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Energy savings strategies at a cool storage facility

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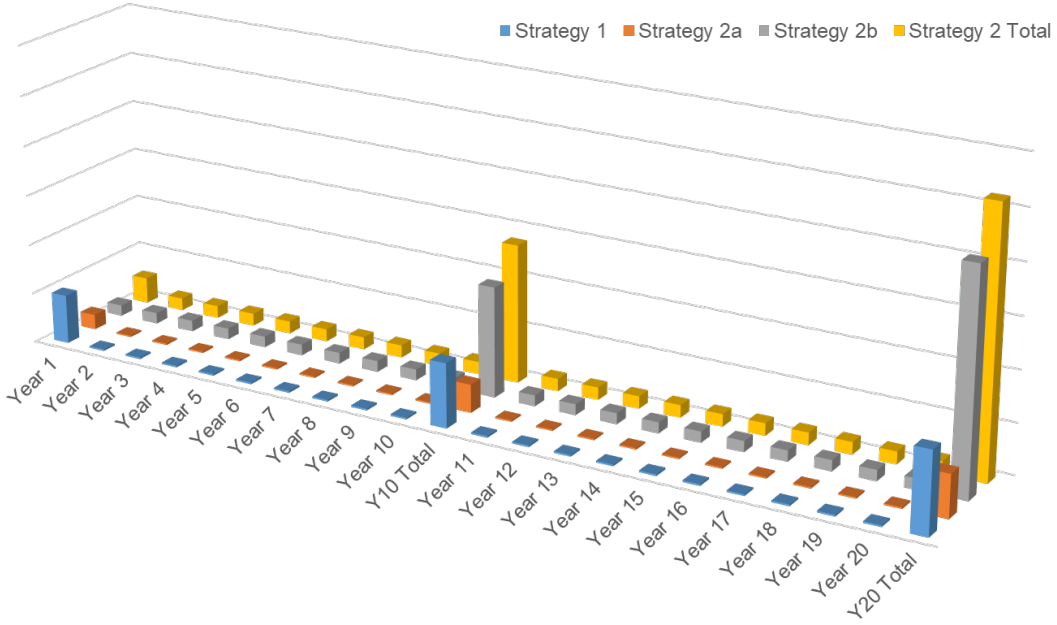
IFLA WLIC 2023 ROTTERDAM

Preservation Strategy

- *Environmentally Optimized Storage* is our best ROI
- *EOS* benefits all collection formats
- *EOS* enhances use through improved housing and inventory control
- Requires us to think through costs across time



Fort Meade Fast Facts

6 storage modules

2.6 million cubic feet

6,371,550 collections

50°F / 10°C

30% - 40% RH

Cold storage rooms (35°F and 25°F) not included in trials

Preservation / Facilities Collaboration

LOC Preservation

- Define collection requirements for design and construction
- Work with Architect of the Capitol (AOC) on environmental targets
- Review renovation plans
- Review and test construction materials used near collections

Sustainability Opportunities at Ft. Meade

Review environmental standards

- ≈ 80% of Book Storage Module utility budget is dedicated to environmental conditioning
- AOC goal to reduce energy usage by 50% by 2025 over 2003 baseline

Review gaseous pollutant filtration to reduce fan resistance

- Duplicate filters were included as safeguard
- Gaseous filtration media showed little depletion of sorbent capacity after 20+ years

AOC Request to Library of Congress

Raise summer RH set point

Immediate benefit

- Reduce gas and electricity consumption by reducing desiccant wheel temperature and reheating to achieve 50°F / 10°C

Future opportunity

- Change gas to hot water utility to dry air passing over desiccant wheel for additional savings

Preservation / Facilities Collaboration

Why raise RH, not temperature?

- At the Ft. Meade facility, a gas burner is used to dry the desiccant wheel
- RH control ≈ 60% of energy required to reach preservation conditions
- Our dehumidification equipment is 3x less efficient than temperature control equipment

Preservation / Facilities Collaboration

Are there ways to optimize other than RH?

- Yes: Our facility and location led to these results: your situation may be different
- Collaboration is essential to solve the right problem for your facility and climate

Preservation Considerations

- Evaluate change to deterioration rate of collections
- Identify any risk of Temp & RH change on stability of collections

	30%	35%	40%	45%	50%
50°F	283	244	211	182	158
55°F	189	163	141	123	106
60°F	145	125	109	95	82

Preservation Index* values highlighted green *substantially extend* useful life of collections

https://s3.cad.rit.edu/ipi-assets/publications/understanding_preservation_metrics.pdf

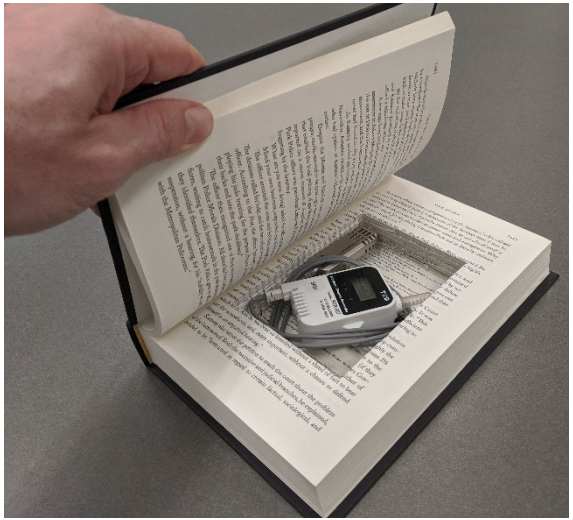
✓ **Change summer setpoint target to 40%**

Pilot Test Summer 2022

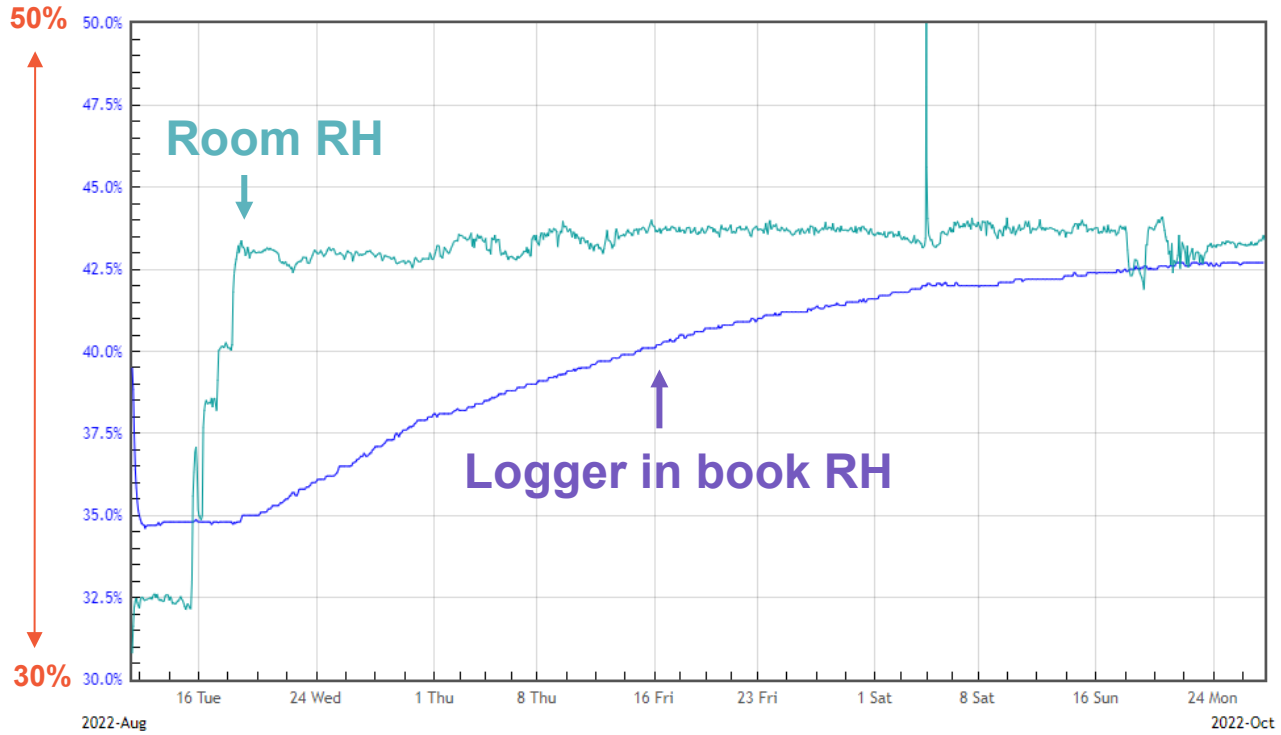
Module RH gradually raised to 40%

Logger embedded in book and standard box to find collection equilibration time

Box placed midway up shelving array



Preservation Data: September – October 2022



Room RH 30% to 40% over 5 days

Box RH 30% to 40% over 60 days

- Logger travelled from more humid space starts at 35%

Negligible impact on preservation goal to slow rate of deterioration

Energy Savings: September – October 2022

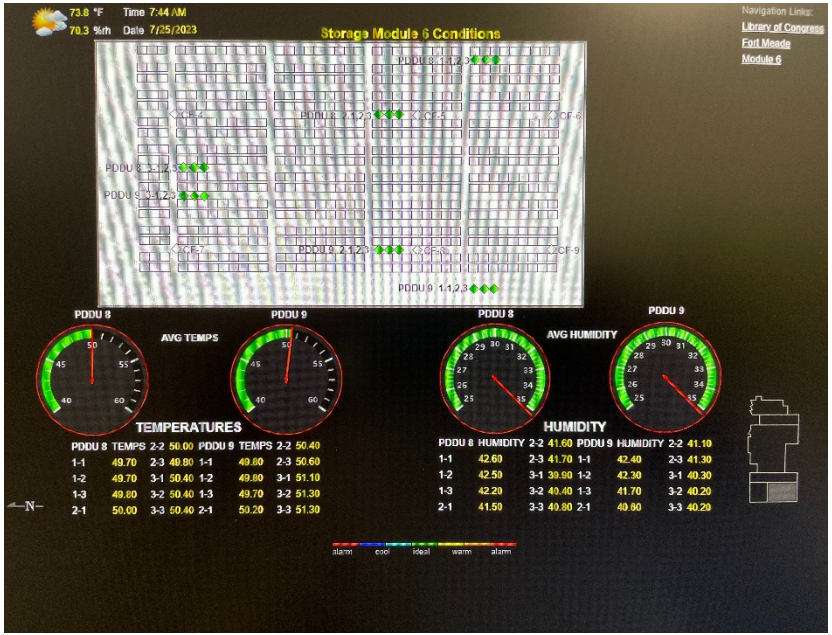
Reduction in consumption

- 5% gas consumption
- 21% electricity consumption
- 91,500kWh
- 75,800 BTU/h same period 2022 / 2021

Saved: $8,600

Equivalent to

- 76 tons CO_2
- 7,748 gallons gasoline
- equivalent annual energy use of 13.4 homes



Energy Savings Opportunities

Potential to *triple* savings per year!

Extend 40% RH to all modules

Extend time at 40% to 5 months/year

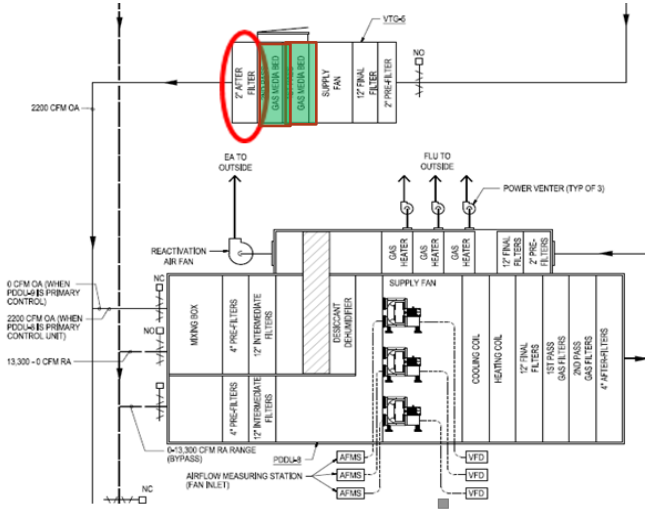
$25,818 / year

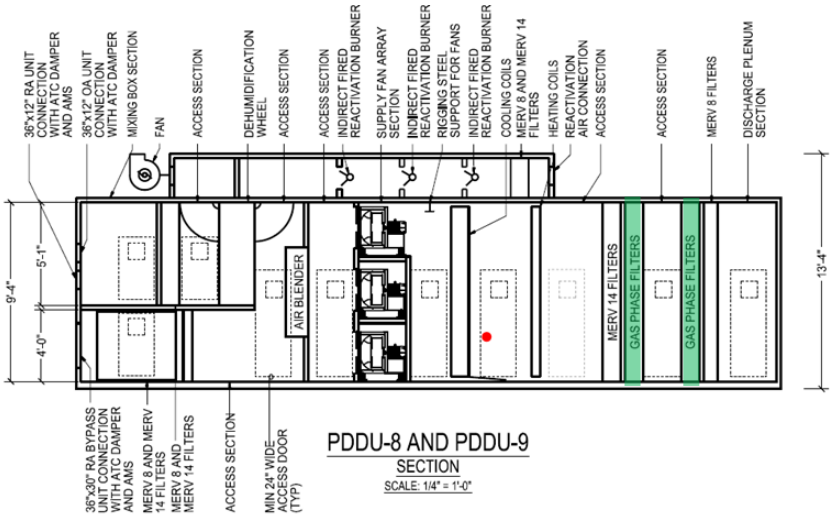
228 tons CO_2 / year

22,244 gallons gasoline / year

AOC Request: evaluate need for duplicate filters

Double filtration of outside air and air returning from collections





Outside air intake filters for external pollutants: Ozone, NO_2, SO_2

Internal air filters for pollutants from modules: Collections and building materials

Energy Consequence of Gaseous Pollutant Filters

External air filters

- Low energy savings potential due to relatively low volume of air (2,000 cfm)
- Potential for upfront savings if external filter not required (future construction)

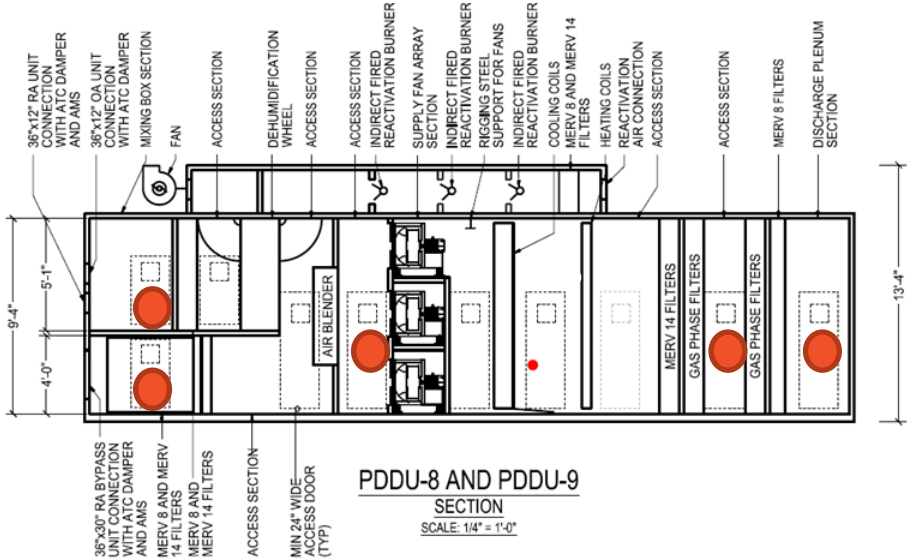
Internal air filters

- Substantial yearly energy savings potential from reducing fan pressure for a high volume of air (15,000 cfm)
- Minimal potential equipment savings

Proposed Preservation Trial

Collect and analyze air samples

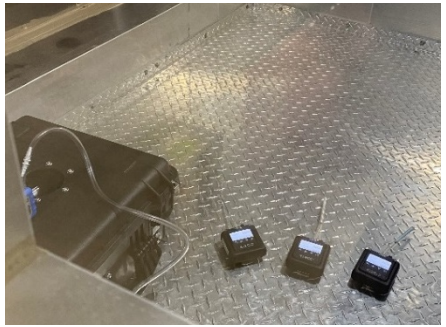
- Outside air
- After outdoor air filters
- Return air from collections
- Mixed air
  (external air + return air from collections)
- Between 1st and 2nd indoor air filter
- After 2nd indoor air filter

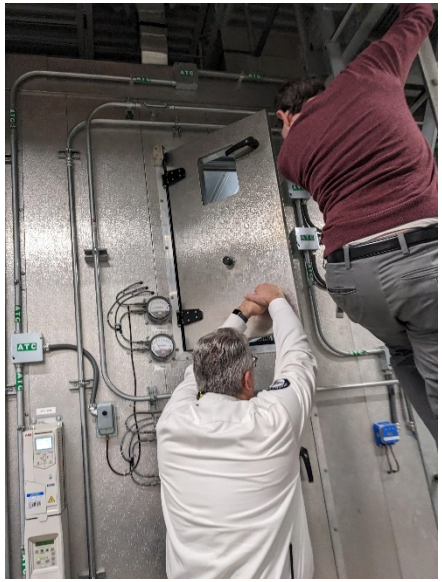


Air Sampling Methods

Gas detector tubes
Nitrogen dioxide (NO_2)
Sulfur dioxide (SO_2)
Ozone (O_3)

Volatiles sampling:
Collect ~10L in sample bags then transfer collected gas onto sorbent tubes for analysis by thermal desorption gas chromatography mass spectrometry.





Air Sampling Results

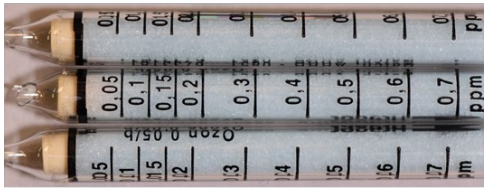
Ozone and sulfur dioxide detected only in outside air sample. No nitrogen dioxide was detected.

Outdoor and return air before the first filter had the highest concentrations of volatile organic compounds. Low benefit from 2nd filter.

Filter sets include fine particulate filters + gaseous pollutant filters. Particulate filtration remains.

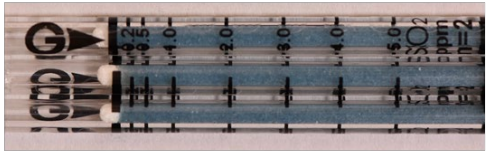
Using both outside air filters and 1st set of internal (return) HVAC filter effectively reduces pollutants to level that meets preservation goals

Ozone



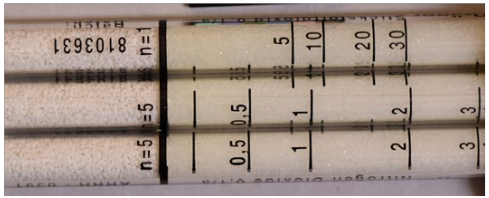
Filtered outside
Outside
Return

Sulfur dioxide



Filtered outside
Outside
Return

Nitrogen dioxide



Filtered outside
Outside
Return

Energy Savings Potential from Module 6 Pilot

Remove gaseous filtration for outdoor air

Potential energy savings of $ 5,000 over lifetime of each unit

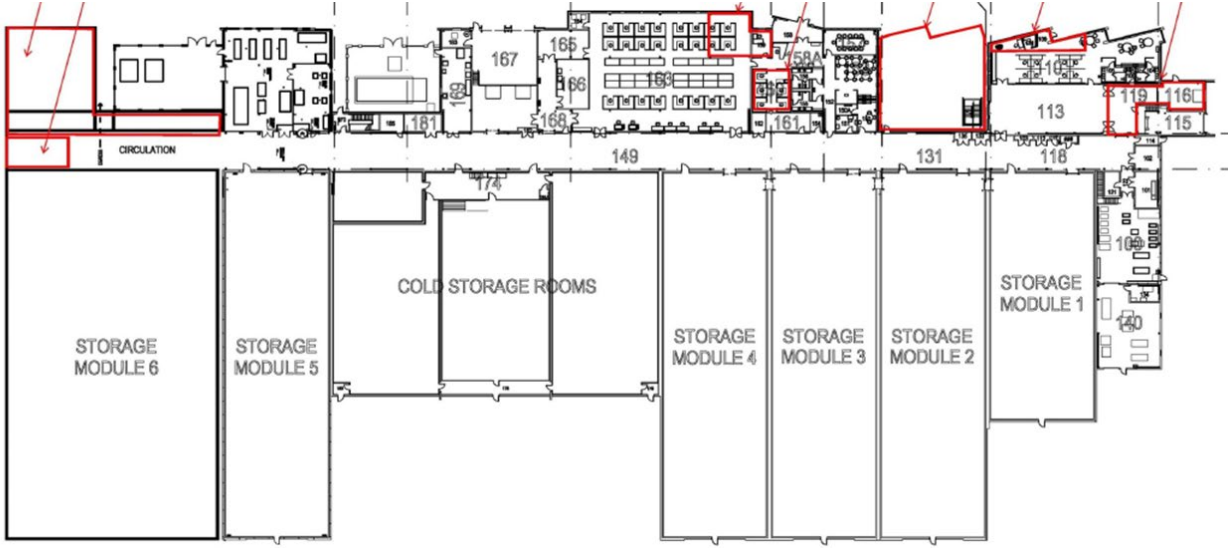
Remove 2nd (duplicate) gaseous indoor air filter

Potential energy savings of $ 40,000 over lifetime of each unit

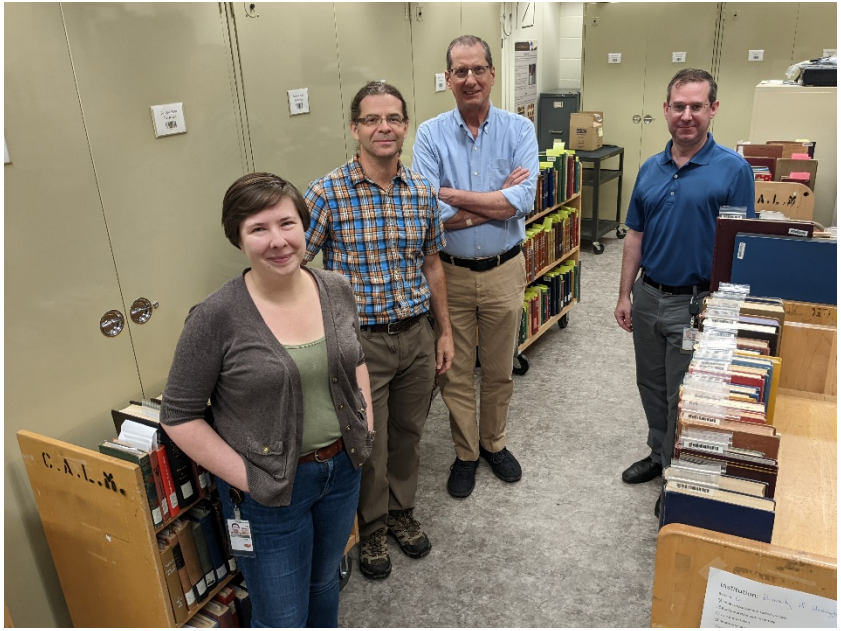
- ✓ **Keep outdoor air filters**
- ✓ **Remove 2nd internal HVAC filter for air returning from module**

Next Steps

Repeat trial for single width module to determine if removing 2nd indoor filter is possible for all modules



Thank You



Questions?

Questions – Ask a Librarian: Preservation
https://ask.loc.gov/preservation/

Blog – Guardians of Memory: Preserving the National Collection
http://blogs.loc.gov/preservation/

Online Resources – Preservation Directorate Website
https://www.loc.gov/preservation