importantly, we learned that the malodor problem occurs sooner, and then with far greater intensity, on a porous surface. Accordingly, for subsequent research, we examined both non-porous- and porous floor surfaces – with the greatest emphasis being on the grout line.

Why Was No-Touch Cleaning More Effective?

According to ISSA, there are three primary components to the process of cleaning when using a solution at tap water temperature: Agitation, Chemical, and Time, which are usually referenced by the acronym ACT. They all work together in direct relationship with one another to accomplish a level of clean; if one is changed, one or both of the others must change as well to maintain the same level of clean. For example, if dwell time is decreased, then either agitation or chemical strength must be increased to compensate.

Kaivac believes that there should be two more components for truly effective cleaning and has adopted the acronym FACTS. The F stands for fresh ingredients (including water) and the S stands for suctioning away the soils. By always using fresh cleaning solution and rinse water, facility service providers will greatly reduce the risk of cross contamination. Perhaps most important, the suctioning of soils and liquid through the system's built-in wet vacuum ensures that all contaminants are removed from surfaces, including the vulnerable grout lines. The vacuum also leaves the floor virtually dry and ready for near immediate use. In addition, the no-touch cleaning process includes built-in dwell time, which is typically minimized during mopping, to loosen and lift soils.

It is quite possible that similar results can also be achieved using traditional and microfiber mops. However, based on our findings, this will be possible only by supplementing those methods with more aggressive agitation, as with a brush, longer dwell time for the cleaning solution and/or an increased duration of mopping and rinsing.

Urine Detection Kit

In designing these soil removal tests, Kaivac searched for a method of measuring the presence of urine in a way that's simple, quick, and affordable, yet consistent. We did this so that we would be able to measure and record data in virtually any location and at any time utilizing multiple personnel with consistent, comparable results. We considered testing the sites with swabs, which would then be sent to an offsite laboratory for results. While this is an accurate method, it is costly and also impractical when scaling field tests involving multiple and varying personnel. Another common method, black light testing, proved to be too inaccurate and very subjective.

In searching for a method that met our objectives, Kaivac modified a procedure that was developed by the medical community. As a result, Kaivac invented a new type of test strip that accurately measures for urine by detecting creatinine, a breakdown product of muscle metabolism that is filtered out by the kidneys and excreted in urine. Creatinine is present in urine even after it has dried. To use the test strip, a cleaning professional simply puts a fresh test strip on a water-dampened area of the floor for several seconds. He or she then waits about a minute and compares the test-strip color with a urine detection color chart to measure the residual urine.

At the request of multiple customers and partners, Kaivac has now made its Urine Detection Kit and test strips commercially available so that facility service providers can measure the

effectiveness of their cleaning programs. With Kaivac's Urine Detection Kit, cleaning professionals now can focus, with confidence, on what really matters in restroom cleaning – the measurable removable of urine soil.

Going Forward

Kaivac believes that it is important for the cleaning industry to pursue science in order to educate the rest of the world on the importance of cleaning and its impact on health. As a result, Kaivac is committed to the science of cleaning. In addition to initiating our own research program, Kaivac is a founding member of CIRI and a major underwriter of their research. This study represents our initial testing comparing the effectiveness of cleaning methods. We have more in-depth research in process, including a continuation of these experiments. We have also begun to research the implications of inadequate soil removal.

Conduct Your Own Research

Only you can accurately judge the effectiveness of your cleaning program and whether or not No-Touch Cleaning can make a difference. Therefore, Kaivac would like to encourage you to perform your own test in your own facility. Please call 1-800-287-1136 (option3) and ask for an Evidence Collection Kit.