Development of a Wardrobe for Life in Space Vehicles and Habitats

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O₂, In The Beginning...

- **Flammability, short-term wear/disposable**
  - Mercury: ~3 days
  - Gemini: ~3 days
  - Apollo: ~6 days

- **Flammability, Long-term wear/disposable**
  - Skylab: ~28 days

- **Mass, Volume, Comfort**
  - Shuttle: 6-16 days
  - ISS: ~6 month average

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O₂ %

- 100%
- 90%
- 80%
- 70%
- 60%
- 50%
- 40%
- 30%
- 20%
- 10%
The Future is Somewhere in the Middle

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Design Parameters

- Reusability
- Functionality
- Human factors
- Toxicity
- Mass
- Flamability
- Volume
- Long-term wear
Still in the study phase of development

- Microbial study: packaging and storage
- Blind study: Acceptance of wool vs. cotton
- Length of wear study: Odor (exercise clothing)
- Lint study: wool vs. other fibers
- Microbial study: packaging and storage
Blind Study

Most participants could not tell the difference -or- preferred wool over other fibers.
Length of Wear Study

4+ Hours longer than other fibers tested
Current Studies: Usage Rate

Understanding usage rate and wear pattern of clothing in a space station

- Shirts ~15 days
- Pants ~30 days
- Socks ~7 days
- Undergarments ~2 days
- Athletic clothing ~7 days
Current Study: Cleaning/life of garment

Evaluate cleaning and sanitation techniques to use in microgravity

- Clean with soap and water
- Stretch and twist results
- Clean with hydrogen peroxide (fade results)
- Clean with ozone (odor results)
Completed Study: Lint Study

ISS cotton crew socks and anklets compared to other type of crew socks with respect to lint production.

No difference

Lint makers
Completed Study: Microbial Study

Fiber integrity did not change when packaged in a clean environment
Work in Progress: Logistics Tracking

- ISS and Gateway clothing experiments
  - Tracking of RFID tags on clothing
Near-term Work: Continuation

- ISS and Gateway clothing experiments
  - Water based clothes cleaning in microgravity in combination with oxidative and physical methods of sanitation
GOAL

• Our goal is logistics reduction for long-duration space travel
  • Flammability issues
  • Toxicity issues
  • Long wear
  • Low odor development/bacterial growth
  • Human factors appeal
  • Moisture management
  • Lint management
  • Logistic process efficiency
Reference @ NASA Technical Report Server


https://ntrs.nasa.gov/search.jsp?R=20160010481&hterms=Adavanced+Clothing+Ground+Study&qs=N%3D0%26Ntk%3DAll%26Ntt%3DAdavanced%2520Clothing%2520Ground%2520Study%26Ntx%3Dmode%2520matchallpartial