Development of a Dry Decontamination System for Personnel Decontamination and Emergency Response – the NIOSH DryCon System

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2019 US EPA International Decontamination Research and Development Conference | Norfolk, VA | November 20, 2019

Current Decon Practices for Mass Casualty Events-Issues

Wet decontamination is the standard for mass casualty events

- Demonstrated to be highly effective
- Steps in wet decontamination
  1. Remove clothing
  2. Shower
- Wet decontamination can be problematic under certain circumstances
  - Compliance issues with disrobing
  - Re-aerosolization of contaminant
  - Cold weather
  - Water-reactive contaminant

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Dry decontamination with DryCon could be another tool

- No disrobing required in public or in inclement weather
- Easily re-aerosolized contaminant removed
- Temperature is of less concern
- No contaminated water for disposal following dry decontamination

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Dry decontamination is not a new idea

- NIOSH Clothes Cleaning System
  - Used in the mining industry
  - Air comes from a compressor
- Rapid Dry Firefighter Field Decontamination System
  - Handheld
  - No particle capture
- Air Showers
  - Used for cleanroom entry
  - Air nozzles are not aligned

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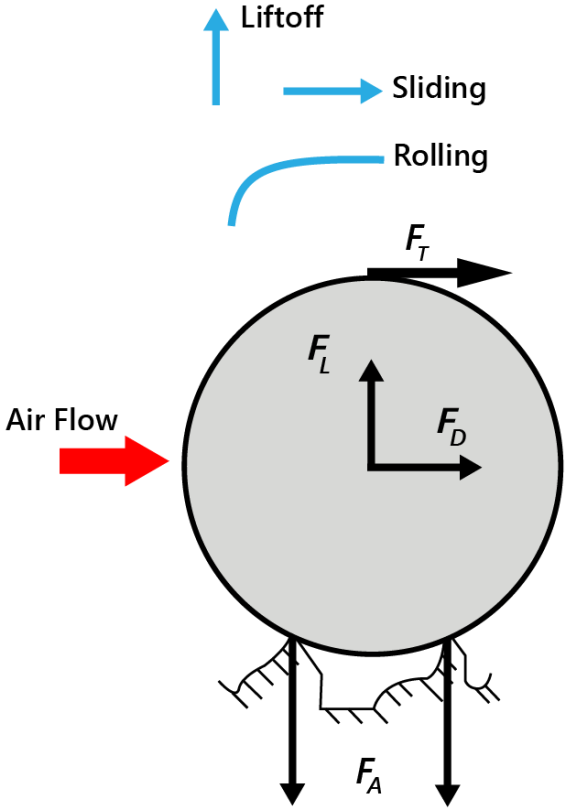
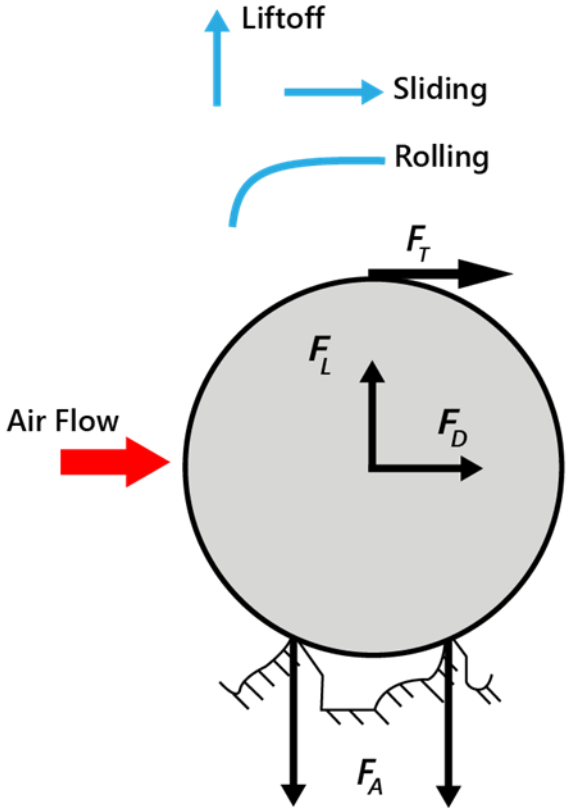
Forces of Particle Adhesion and Removal

- Forces of particle adhesion (F_A)
  - van der Waals
  - Chemical bonds
  - Capillary action of moisture
  - Electrostatic forces
- Forces of particle removal
  - Lift (F_L)
  - Drag (F_D)
  - Torque (F_T)



Factors Affecting Particle Removal

- Particle size
- Air speed
- Properties of the particle and the surface
- Relative humidity
- Residence time on the surface
- Stiffness of fabric



Components of DryCon

- Positive pressure blower
  - Delivers up to 600 cfm at 1 PSI pressure
  - Controlled by a programmable controller and variable frequency drive
- Enclosure
  - Doors on both sides
  - Vertical and horizontal rows of air nozzles
  - Controlled to slight negative pressure
- Exhaust blower
  - HEPA filter for particle capture
  - Rated up to 1600 cfm

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DryCon in Operation

- Video link: EPA Decon video.mp4

Test Method Developed

- Fluorescent powder used as surrogate
  - Applied with pesticide duster
  - Amount applied/removed measured with black light and light meter
- Three different types of fabric squares tested:
  - Polyester double knit
  - Cotton denim
  - Firefighter turnout fabric

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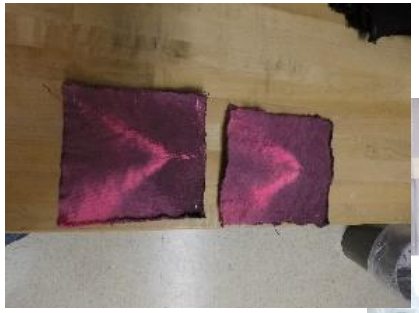
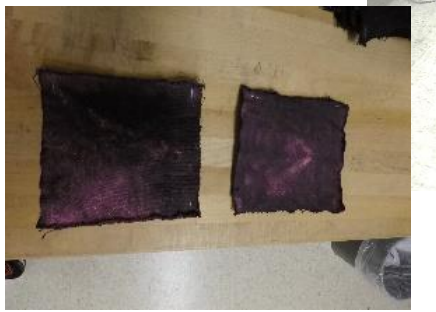
Fabric squares were attached to manikin on turntable

- Treatment time was 60 seconds
- Fluorescence was measured before and after
  - Two air flow rates were tested, 480 cfm (13,500 feet/min exiting the nozzle) and 540 cfm (15,000 feet/min exiting the nozzle)
  - Nozzle angles of 0^{o} and 10^{o} were tested





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Results of Laboratory Testing

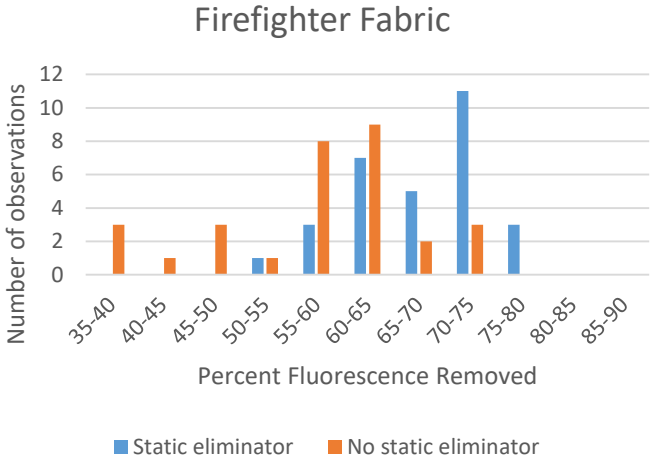
- Higher air flow rate was best overall
- Changing nozzle angle was insignificant
- Decontamination of double knit fabric was highest

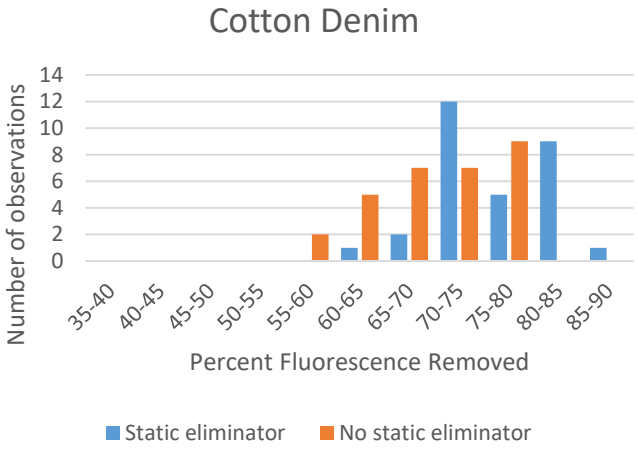
Mean fluorescence removal efficiency by fabric and blower speed.

Fabric	Mean fluorescence removal efficiency (%)	N	Air Flow Rate (cfm)
Double Knit	80.9	60	480
	80.7	58	540
Cotton Denim	64.5	60	480
	70.3	60	540
Firefighter fabric	53.4	70	480
	56.8	60	540

Improved results with Linear Ionizer to Eliminate Static Charge

- Firefighter fabric and cotton denim were tested
- Statistically significant improvements in contaminant removal were measured
  - Denim from 70.3% to 76.2%
  - Firefighter fabric from 56.8% to 68.0%





Modifications have made DryCon more adaptable

- Inflatable shelter sets up quicker
- Components modified to run on generator power
- Internal lighting

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Proof-of-concept study shows promise of DryCon technology

- Emergency decontamination for dusty substances
- Pre-decontamination before disrobing for wet decontamination
- Decontamination at the end of a work shift

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Questions?

For more information, contact CDC
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