A durable and rechargable antimicrobial technology using sequestered hydrogen peroxide in fabrics with initial implementation in hospital thermal blankets.

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Antimicrobial Textiles in Healthcare Settings

All aspects of hospital equipment, including medical devices, personnel hygiene practices and even textiles have been under pressure to contribute to reducing hospital acquired infections (HAIs). A premium quality thermal blanket targeted for health care settings features a new durable antimicrobial technology based on sequestered hydrogen peroxide (HP). The technology involves sequestration of HP into a particulate inorganic oxide (Zinc oxide) that is bound within the fabric. Peroxide is regenerated from the matrix on fluid contact to protect the treated article. HP is broadly used as a cleaning and disinfecting agent and antiseptic, and functions by oxidative degradation of cellular components. Peroxide based antimicrobial mechanisms are also found within human biology, supporting the antibacterial activity of neutrophages, and functioning as part of the natural antiseptic systems within saliva. Degradation products of hydrogen peroxide are water and oxygen.

Treated blankets were shown to have antimicrobial efficacy >99% kill at test points including 1x, 10x, 25x, 50x and 100x Industrial laundering (IL). Antimicrobial efficacy was measured per AATCC method 100 derived protocol, using common pathogens Staph. aureus (SA, ATCC# 6538), Methicillin resistant Staph. aureus (MRSA, ATCC# BAA-44), Klebsiella pneumoniae (KP, ATCC# 4352) and E. coli (EC, ATCC# 8739). The extreme durability of antimicrobial efficacy is partly due to industrial laundering processes that use hydrogen peroxide in the cleaning cycle to recharge the particulate peroxide binders in the blanket during each laundering cycle. The construction of the blanket was optimized to provide maximum insulation value for minimum weight, and physical durability testing shows excellent fabric integrity after 100+ launderings. The physical and antimicrobial durability of the blanket allows extended life cycle compared to competing thermal blankets; the light weight and thermal insulation value minimize laundering costs (laundering charges are traditionally per lb) to provide a low overall life cycle cost for the product.

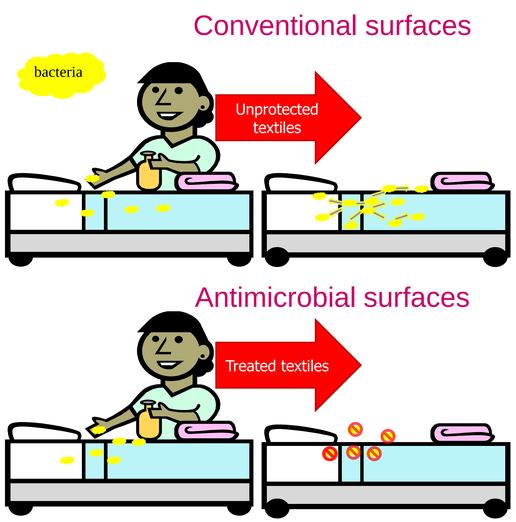


Figure 1: Pathogen transfer on unprotected surfaces, vs. antimicrobial surfaces. Antimicrobial surfaces are able to prevent pathogen transfer by suppressing microbes. Microbes on a conventional surface can easily multiply and transfer to a person or secondary carrier surface, while antimicrobial surfaces are able to arrest this process at the source. The figure at right shows how bacteria shed onto bedding are suppressed on the treated textile.

Bacteriocidal Efficacy of *Stay Fresh* After 25 Launderings

Table 1: Antimicrobial efficacy of *Stay Fresh* cotton jersey tested per AATCC method 100-2004. Samples tested both unlaundered and after 25 home laundering cycles (hot water).

Organism	% killed unlaundered	% killed, 25x laundered	ATCC#
Common Pathogenic organisms			
Staphylococcus aureus	>99.999%	>99.999%	6538
Staphylococcus epidermidis	>99.999%	>99.999%	12228
Enterococcus faecium	>99.999%	>99.999%	19434
Escherichia coli	>99.999%	>99.999%	15597, 8739
Pseudomonas aeruginosa	>99.999%	>99.9%	15442
Klebsiella pneumoniae	>99.999%	>99.999%	4352
Streptococci	>99.999%	>99.99%	10096
Resistant bacterial species			
MRSA	>99.999%	>99.999%	BAA-44
VRE	>99.999%	>99.99%	51299
Common bacterial species associated with body odor			
Corynebacterium diptheriae	>99.999%	>99.99%	43145
Micrococcus luteus	>99.999%	>99.9%	21102
Proteus vulgaris	>99.999%	>99.999%	13115

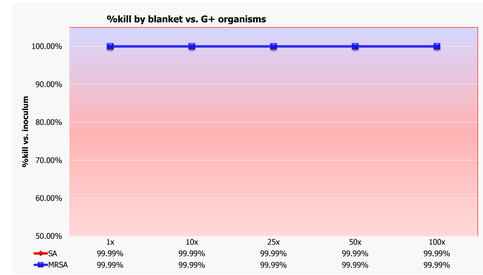
Methods and Testing

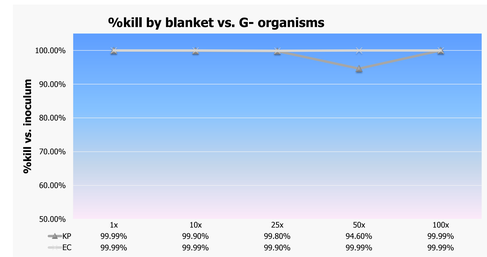
Peroxide Sequestration technology. This technology, (trademarked as *Stay Fresh™),* was designed to be durable to repeated laundering cycles while maintaining very high antimicrobial efficacy. This is accomplished by using a patented technology that sequesters hydrogen peroxide into a matrix product. In the case of textile applications Zinc Oxide particles are bound into the fabric to provide the matrix. The particles absorb peroxide on drying (changing the particle surface chemistry to a zinc peroxide state) and regenerate peroxide on contact with water, to generate a highly local concentration of hydrogen peroxide that renders the surface microbicidal. The microbicidal activity of hydrogen peroxide is from oxygen radicals that are transient products of the degradation of H_2O_2 to water and oxygen. The oxygen radicals chemically degrade cell wall structures, in effect physically disassembling the cell. This provides a very broad spectrum of efficacy, including against organisms of concern for public health such as 'superbugs' that have evolved resistance to antibiotics. As degradation products are water and oxygen, there are no toxic residues to consider. When goods are washed with peroxide in industrial laundering processes, this allows the treated fabric to 'recharge' its antimicrobial capacity. Data shows samples lasting beyond 25 home launderings (no recharge cycles), and past 100x industrial launderings with excellent efficacy.

Antimicrobial Testing. Antimicrobial efficacy testing was executed at Quick-Med Technologies' laboratory, in Gainesville FL, per AATCC method 100, adapted to increase replicates per test sample (improving statistical accuracy), and has been validated through coordinated testing with 3rd party sources. All data presented is compared to original inoculum, also called t=0.

Laundering Testing. Home laundering of cotton jersey / t-shirt material was executed as detailed in AATCC methods 135 and others, using hot water settings and individual laundering cycles (not accelerated). In the case of industrial laundering for healthcare blankets, the blankets were cycled through standard industrial cycles at facilities contracted through the blanket producer (Polartec of Lawrence, Mass).

Blankets tested through 100x laundering cycles





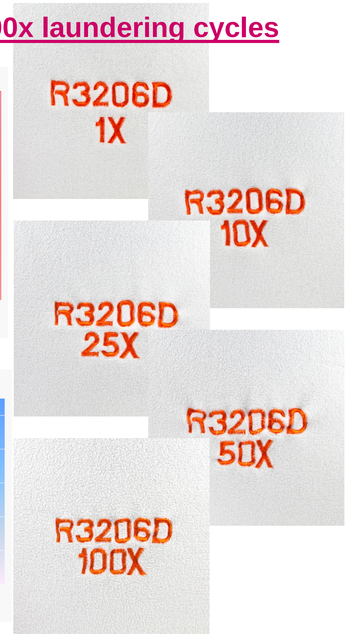
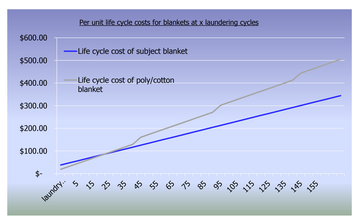


Figure 2: Images showing healthcare blankets that have been industrially laundered for the indicated number of cycles to test durability of both the blankets and the antimicrobial treatment. Antimicrobial test data is presented for the samples per charts for G+ and G- organisms. Images of the blanket materials after laundering cycles shows durability of the fabric, with no fraying to pilling and only slight matting at 100x IL.

Life cycle costs Polyester healthcare blankets described were engineered to provide superior insulation value, lower weight, higher durability and softer feel than a conventional cotton/poly blanket, in addition to providing antimicrobial protection to facilitate infection prevention and control strategies for patient and caregiver comfort, hygiene and safety. Using model conditions cited, cost benefits manifest around 30 cycles.



Model assumptions for life cycle cost analysis	Acquisition cost	Weight	Blanket lifetime (durability)	Laundering cost / lb of goods
Polyester blanket (treated)	$38	2.5 lbs	150+ industrial launderings	$0.70 / bl of goods
Cotton / poly blanket	$19	3.5 lbs	50 industrial launderings	$0.70 / lb of goods

Materials and Goods information

Polartec LLC. Developed and produces the healthcare blankets that are described herein.

www.Polartec.com

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