UniTech R3 Workshop

"Fulfill the Nuclear Promise" June 5th - 7th, 2019

MCS COMFORT FACTOR

Taking UniTech's CoolTech Fabric Performance To The Next Level
with Burlington's MCF

MCS Comfort Factor Presentation

- **THERMO-PHYSIOLOGICAL COMFORT**
- **ENGINEERING PERFORMANCE**
    - Comfort Through Adsorption
    - Moisture Management Through Capillary Action
    - Engineering Comfort with Synthetics
    - MCS® Technologies/Cooling Mechanisms
- **MCS COMFORT FACTOR (MCF)**
    - Standard Test Methods
    - Quantifying Performance / Comfort
    - Unitech CoolTech Versus Top Competitors
- **QUESTIONS**

Thermo-Physiological Comfort

Thermo-physiological comfort:

The metabolic heat and moisture produced by the human body is in balance with the heat and moisture loss from the skin surface. Human comfort is related to skin temperature (Heat) and wetness perception (Moisture)

Performance Fabric Demands

- Maintain breathability
- Transport sweat from skin to fabric
- High evaporation rate
- Short dry times
- Thermal energy transfer
  - Conduction, Convection & Radiation

Faster the fabric Wick and Adsorb moisture

More surface area the moisture cover

Faster evaporation of the moisture

Quicker evaporation of sweat from skin

Cool sensation/ dry and comfort

ENGINEERING PERFORMANCE

How we engineer fabrics with enhanced comfort

ENGINEERING PERFORMANCE – With Adsorption

Absorption

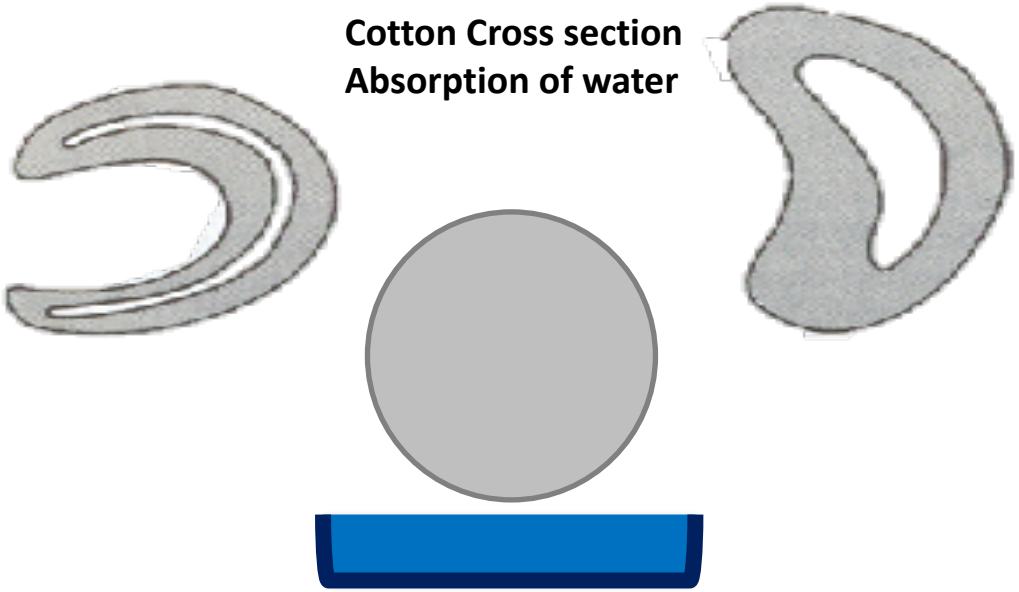
Allows fibers to uptake and retain water (water diffuses into fiber) depends on their chemical affinity.

Hydrophilic (water loving) fibers such as cotton absorb more water.

Cotton High Water Absorbency = High Dry Time

High Moisture Regain = Wetness Perception

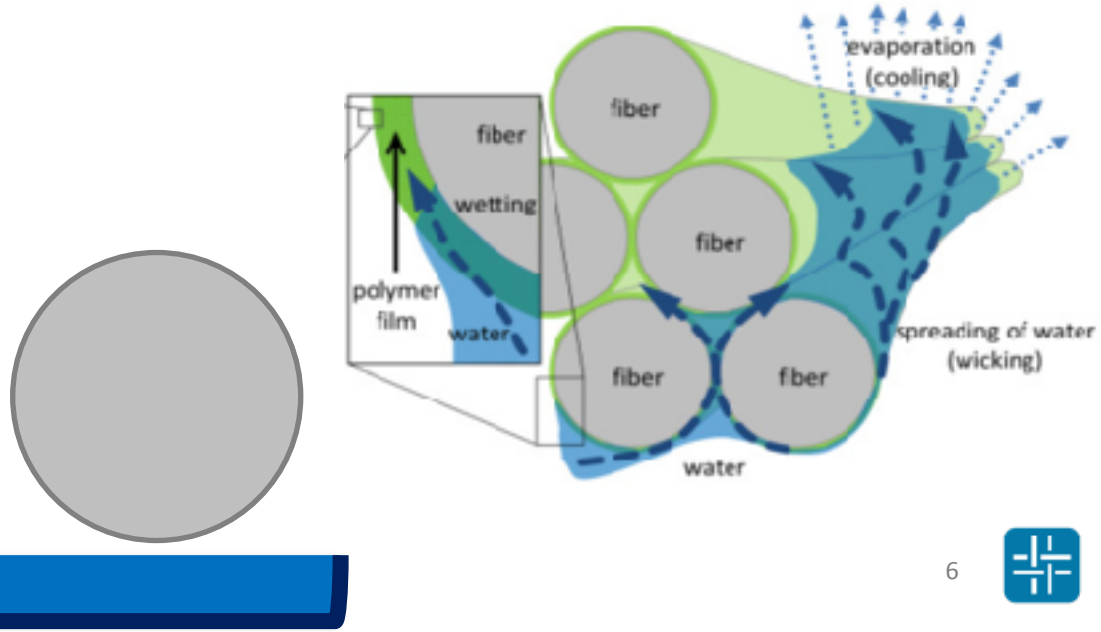
Cotton Cross section
Absorption of water



Adsorption

Moisture is transported over the surface and between the fibers.

The surface of synthetic fibers are modified by hydrophilic chemistries (MCS technology).



ENGINEERING PERFORMANCE – Moisture Management Through Capillary Action

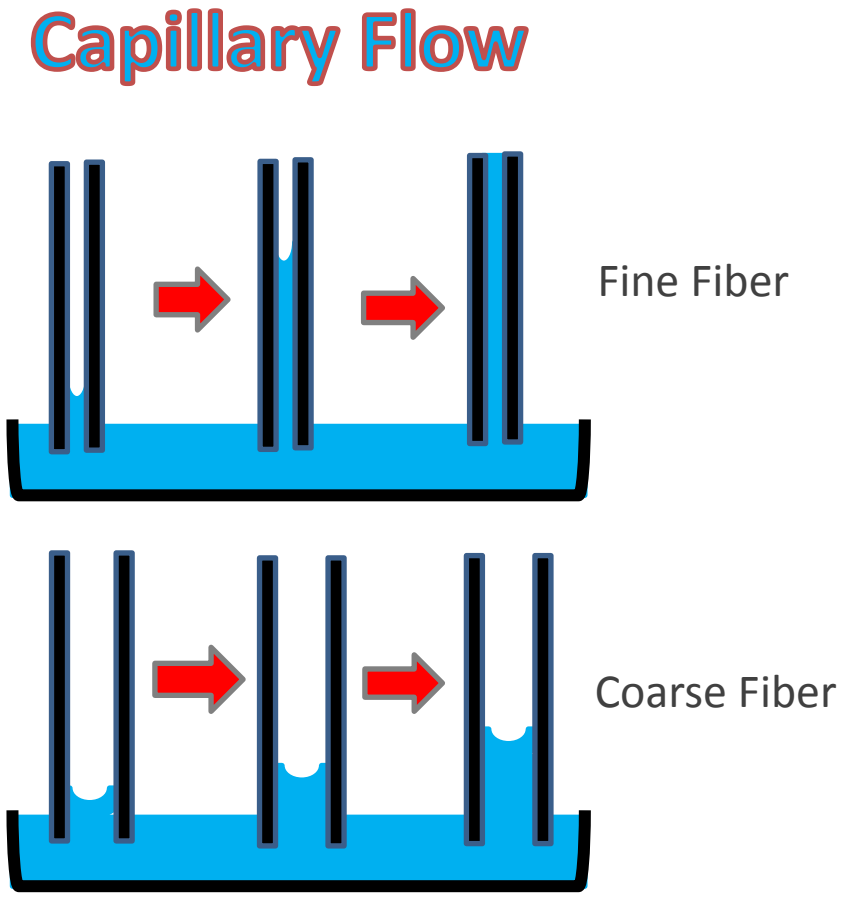
Wicking: The movement of water through fabric, which is identified with the ability of fabric to maintain capillary flow

Moisture can be transferred from the inner surface to the outer surface of the fabric

The fiber type, fabric design & applied finishes play a key role regarding wicking properties

Polyester & Nylon

- High Breathability
- Effectively Transport Water



ENGINEERING PERFORMANCE – With Synthetics

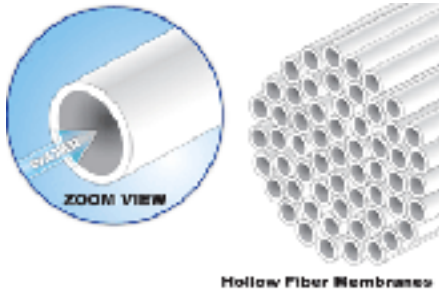
Fiber types

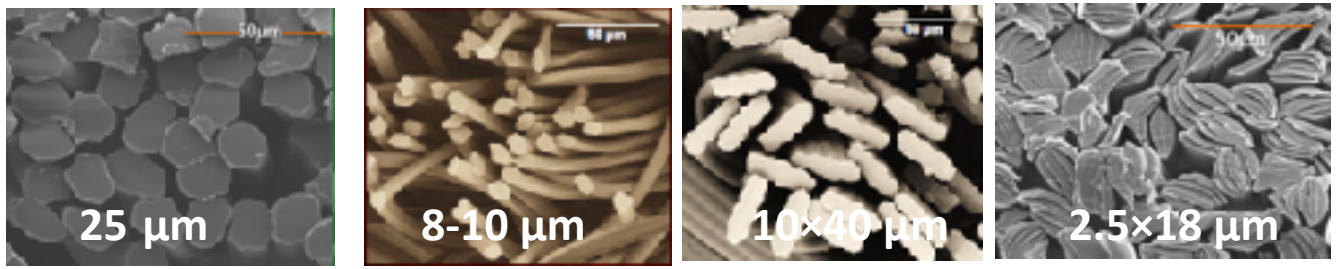
Synthetic versus natural fibers

Fiber morphology

Increasing the fiber's surface area by reducing fiber diameter or by changing the shape of its cross-section. Ex: microfibers, hollow fibers, channeled fibers

- Air permeability, wicking and drying rate are all influenced by the number & dimension of filaments
- More filaments/fibers in yarn results in more surface area





So much we can do to enhance comfort!

Yarn type

- Yarn twist affects wicking properties where both low & highly twisted yarns presents lower wicking ability
- Textured yarns provide better aesthetics and performance (MCS properties)

Fabric Construction

- Plain structure and more filaments with lower linear density = greater capillary action
- Thinner and more porous fabrics present better moisture vapor transmission
- Blends

Finishing Technology

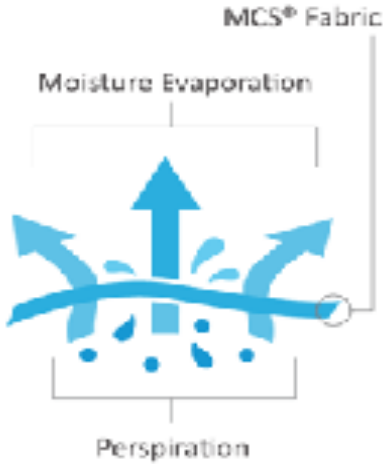
- Chemically and physically treating fabrics can alter moisture management properties

ENGINEERING PERFORMANCE – MCS® Technologies/Cooling Mechanisms

Heat/Cool by respiration evaporation mechanism

Hydro functional polymers

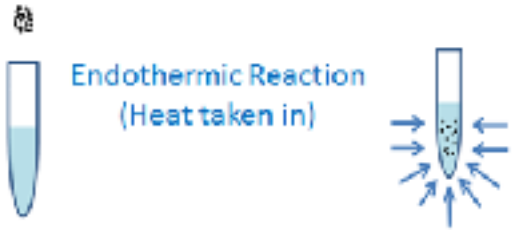
MCS® ADAPTIVE



Heat/Cool by solution

Multilayer structure of sugar alcohols

MCS® AC ACTIVE COOLING



Heat/Cool by evaporation + melting mechanism

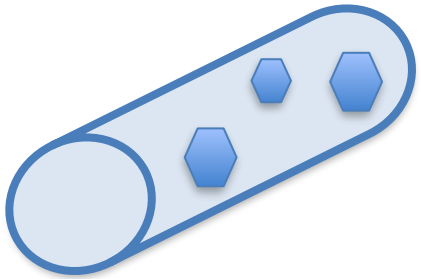
Melting Material

MCS® HYBRID COOL

Heat/Cool by conduction/ irradiation/reflection

Cooling Minerals permanently embedded to the fibers

Next Generation



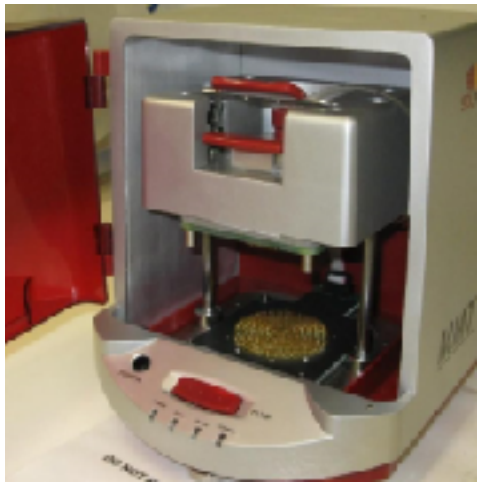
MCS COMFORT FACTOR (MCF)

Taking UniTech's CoolTech Fabric Performance To The Next Level with Burlington's MCF

MCS COMFORT FACTOR (MCF) – Standard Test Methods (USA)

What is moisture management fabric?

Fabric made of fibers with hydrophilic surface which can efficiently transfer moisture from a skin-fabric interface to an atmosphere-fabric interface



How to evaluate?

How fast can liquid spread out?

Absorbency (AATCC 79)

Wetting Time, Spreading speed, Wetted Radius (AATCC 195)

Efficient wicking vertical (AATCC 197)

How fast can liquid evaporate?

Dry time (AATCC 199)
Dry Rate (AATCC 201)
Dynamic Evaporation Test (For MCS-Adaptive)

How good is the air flow through the fabric?

Air permeability: (ASTM D737)

MCS COMFORT FACTOR (MCF) – Standard Test Methods (USA)

Absorbency (AATCC 79)

Take the water (liquid) in and retain the water (sec)

Wetting Time, Spreading speed, Wetted Radius (AATCC 195)

- Rate of surface wetting from the center (drop of liquid) to the maximum wetted radius (mm/sec)
- Maximum radial spreading (mm)

Efficient wicking vertical (AATCC 197)

- Movement of liquid through porous by capillary action / upward movement of liquid from cut edge (mm)

Dry time (AATCC 199)

Specific amount of liquid to evaporate from fabric under control condition (min)

Dry Rate (AATCC 201)

Rate at which liquid evaporates from fabric with heated plate at 37^{o}C (ml/h)

Dynamic Evaporation Test (For MCS-Adaptive)

Evaporation of specific amount of water on MCS-Adaptive Vs control fabric at 2 different temperatures (% @ 15min)

Air permeability: (ASTM D737)

Tendency of fabric to allow air and/or moisture to pass through ($cm^3/s/cm^2$)

MCS COMFORT FACTOR (MCF) – Quantifying Performance / Comfort

What is MCS Comfort Factor?

Raw data is collected for each test parameter using standard test method.

Air Permeability		ASTM D737 (cfm/ft2)	21.33	17.03	13.17	23.50	17.27	19.90
Martindale Abrasion		ASTM D4966 (cycles)	+100,000	+100,000	+100,000	+100,000	+100,000	+100,000
Absorbency - Original		AATCC 79 (sec)	1	1	1	1	1	1
Absorbency - 3X			2	2	2	2	2	1
Wetting Time Top		AATCC 195 (Sec)	2.65	3.62	2.6	7.3	2.52	4.71
Wetting Time Top Wash/ Rinse			4.92	2.82	3.48	3.93	3.81	3.51
Wetting Time Bottom			3.38	6.21	5.05	6.17	2.54	2.86
Wetting Time Bottom Wash/ Rinse			4.88	2.86	3.51	4.2	3.98	3.65
Absorption Rate Top		AATCC 195 (%/Sec)	30.17	19.61	22.39	10.66	50.65	35.81
Absorption Rate Top Wash/ Rinse			28.09	24.71	25.23	26.2	34.95	33.83
Absorption Rate Bottom			48.97	24.36	51.34	24.72	47.11	36.63
Absorption Rate Bottom Wash/ Rinse			38.47	29.52	32.29	38.73	41.88	42.95
Wetted Radius Top		AATCC 195 (mm)	21	17.14	20.83	25	25	30
Wetted Radius Top Wash/ Rinse			26	29	25	19	27	20
Wetted Radius Bottom			25	24.28	16.66	25	25	30
Wetted Radius Bottom Wash/ Rinse			25	30	27	19	28	20
Spreading speed Top		AATCC 195 (mm/Sec)	4.85	3.26	4.95	1.37	6.04	7.29
Spreading speed Top Wash/ Rinse			4.13	6.25	4.76	3.76	5.49	4.2
Spreading speed Bottom			5.39	4.59	4.24	4.64	5.88	6.96
Spreading speed Bottom Wash/ Rinse			3.97	6.39	4.91	3.66	5.79	4.21
Vertical Wicking Warp		AATCC 197 (min)	19	14	14	9	13	15
Vertical Wicking Warp Wash/ Rinse			14	9	19	9	9	14
Vertical Wicking Fill			9	9	14	9	9	19
Vertical Wicking Fill Wash/ Rinse			19	14	14	14	19	14

MCS COMFORT FACTOR (MCF) – Quantifying Performance / Comfort

What is MCS Comfort Factor?

Raw data is collected for each test parameter using standard test method.

We generate a normalizing formula to convert raw data to a normal scale 1 to 10. The higher the number is better

		Burlington MCS										Banana Republic			Eddie Bauer	johnnie-O	Express
Style		29745-01	29744-02	29739	29747-02	29722-2	4138	1183	1126	13066	12671	12614	#1	#2	#3	#4	#5	#6
Fiber Content		Polyester								Poly/Spandex			Cotton/ Poly/ Elastane			cotton/Poly	Nylor/ Pyor/Poly/Spandex	Nylor/Spandex
Thickness	mm	0.27	0.27	0.2	0.14	0.18	0.2	0.15	0.2	0.25	0.26	0.23	0.17	0.18	0.18	0.19	0.2	0.23
Fabric Weight	OZ/SY	2.84	2.72	2.76	2.77	2.51	2.75	2.25	2.9	3.71	3.71	3.57	3.25	3.39	3.3	2.98	3.56	2.81
Wetting Time		7	7	7	7	7	7	7	7		6	8	6	2	2	1	1	2
Absorption Rate		7	5	6	2	6	4	2	6		6	4	2	3	4	2	6	5
Wetted Radius		10	10	10	10	10	10	6	10		10	10	5	6	6	1	1	8
Spreading speed		7	7	9	5	8	6	2	6		5	6	3	2	2	1	1	3
Dry Time (Modified AATCC 199)		5	5	6	7	6	5	6	5		4	3	6	7	7	7	1	5
Dry Rate (AATCC 201)		5	4	5	8	5	4	3	3		1	4	3	1	3	1	1	1
Air Permeability (ASTM D-737)		6	6	5	5	10	5	5	5		2	5	3	2	2	3	3	4
Burlington MCS Comfort Factor	%	**76.76**	**75.14**	**79.73**	**75.41**	**82.16**	**67.30**	**59.73**	**68.38**	**0.00**	**60.54**	**62.97**	**47.84**	**40.00**	**43.78**	**27.84**	**21.35**	**45.41**

MCS COMFORT FACTOR (MCF) – Unitech CoolTech Versus Top Competitors

Burlington LABS		Burlington	Competitors				
		Cooltech	Woven #1	Woven #2	Nonwoven #3	Nonwoven #4	Nonwoven # 5
		100% Polyester	55% Cotton/45% poly	100% cotton	Polyester	PVA	PVA
Thickness	mm	**0.19**	0.22	0.33	0.32	0.36	0.36
Fabric Weight	OZ/SY	**2.72**	3.84	4.95	2.02	1.95	2.16
Wetting TimeTop		**6**	1	2	1	5	6
Absorption Rate Top		**4**	1	7	10	6	5
Wetted Radius Top		**10**	2	7	1	7	7
Spreading speed Top		**5**	3	4	2	4	5
Dry Time (Modified AATCC 199)		**9**	4	1	1	1	1
Dry Rate (AATCC 201)							
Air Permeability (ASTM D-737)		**4**	7	10	10	10	10
Burlington MCS Comfort Factor	%	**63.24**	**25.68**	**42.7**	**32.97**	**45.95**	**47.57**

What can our fabric do for you?

Burlington®

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