Using a new low temperature, non-corrosive laundry system to improve the cleanliness of high performance mattresses and reduce energy costs associated with the laundry process

KATHY LEES, Microbiologist, Manchester Metropolitan University, Manchester, UK

Improvement Issue and Context

Linen, bedding fabrics and textiles such as mattress covers exposed to patients and / or the hospital environment will be significantly contaminated with potentially pathogenic microbes after use. [1, 2] In addition they are likely to contain significant levels of soiling such as food residues, blood, vomit, faecal matter, urine, sweat etc. [2] which can act as a microbial food source, thereby increasing the risk of infection and cross contamination from these textiles.

To reduce the infection / cross contamination risk from these products they must be thoroughly cleaned and disinfected before re-use, however, even after terminal cleaning, mattresses frequently remain contaminated with microbes. [3, 4] One way to eliminate the human error and variation in terminal cleaning of mattress covers is to put them through an appropriate laundry process.

Historically, laundry processes have relied upon thermal disinfection and / or use of aggressive / corrosive chemical disinfectants to destroy microbes and achieve clean textiles. In recent years high performance mattresses have been cleaned and decontaminated either via heat (75°C) or chemical exposure i.e. chlorine releasing agents. Regular exposure to either of these can result in damaged mattresses which can themselves present an important cross infection risk to healthcare facilities and patients.

The laundry process itself and replacing damaged or worn mattress covers and components represent significant costs for mattress providers, Trusts, loan stores etc. managing fleets of specialist air mattresses.

This work aimed to identify a more energy efficient laundry process which could deliver equivalent or improved mattress cleanliness without using significantly elevated temperatures or corrosive disinfectant chemicals.

Methods and Measurement

A formal evaluation at a commercial laundry compared the standard laundry process (75°C + detergent) with the TECcare® CONTROL Laundry System at 35°C. The TECcare® CONTROL Laundry System (see Figure 1) combines a specialist detergent with a unique, non-corrosive, high-level disinfectant rinse based on the clinically proven [5, 6] TECcare® CONTROL technology platform.

Figure 1. TECcare® CONTROL Laundry System

A head to head comparison between the two laundry processes focussed on mattress cleanliness, process efficiency (wash cycle duration, water usage and overall energy expenditure per wash) and cost effectiveness (see Table 1).

A combination of controlled 90mm biomarker tests and pre- vs. post-laundry mattress swabbing were used to determine how effective the two laundry processes were in terms of textile disinfection.

90mm biomarker test methodology. This test method is adapted from two American Society for Testing and Materials (ASTM) standards; ASTM E2274-09 (evaluation of laundry sanitisers and disinfectants) and ASTM E2406-09 (evaluation of laundry sanitisers and disinfectants for use in high efficiency washing operations). The test method is given below;

1. 1m² pieces of 300 thread count, 100% bleached cotton fabric was used. One piece per inoculant organism, testing took place in triplicate.
2. Two 90mm inoculation areas (circles A and B) were drawn per fabric sample using a laundry marker.
3. A bacterial bioburden of log 10^6 cfu was used to inoculate each fabric sample with one of the following microbes: *Escherichia coli* (ATCC 11229); *Staphylococcus aureus* (ATCC 6538); *Pseudomonas aeruginosa* (ATCC 15442).
4. Inoculated fabric was incubated at 37°C (*E.coli and S.aureus*) or 30°C (*P.aeruginosa*) for 24 hours.
5. Nutrient agar dip slides were pressed flat over area A per fabric sample and incubated for 18-48 hours at 30°C.
6. Fabric samples were washed using either the standard or TECcare® CONTROL process.
7. Area B of each post wash fabric sample was then tested using nutrient agar dip slides pressed flat over the area and incubated for 18-48 hours at 30°C.
8. All post incubation dip slides were enumerated and results summarised in Table 1.

Mattress swab test methodology. Quantifying the microbial bioburden [total viable count (TVC)] on forty mattresses pre- and post-laundry was performed as follows;

1. Two swabs were taken from each dirty mattress using standard cotton tip swabs moistened with sterile water. These were serially diluted in 9ml Oxoid Ringers solution, plated onto Oxoid nutrient agar, incubated at 30°C for 24-48 hours and enumerated.
2. Twenty mattresses were then washed according to the standard laundry process, and twenty washed using the TECcare® CONTROL Laundry System. Post wash swabs were taken and processed as before.

Wash cycle duration, water usage and energy expenditure were measured and reported for each wash cycle (see Table 1 for results).

Evidence of Improvement

Table 1. Comparison of the standard laundry process vs. the TECcare® CONTROL Laundry System.

Outcomes		Standard Laundry Process (75°C)	TECcare® CONTROL Laundry System (35°C)	% Improvement with TECcare®
90mm Biomarker testing (mean TVCs)	Pre-Laundry	Log 10^6	Log 10^6	-
	Post-Laundry	Log 10^2	<10	90%
Mattress swab testing (mean TVCs)	Pre-Laundry	10^5	10^5	-
	Post-Laundry	10^2	<10	90%
Wash cycle duration (minutes)		64	42	34%
Total water usage per wash (litres)		276	165	40%
Cost of water per wash (based on £0.05 / litre)		£13.80	£8.25	40%
Energy (electricity) expenditure per wash (£)		£3.74	£1.47	61%
Product cost per wash (£)		£1.96	£1.38	30%
TOTAL PROCESS COST (£) (Water + Electricity + Product)		£19.50	£11.10	43%

The new TECcare® CONTROL Laundry System offers multiple benefits over a standard laundry process which relies on heat based disinfection. These benefits include;

- Improved cleanliness of the textiles post laundry
- a 34% time saving per wash cycle
- a 40% saving on water per wash cycle
- a 61% saving in energy costs per wash cycle
- an overall process cost saving of 43% (equivalent to saving £8.40 per wash)

In addition to the above points the new system from TECcare® is simple to use and requires no specialist equipment or modifications to existing washing machines.

Future Steps

As a direct result of this evaluation the commercial laundry has adopted the new TECcare® CONTROL Laundry System where it has now been in daily use for the past eighteen months.

The laundry primarily processes specialist dynamic air mattress systems once they have been used under patients for the prevention and / or treatment of pressure ulcers. Mattresses are often returned with soiling from faeces / urine and in some cases wound exudate and blood. Therefore to reduce the risk of infection and cross contamination it is imperative that all mattresses are thoroughly cleaned and disinfected prior to re-use.

The TECcare® CONTROL Laundry System has proved very effective in decontaminating these mattresses and since its adoption into routine use the laundry has increased mattress throughput by approximately six loads (= sixty mattresses) per 12 hour shift whilst simultaneously recording a reduction in its carbon footprint as a direct result of employing the new, more energy efficient system.

It has been previously noted that most healthcare laundries use thermal laundering processes with high energy and water consumption for the disinfection of hospital textiles.[7] Whilst many advanced textiles can be damaged by frequent exposure to excessive heat the risk of decreasing the laundry temperature (to protect the textiles) is the increased likelihood of pathogenic microbes surviving the laundry process.[7] Use of the TECcare® CONTROL Laundry System delivers cleaner textiles, while simultaneously reducing the wash temperature and saving time, water and energy.

In addition to reducing the risk of cross infection and cross contamination by creating cleaner textiles the TECcare® CONTROL Laundry System also offers the consumer clear cost savings both in terms of product costs and overall laundry process costs.

The current economic climate continues to force healthcare (along with many other industries) to look at all aspects of service provision. Quality, productivity, outcomes, energy consumption and costs are all areas where improvements are welcome – irrespective of the industry. The TECcare® CONTROL Laundry System meets all of these requirements and is of potential benefit to any laundry service provider.

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Poster produced by TECcare® in association with Manchester Metropolitan University. TECcare® have provided the author of this poster with conference sponsorship only. No other funding has been provided.

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