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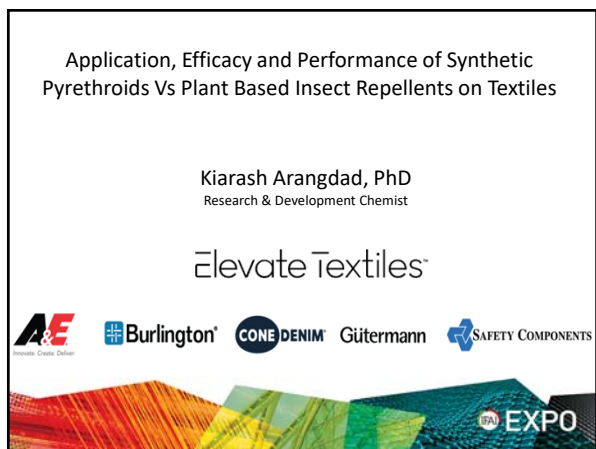
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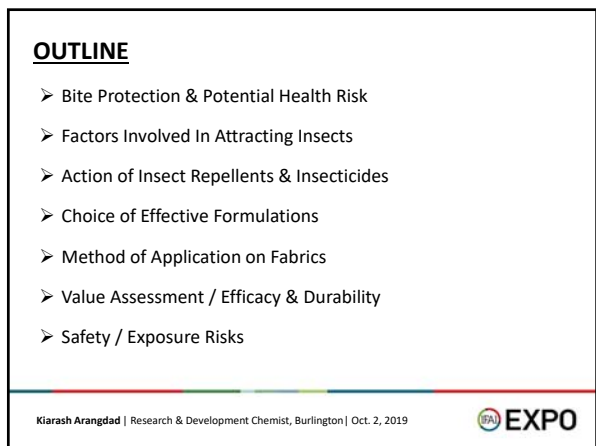
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## BITE PROTECTION & POTENTIAL HEALTH RISK

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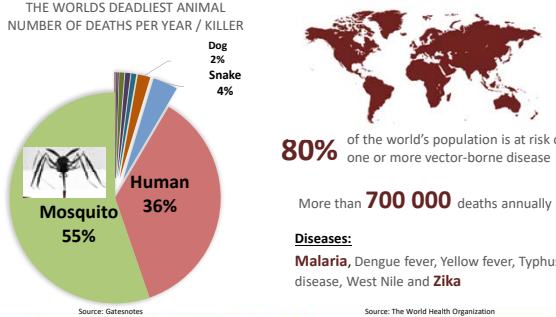
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### BITE PROTECTION & POTENTIAL HEALTH RISK

THE WORLDS DEADLIEST ANIMAL  
NUMBER OF DEATHS PER YEAR / KILLER




**80%** of the world's population is at risk of one or more vector-borne disease

More than **700 000** deaths annually

**Diseases:** Malaria, Dengue fever, Yellow fever, Typhus, Lyme disease, West Nile and Zika

Source: Gatesnotes Source: The World Health Organization

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### BITE PROTECTION & POTENTIAL HEALTH RISK


#### Not Just Mosquitos



Over 800 tick species in the world



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**BITE PROTECTION & POTENTIAL HEALTH RISK**

Many of these diseases are preventable through informed protective measures

Insecticide/insect repellent treated fabrics may help prevent the spread on insect borne diseases by knocking down or repelling insect through apparel, uniforms or gear.


**Advantages of Bite Protective Textiles:**

- > Physical protection/barrier
- > Repellency/insecticidal properties

Source: L.L.Bean, Shooz, Manhattanadd@ery

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**ACTION OF INSECTICIDES & INSECT REPELLENTS**

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**ACTION OF INSECTICIDES AND INSECT REPELLENTS**

**Identifying a host**  
Insects are attracted to

- LIGHT
- COLOR
- HEAT
- HUMIDITY
- CARBON DIOXIDE
- OCTENOL (1-Octen-3-ol)

**Landing without probing or biting**

**Biting & Probing**


- DIGGING THE PROBOSCIS
- LOOKING FOR BLOOD VESSELS

**Anosmia/ Hyposmia:**  
The inability to sense smells or a reduced ability to sense smells

Small amount of inhibitor such as **"1-methylpiperazine"** on human skin decreased attraction of Ae. Aegypti

\*https://www.bbc.com/news/science-environment-23987827

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### ACTION OF INSECTICIDES AND INSECT REPELLENTS

- Action of spatial repellents / Olfactory senses
  - Volatile compounds creates repellency and keeping insects away*
  - DEET (N, N'-diethyl-m-toluamide)
  - Picaridin
  - Oil lemon eucalyptus
  - p-menthane-3,8-diol (PMD)
  - Ethyl butylacetylaminopropionate (IR3535)
- Action of contact repellents
  - Tactile senses**
  - Insects must come in contact with the chemistry/ Affect the insect nervous system*
  - Permethrin
  - Etofenprox

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### ACTION OF INSECTICIDES AND INSECT REPELLENTS

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### ACTION OF INSECTICIDES AND INSECT REPELLENTS

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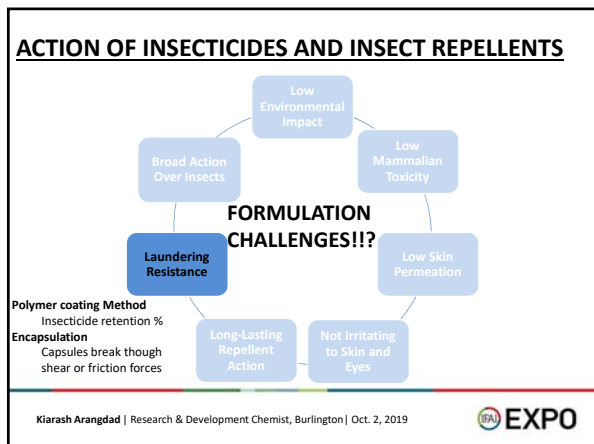
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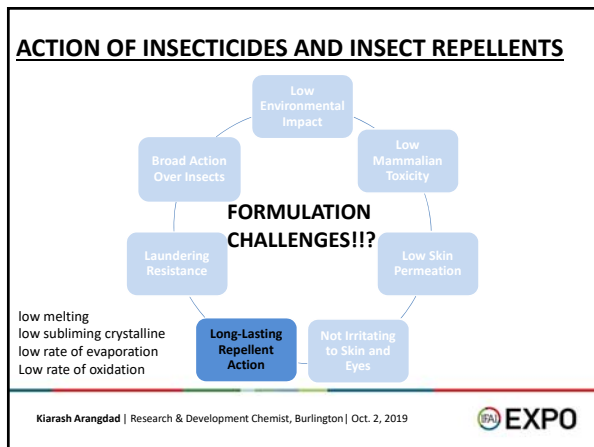
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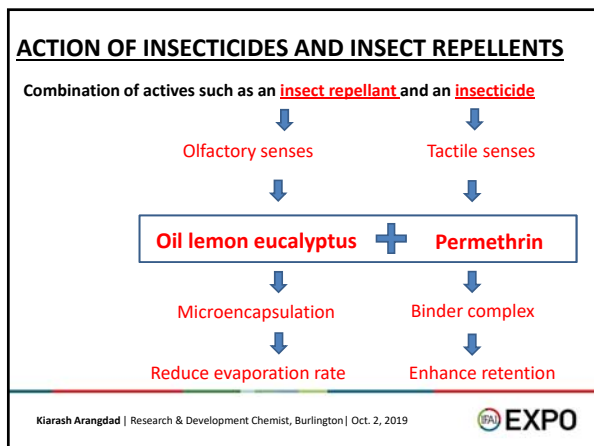
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## Method of application

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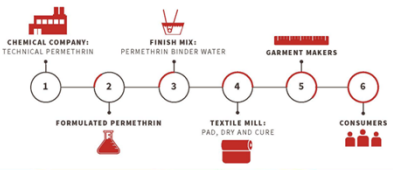
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### METHOD OF APPLICATION

Insect repellent fabric is achieved by binding permethrin to the fabric during manufacturing.


- Practical & compatible with mass production
- Consistently and uniformly applied across fabric
- Durable
- Eliminate shade change or shade shift




**Garment Spray Application**




**Garment Laundry Application**



**Fabric Application**



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### METHOD OF APPLICATION

#### Pad/Dry/Cure



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# Consistency & Durability Testing

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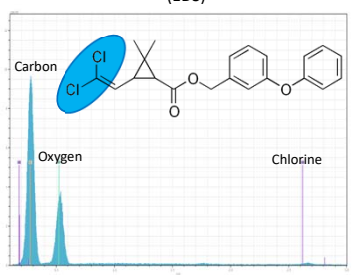
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## CONSISTENCY & DURABILITY TESTING

Energy Dispersive Spectroscopy (EDS)



Carbon  
Oxygen  
Chlorine

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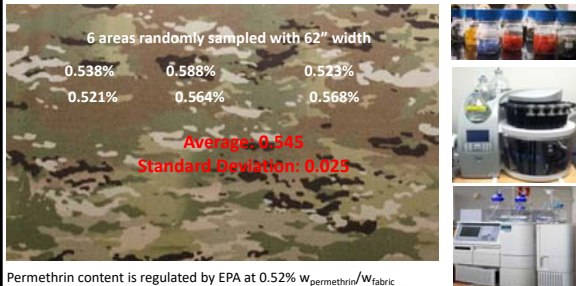
## CONSISTENCY & DURABILITY TESTING

ASE/HPLC/ GC-MS Testing

6 areas randomly sampled with 62" width


0.538%	0.588%	0.523%
0.521%	0.564%	0.568%

Average: 0.545  
Standard Deviation: 0.025



Permethrin content is regulated by EPA at 0.52%  $w_{\text{permethrin}}/w_{\text{fabric}}$

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### CONSISTENCY & DURABILITY TESTING

OVERALL DURABILITY WASH TESTS BETWEEN 75-110 WASHINGS

FABRIC TYPE	WASHINGS	PERMETHRIN (OWF)	% RETENTION
Poly/Nylon	Original	0.54%	--
	25 X	0.51%	89%
	50 X	0.46%	85%
	75 X	0.45%	83%
	95 X	0.43%	80%
	110 X	0.47%	87%
Ny/Co	Original	0.46%	--
	25 X	0.39%	85%
	50 X	0.24%	52%
	75 X	0.19%	41%
Poly/Nylon	Original	0.52%	--
	25 X	0.51%	0.98
	50 X	0.49%	94%
	75 X	0.49%	94%
	95 X	0.48%	92%
	110 X	0.35%	67%

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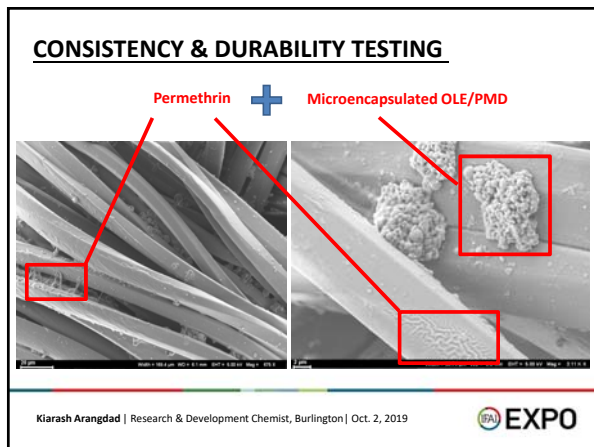
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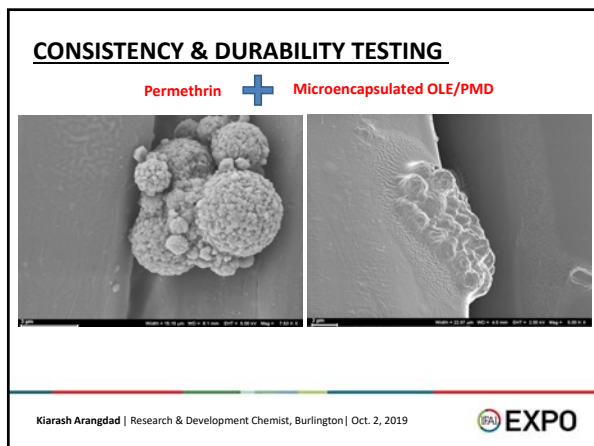
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# Efficacy Testing

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## EFFICACY TESTING

- Petri dish/Cone test
- Arm In Cage test
- Excito chamber
- Cage test with meal target (mouse)
- Tunnel Assay (WHO Test)

<u>Evaluation based on:</u>	
Insect repellents:	Blood feeding inhibition rate
Insecticides:	Mortality rate/Knock down

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## EFFICACY TESTING

- Petri dish/Cone test
- Arm In Cage test
- Excito chamber
- Cage test with meal target (mouse)
- Tunnel Assay (WHO Test)



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**EFFICACY TESTING**

- Petri dish/Cone test
- Arm In Cage test
- Excito chamber
- Cage test with meal target (mouse)
- Tunnel Assay (WHO Test)

**MOSQUITO BITE TEST**

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**EFFICACY TESTING**

- Each subject tests an untreated fabric as a control and the treated fabric.
- Exposure time is 15 minutes with 200 mosquitoes

**Control**




**Treated**



Sample	#	Original		20X Wash			50X Wash			
		mg/cm2	Bite Protection %		mg/cm2	Bite Protection %		mg/cm2	Bite Protection %	
			Ae.Aeg	An.Alb		Ae.Aeg	An.Alb		Ae.Aeg	An.Alb
Nylon/Cotton	1	0.126	98.8%	99.2%	0.087	100.0%	98.1%	0.035	100.0%	100.0%
	2	0.128	99.7%	97.7%	0.086	99.6%	99.0%	0.037	100.0%	100.0%
	3	0.122	99.3%	98.6%	0.084	100.0%	100.0%	0.037	100.0%	100.0%
	Average	0.125	99.3%	98.5%	0.086	99.9%	99.0%	0.036	100.0%	100.0%

\*Data Collected prior to 2015

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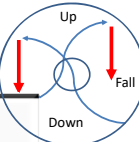
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**EFFICACY TESTING**

**In vitro test for evaluating tick repellents**



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### SAFETY / EXPOSURE RISKS

The U.S. Environmental Protection Agency (EPA) issues a product labeling category rating for all products that are registered.

Some of your common household products require danger, warning, or caution labels. No Fly Zone does not require any of these precautionary labels.

**TOXICITY LABELING REQUIREMENTS**

CATEGORY I High Toxicity	CATEGORY II Moderate Toxicity	CATEGORY III Low Toxicity	CATEGORY IV Very Low Toxicity
<b>DANGER</b> Hairspray Bleach	<b>WARNING</b> Laundry Detergent Window Cleaners	<b>CAUTION</b> Sunscreen Tick Repellent Spray Insect Repellent for Kids	<b>NONE REQUIRED</b> No Fly Zone* Insect Repellent

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### SAFETY / EXPOSURE RISKS

The EPA uses a calculated value known as "Margin of Exposure" (MOE) to determine exposure risk.

*MOE greater than 100 is of no concern.*

**Dangerous MOE :**  
100 or less

**MOE for Treated Fabrics:**  
Garment manufacturers - 26,000 Military personnel - 6,700

As assessed by EPA, "All post-application exposure scenarios for permethrin impregnated clothing do not exceed the agency's level of concern"\*

\*EPA Docket ID EPA-HP-OPP-2004\_0385, Overview of Permethrin Risk Assessment, August 2005.

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# Thank You

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Research & Development Chemist  
kiarash.arangdad@elevatetextiles.com

**elevate Textiles**

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