Should Exposed Fiberglass Insulation (EFI) Be Used Below Grade or in HVAC systems

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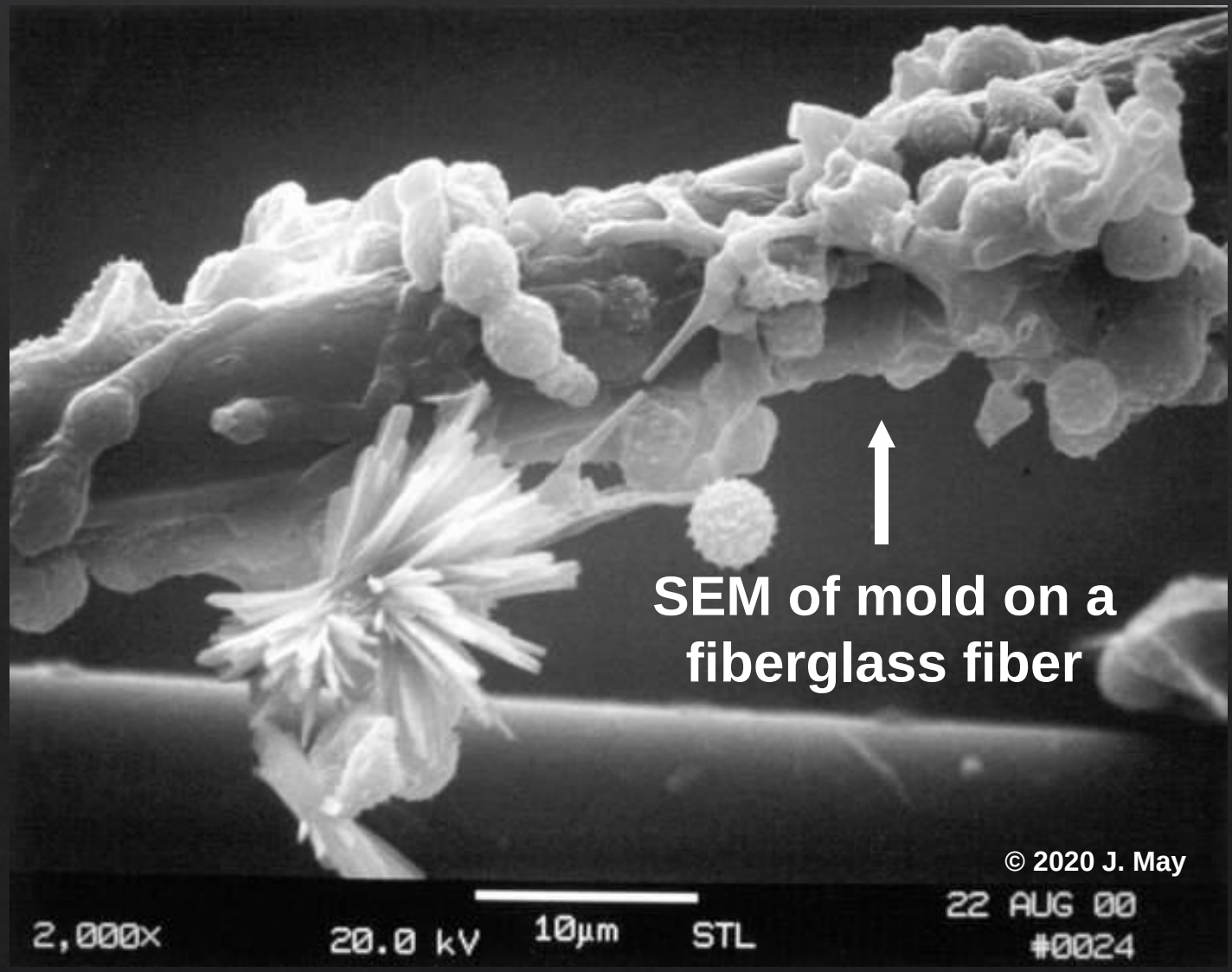
OUTLINE

Moisture and dust in EFI and exposed fiberglass ceiling insulation (FGCI)

Test methods, results & examples: unfinished basements, crawl spaces, and finished basement wall

Mold in HVAC systems

Why Does Mold Grow in Insulation?



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Glass fibers are mineral and cannot alone support microbial growth

Why Does Mold Grow in Insulation?

Fiberglass acts like a filter trapping particles between the fibers

It traps dust, including spores from the air, starting from construction

The dust also contains biodegradable particles: sawdust, skin scales, pollen, etc.

If the relative humidity gets above 80% mold can grow


Rust on wire support
The weather changed from cool to hot and humid . . .
There is biodegradable dust trapped in the fibers and water condensation on EFI (or maybe only RH>80%)
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Introduction to study:

28 bulk samples EFI tested, primarily from ceilings of unfinished basements but including a few from crawl spaces.

The samples were analyzed for fungal content, all by direct microscopic examination and all by culturing.

Criteria for Growth in FGCI:

1. The presence of large numbers of fungal spore clusters and/or chains in FGCI samples determined by direct microscopic examination;

2. Very significant fungal concentrations upon culturing.

Results:

Approximately 43% of the samples evaluated were considered to have fungal growth and colonization.

Species of *Cladosporium* and *Aspergillus* were the most frequently encountered colonizers.

Fungivorous mites and mite fecal pellets were present in a small percentage of the samples.

Examples (CFU/g):

***A. versicolor* : 36,000-190,000**

***C. sphaerospermum*: 50,000-16,000,000**

Other:

***A. candidus*: 46,000**

***Scopulariopsis candida*: 230,000**

***Penicillium implicatum:* 530,000**

***Engyodontium* species: 4,500,000**

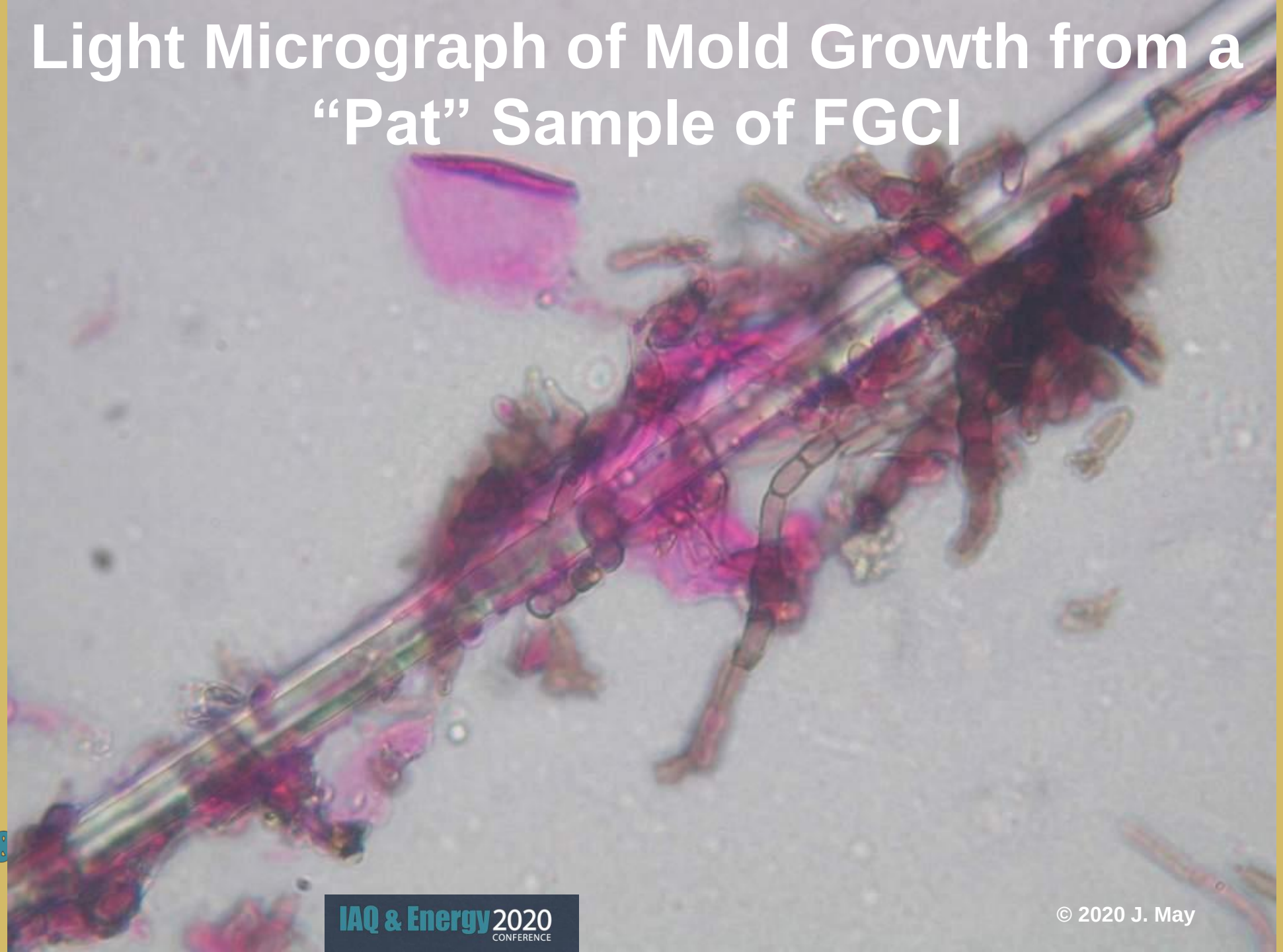
***Acrodontium myxomyceticola*: 3,000,000**

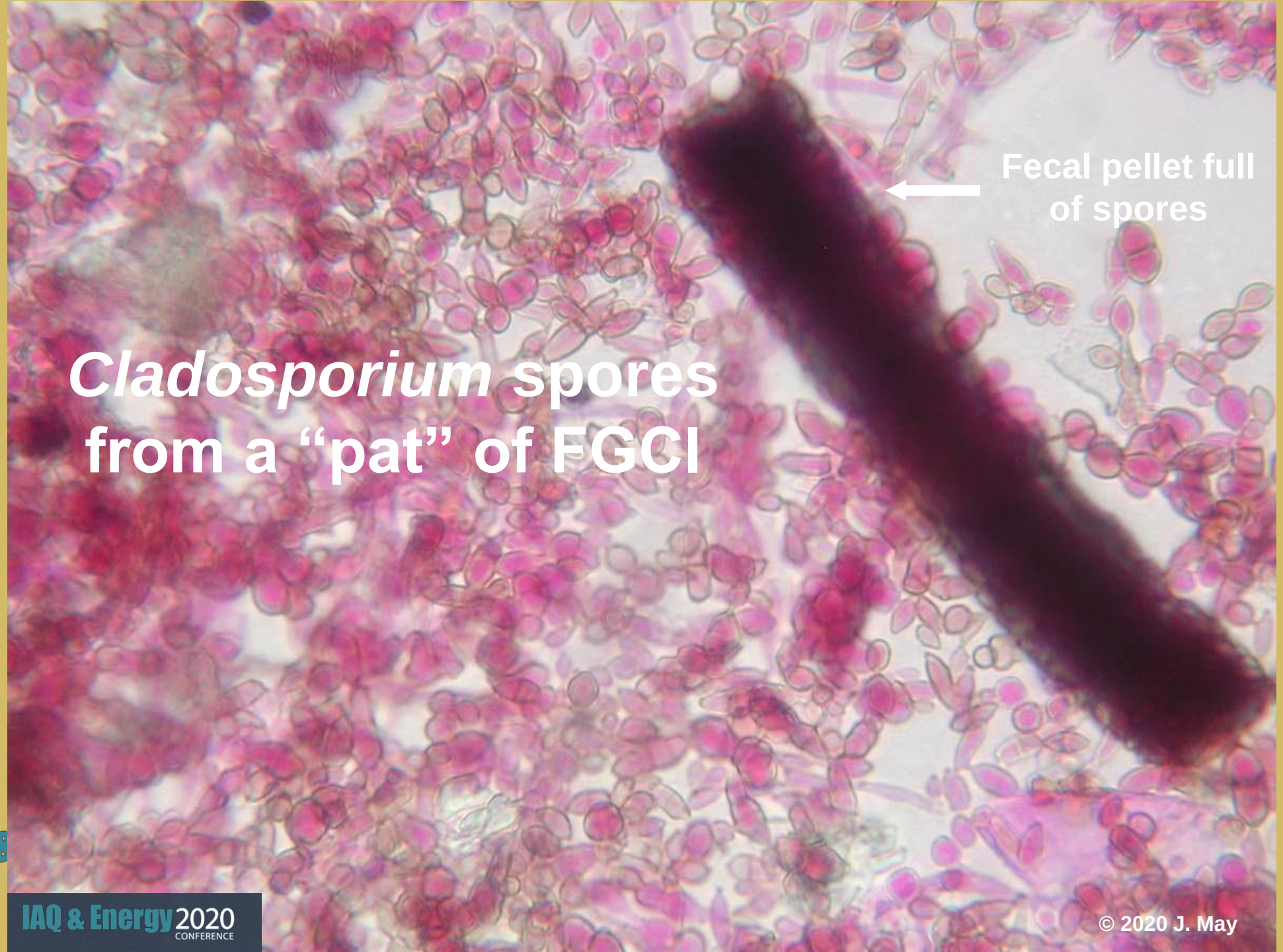
The “pat” sample:

The insulation is lightly tapped with a screwdriver and the aerosol collected for a few seconds with a Burkard sampler.

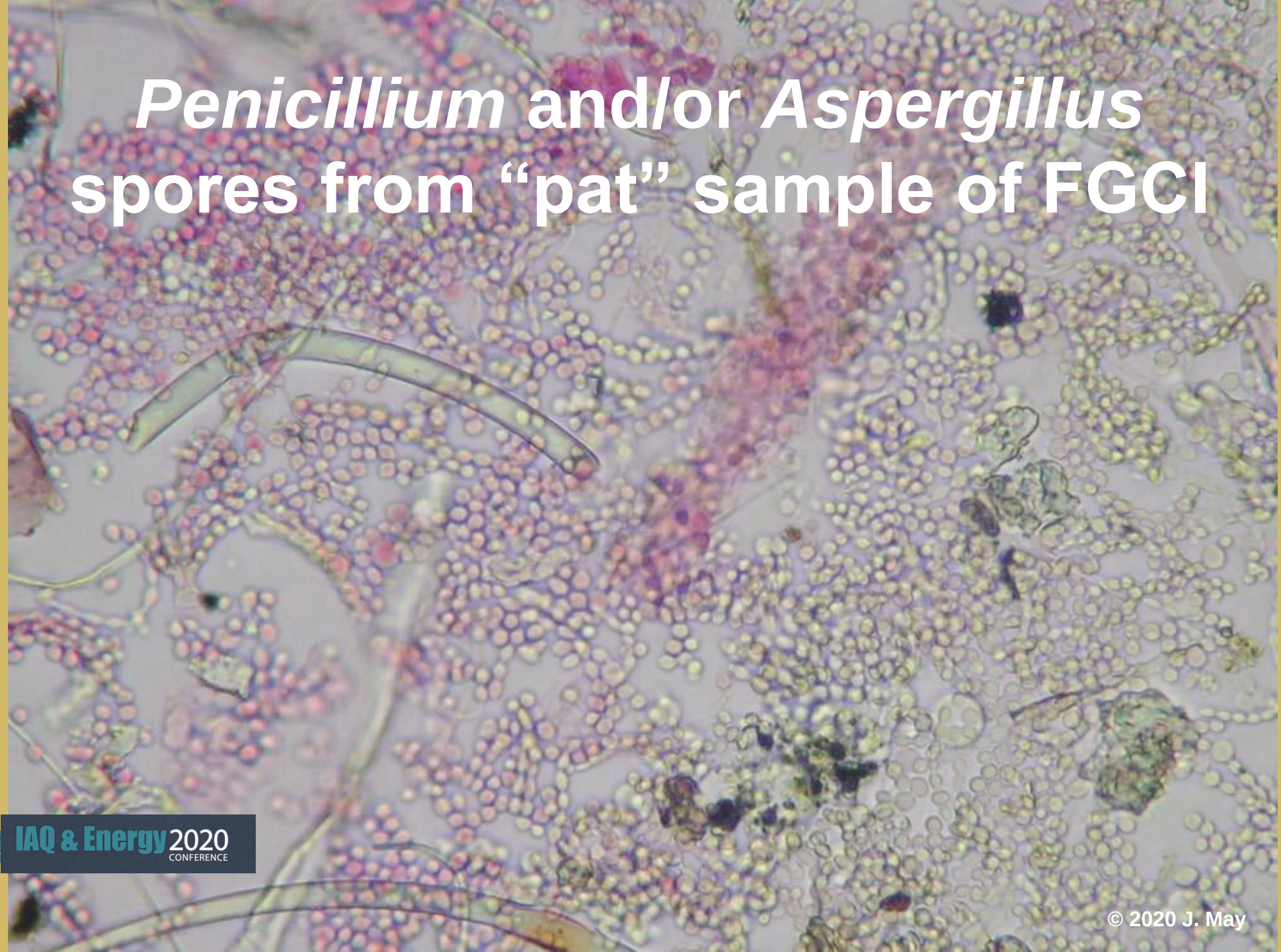
This can also be done with any style spore trap but . . .

Light Micrograph of Mold Growth from a "Pat" Sample of FGCI





Cladosporium spores from a "pat" of FGCI


Penicillium and/or *Aspergillus*
spores from "pat" sample of FGCI
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Fecal Pellet Full of Germinating Spores (hyphae stained pink)

Microarthropod (mite) fecal pellets are allergenic but so are the partially digested spores within, many capable of growing when conditions become damp

Mite Findings were disappointing!

Though some fecal pellets were present, only one sample of the 28 had a mite:

Tarsonemidae family,

possibly from the genus *Tarsonemus*, species of which are fungivores.

In the past I have estimated that about one third of mold-infested FGCI contained mite infestations.

Note On Mites in the Ecosystem:

There are over 40,000 named species

They are essential soil organisms

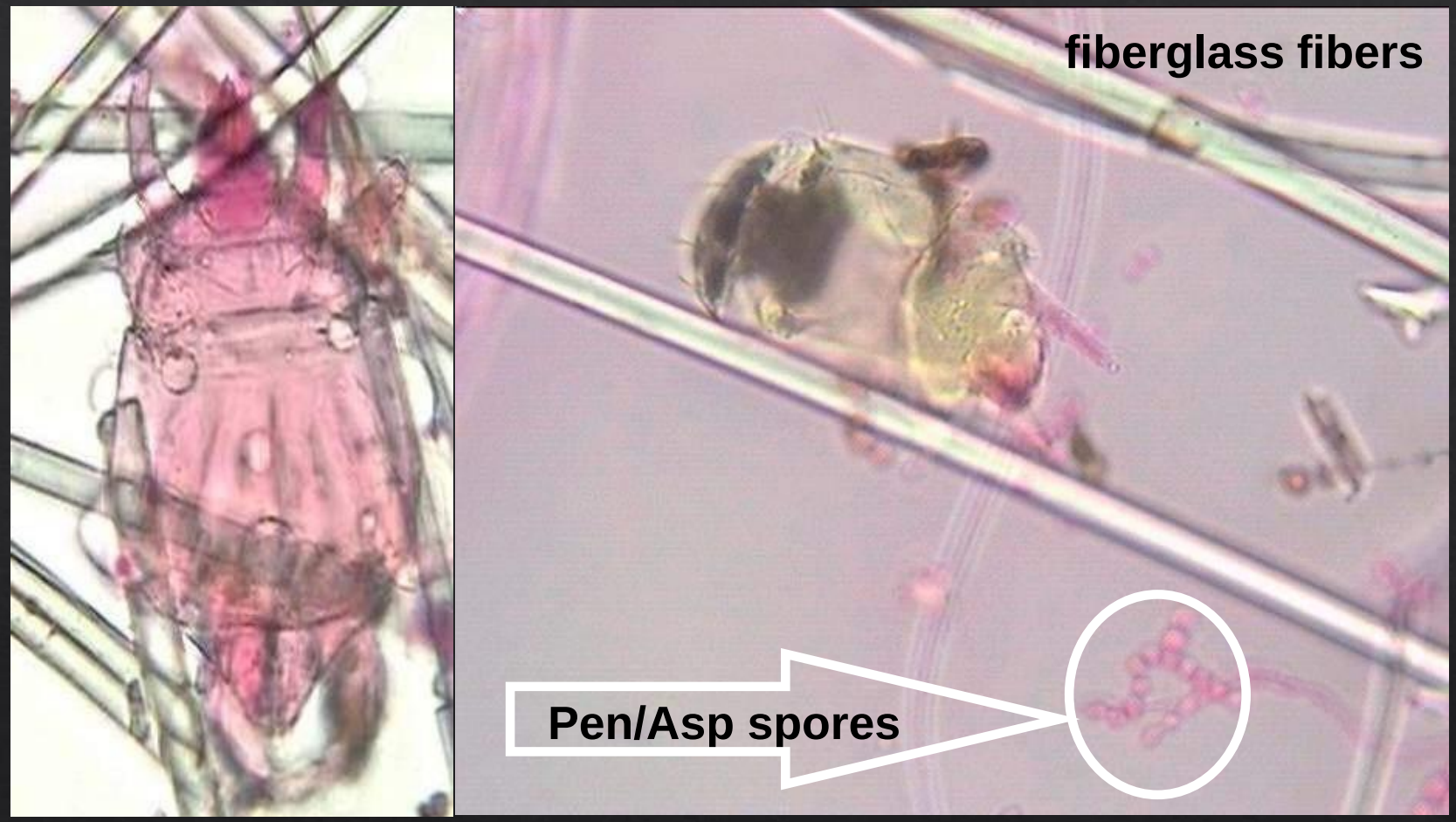
Up to 250,000 /m^2 in upper 10 cm

Some species eat nematodes that attack plant roots

Other species eat fungal plant pathogens


Possible
Tarsonemus mite
from "Pat"
sample of FGCI
At least a dozen
different species of
mites are common
indoors; all are
allergenic

Mites and Pen/Asp Spores at 400x
in “Pat” Air Samples from Exposed Basement Ceiling Fiberglass



In the home of a mold allergic client, slight agitation of the fiberglass produced numerous airborne spores and six mites.

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Visible *Cladosporium* Growth in Basement FGCI….
A rare example!
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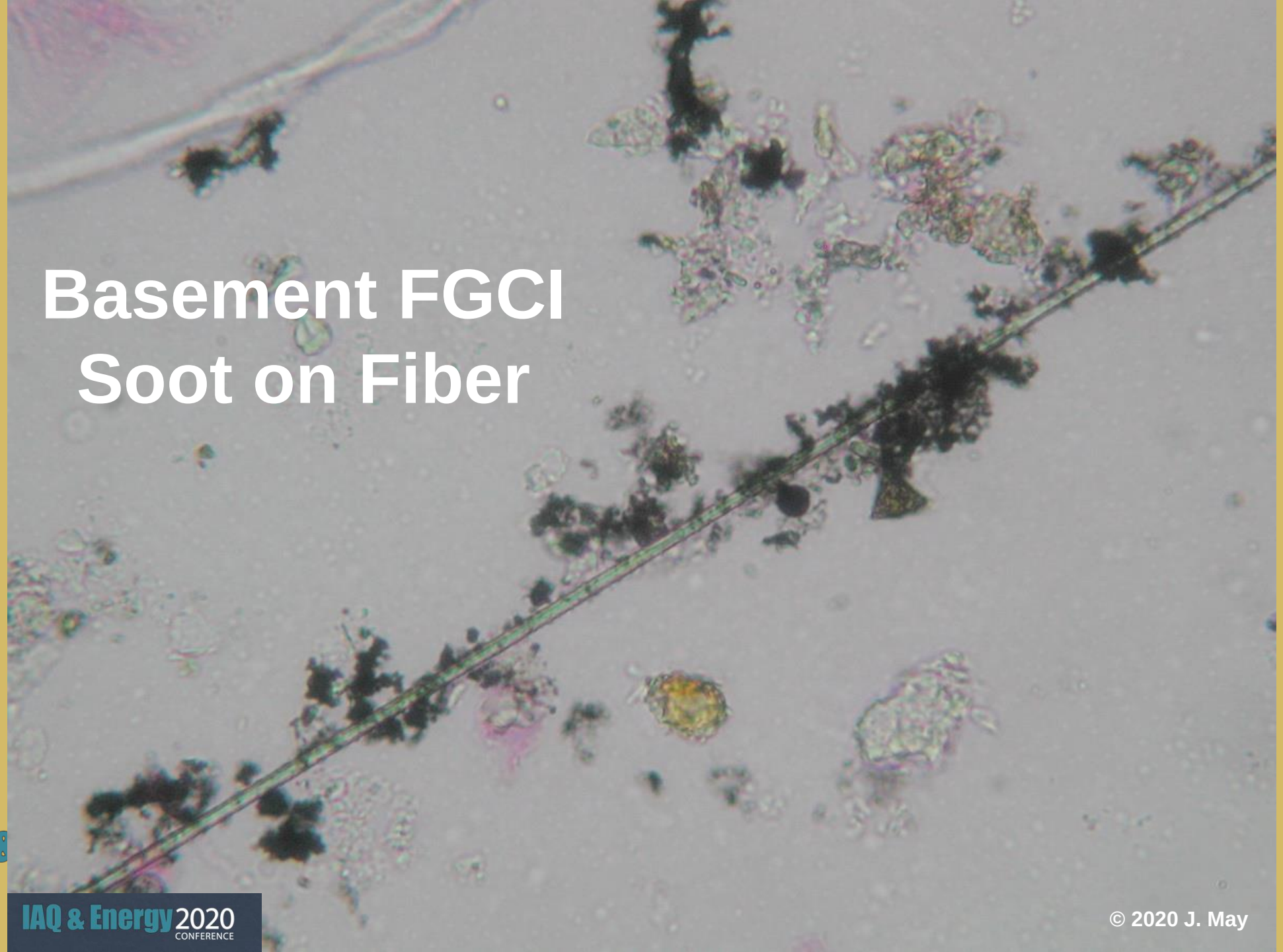
Visible *Cladosporium* Growth in Basement FGCI….

Another rare example!

Cladosporium spores + fecal pellets from visible FGCI mold

FGCI staining may not be from mold



Basement FGCI
Soot on Fiber

Basement dehumidification is the only way to avoid mold growth in FGCI.

Keep RH at no more than 50%

Exhaust-only so-called “dehumidifiers” are a scam!

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Mold growing in sawdust on a “dehumidifier”

Exhaust-only so-called “dehumidifiers” are a scam!

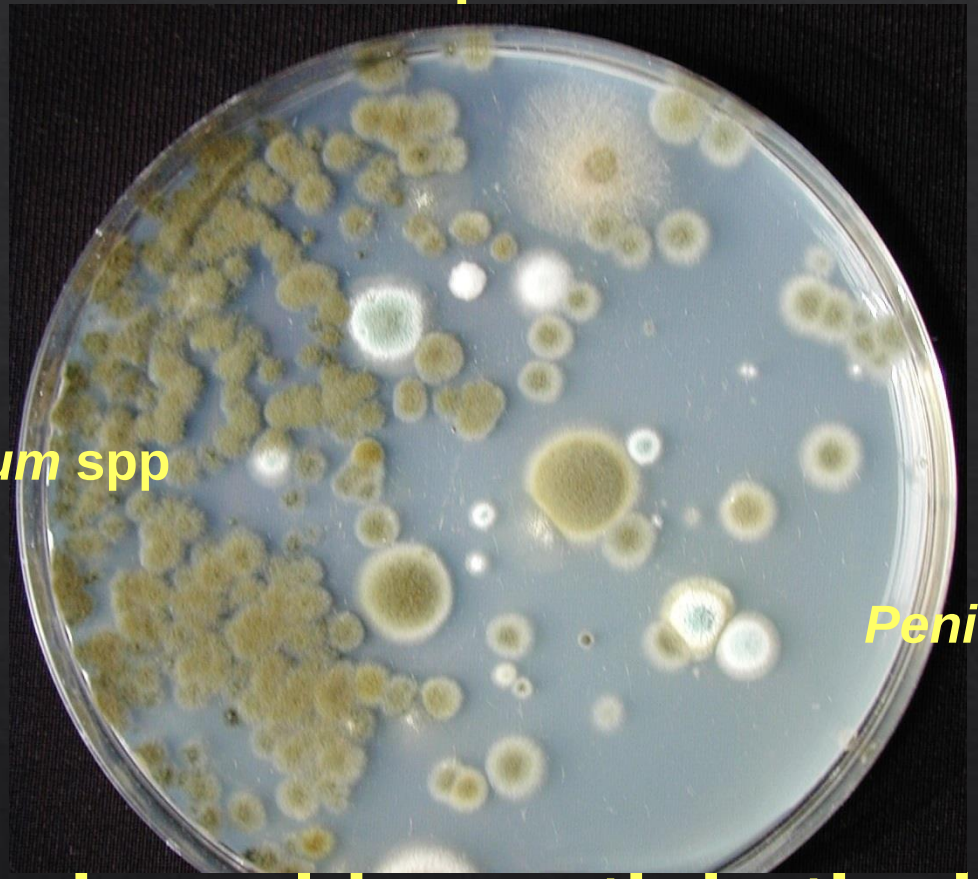
Manufacturers claim the device simply driven by a small fan saves money since there is no compressor.

The only time it can work is where there is a transfer grille open to an air conditioned habitable space.

Then more outdoor air must be taken in and air conditioned, negating any cost savings

Surface “Pat” Sample for Fiberglass Insulation

Press Petri dish gently against insulation two or three times; Incubate at room temperature for about a week.



Cladosporium spp

Also, often *Aspergillus* spp

Penicillium spp

If there is mold growth in the insulation, dozens of similar colonies will grow.

“Pat” Samples for Fiberglass Ceiling Insulation

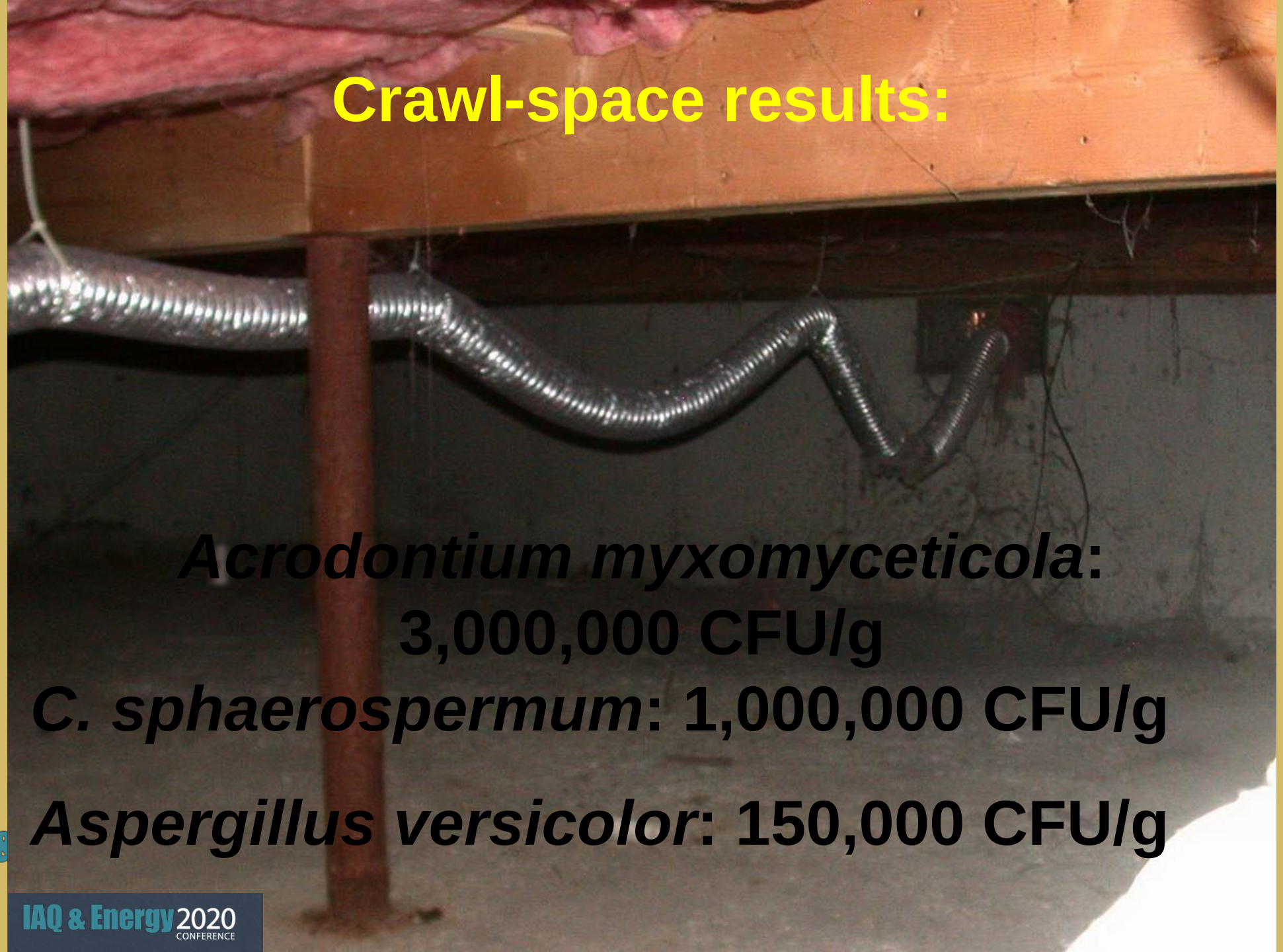
If using either type of “pat” test (spore trap or petri dish) always do two separated locations because often there will be significant mold growth in one area and not another.

Do not test above an area heated by a furnace or water heater or areas close to ducts.

Best locations are in spaces close to a bulkhead door or basement window or isolated alcove.


Mold on vinyl wrap
Crawl Spaces
Dew-point condensation in a crawl space: 85% RH

Crawl-space results:



***Acrodontium myxomyceticola*: 3,000,000 CFU/g**

***C. sphaerospermum*: 1,000,000 CFU/g**

***Aspergillus versicolor*: 150,000 CFU/g**

Crawl-space results:

***Engyodontium* species: 4,500,000 CFU/g**

Should Crawl Spaces have Walls with Ventilation to the Exterior??

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Comparing a vented crawl space to a closed crawl space and exterior air

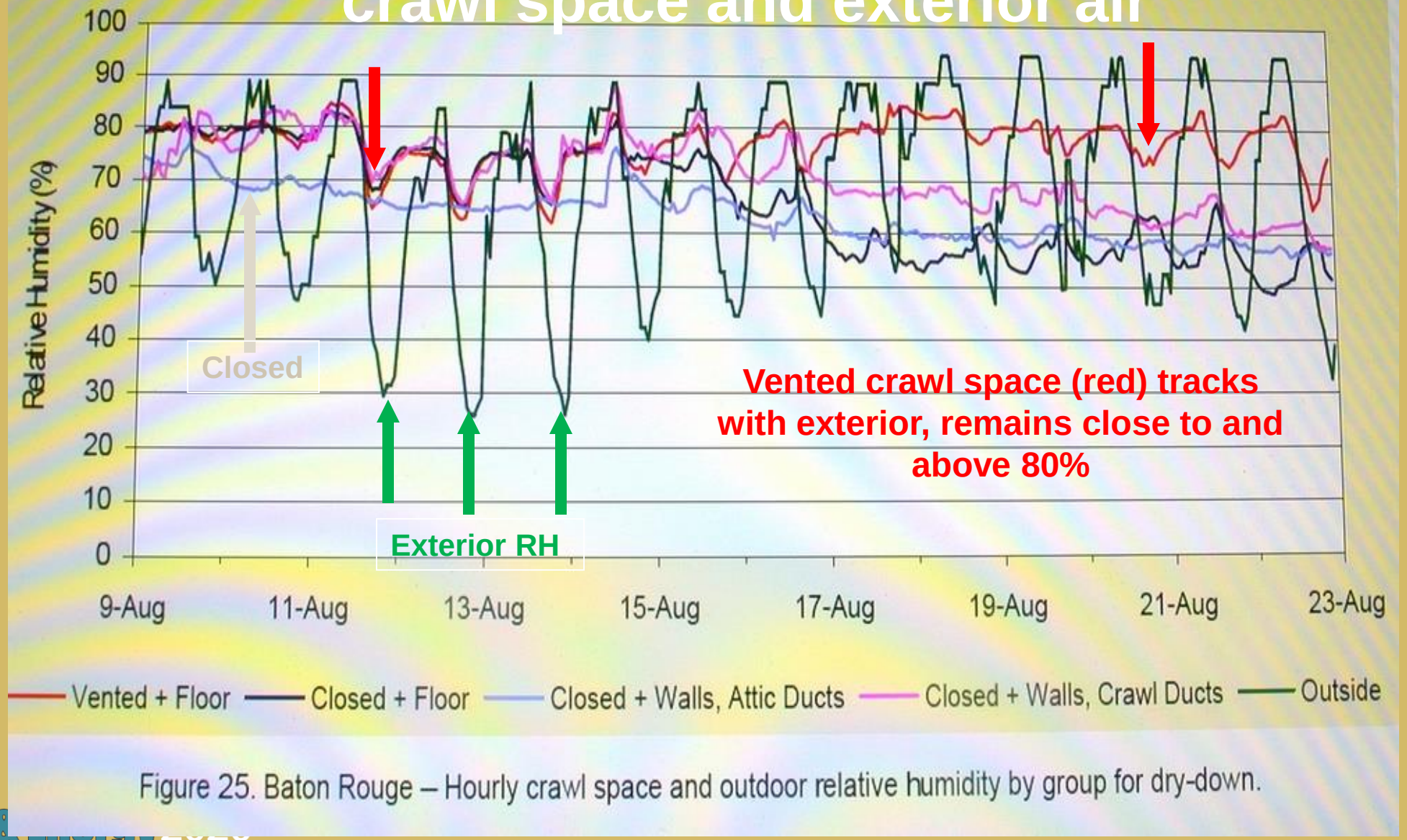
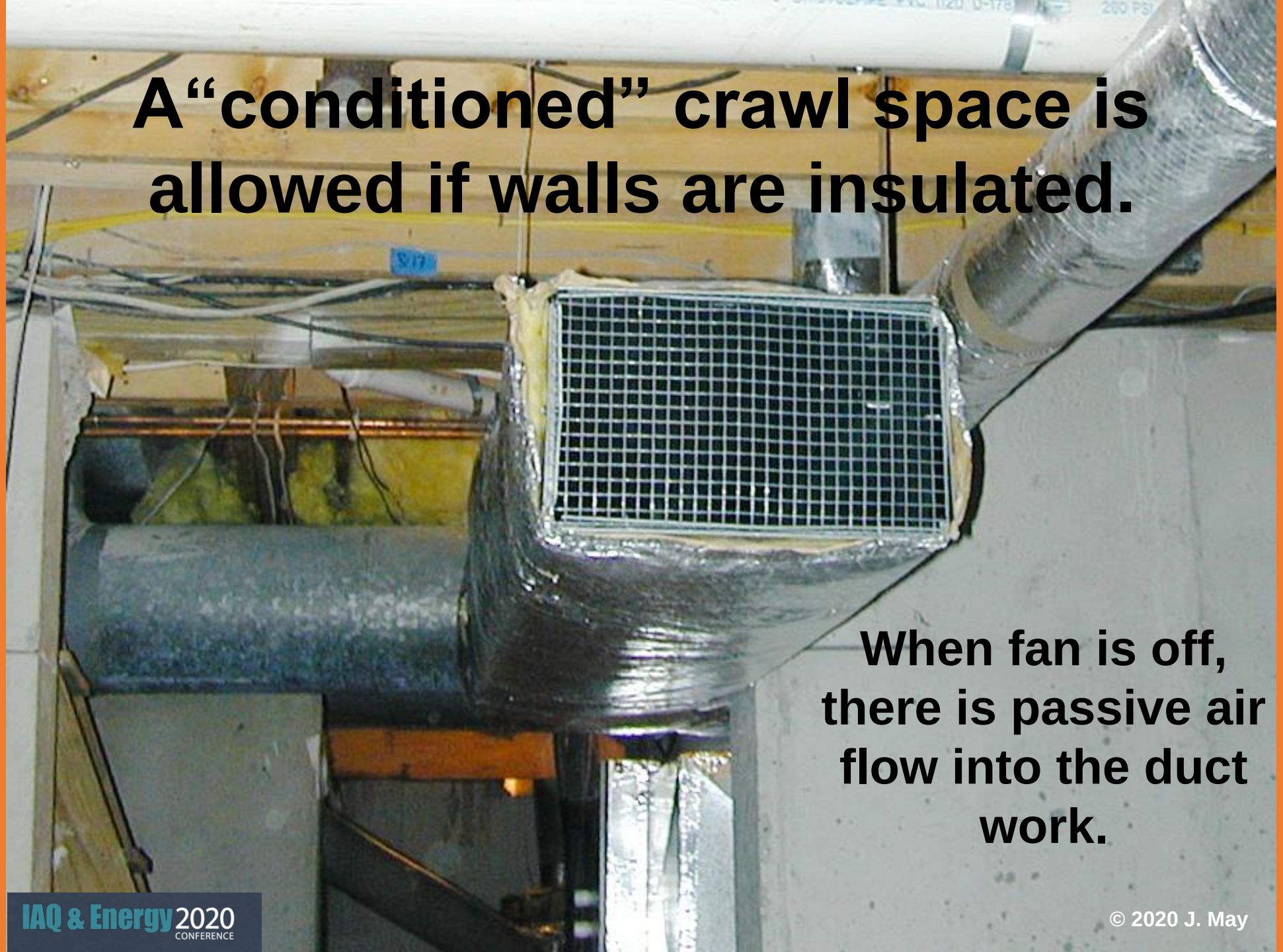
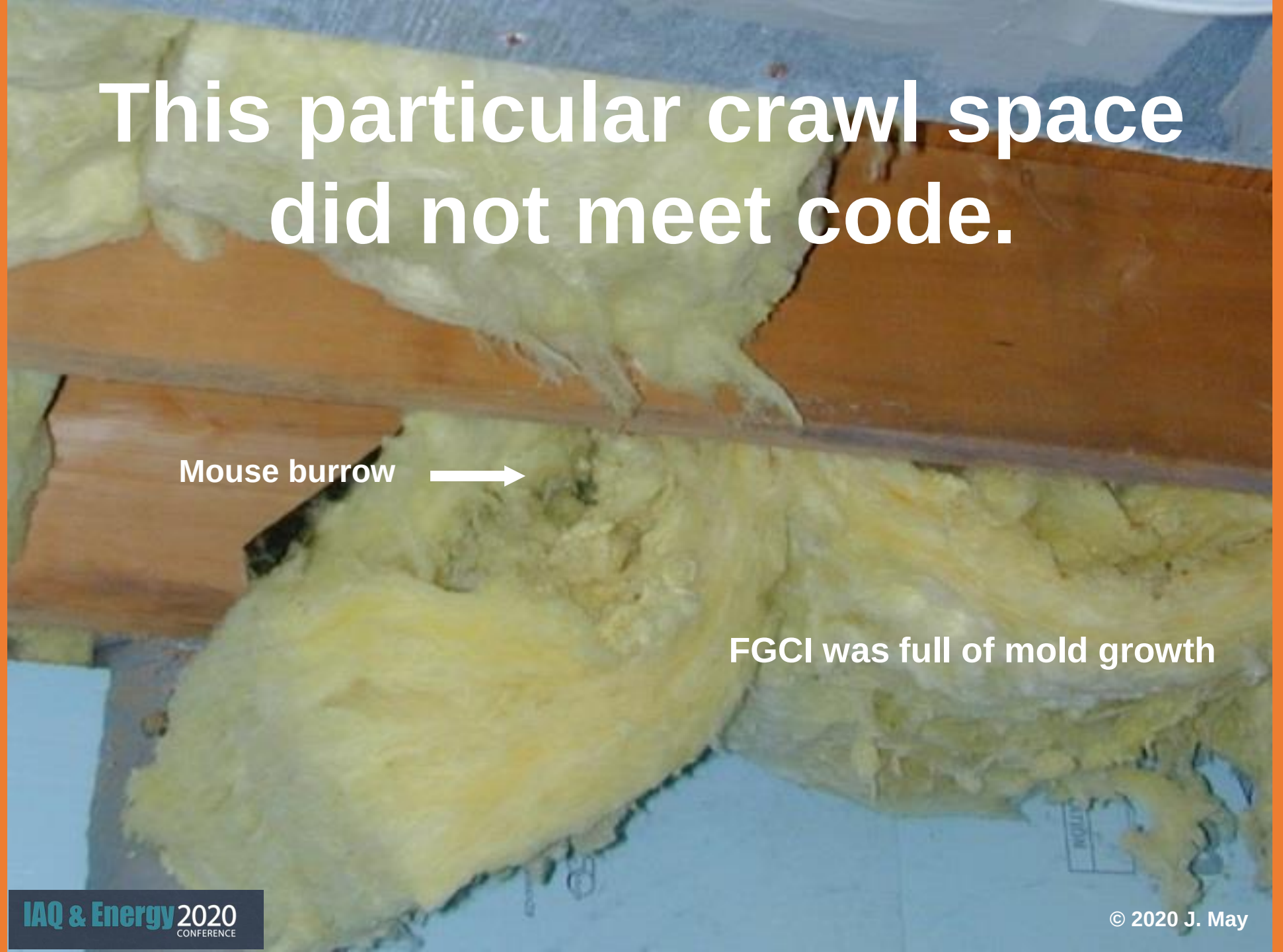


Figure 25. Baton Rouge – Hourly crawl space and outdoor relative humidity by group for dry-down.

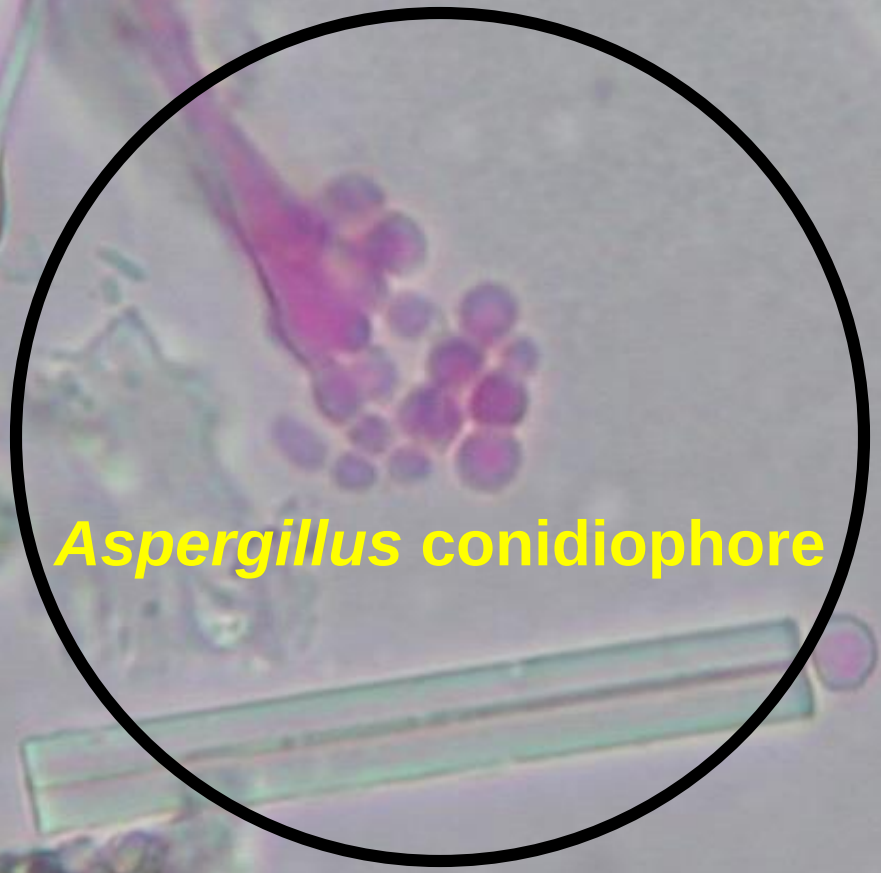
Some new buildings allow crawl spaces without ventilation to the exterior, as long as they are ventilated to a conditioned space (or dehumidified).

If insulated at the foundation, a “sealed” crawl space can be part of the supply or return system.


A“conditioned” crawl space is allowed if walls are insulated.
When fan is off, there is passive air flow into the duct work.

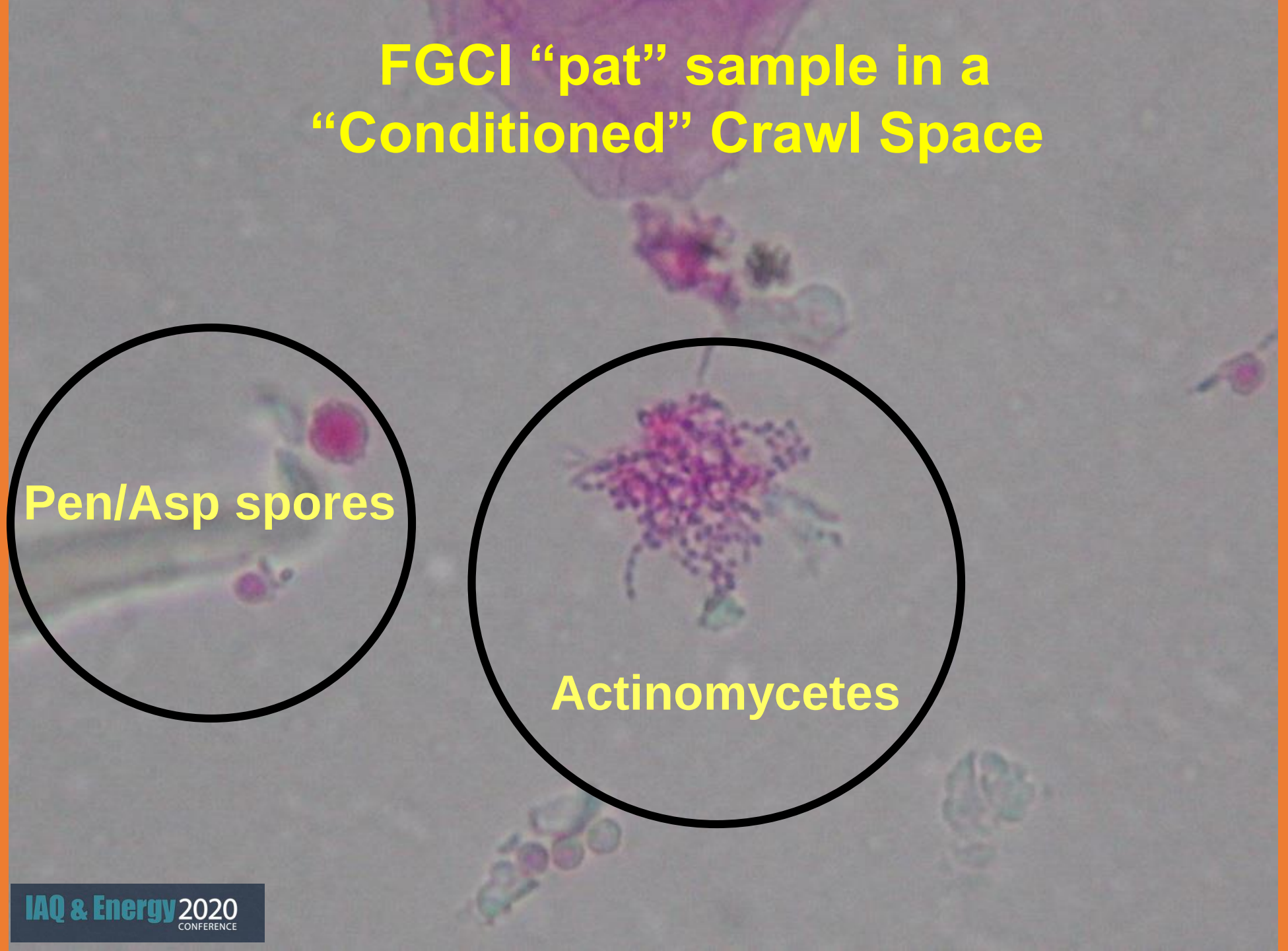

This particular crawl space did not meet code.
Mouse burrow
FGCI was full of mold growth

FGCI “pat” sample in a “conditioned” crawl space



Aspergillus conidiophore

FGCI “pat” sample in a “Conditioned” Crawl Space



Are other types of basement fiberglass installations also subject to mold growth?

Wall-cavity sample at electric outlet

Wall cavity sampling

Fiberglass fiber with Pen/Asp growth

Owens Corning Basement Finishing Systems

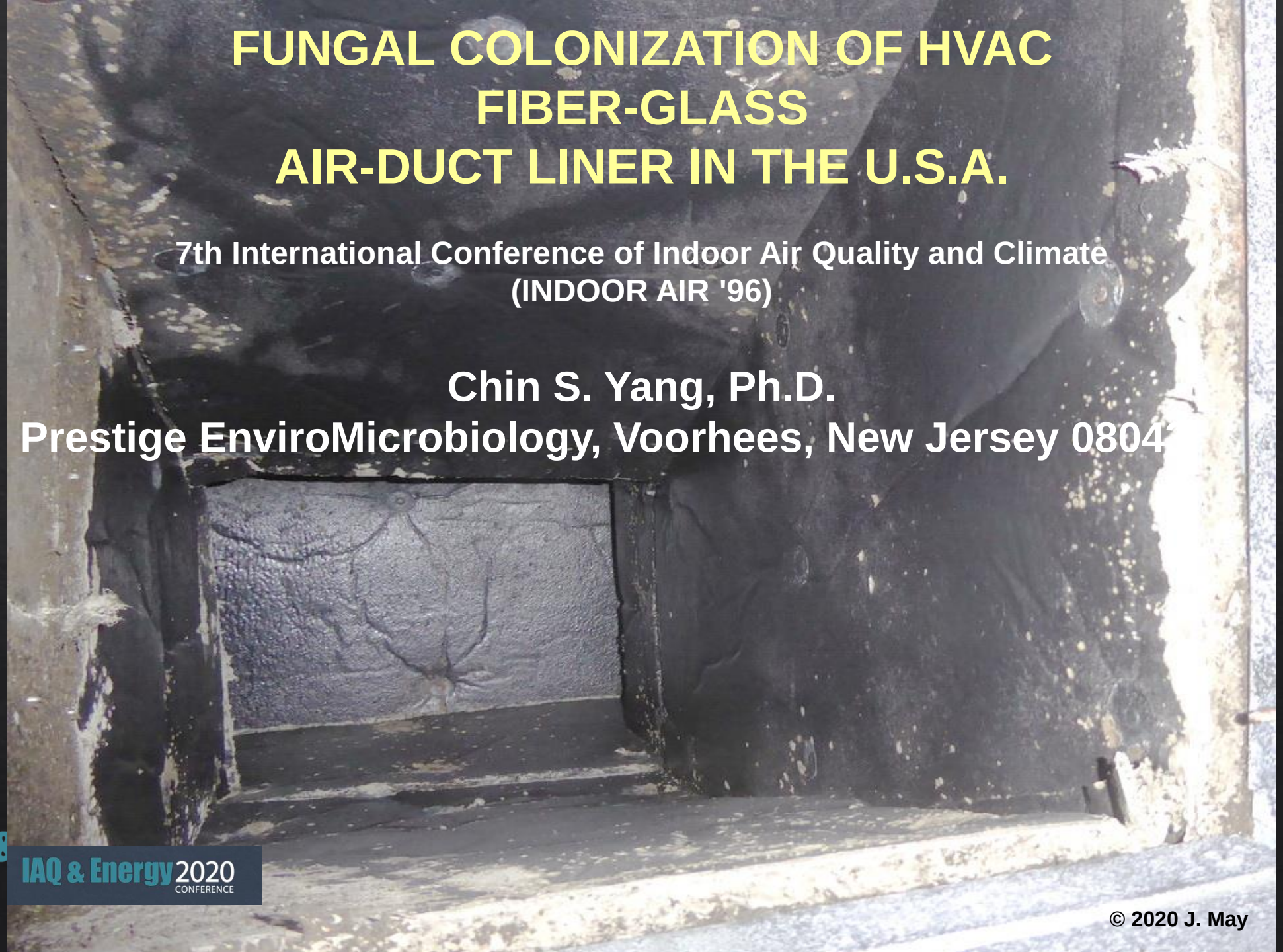

Owens-Corning
Finished
Basement

CONCLUSION:

Keep Below-Grade Spaces Dehumidified!!

Avoid fibrous insulation below grade whenever possible

In new construction, insulate foundation exterior



FUNGAL COLONIZATION OF HVAC FIBER-GLASS AIR-DUCT LINER IN THE U.S.A.

7th International Conference of Indoor Air Quality and Climate
(INDOOR AIR '96)

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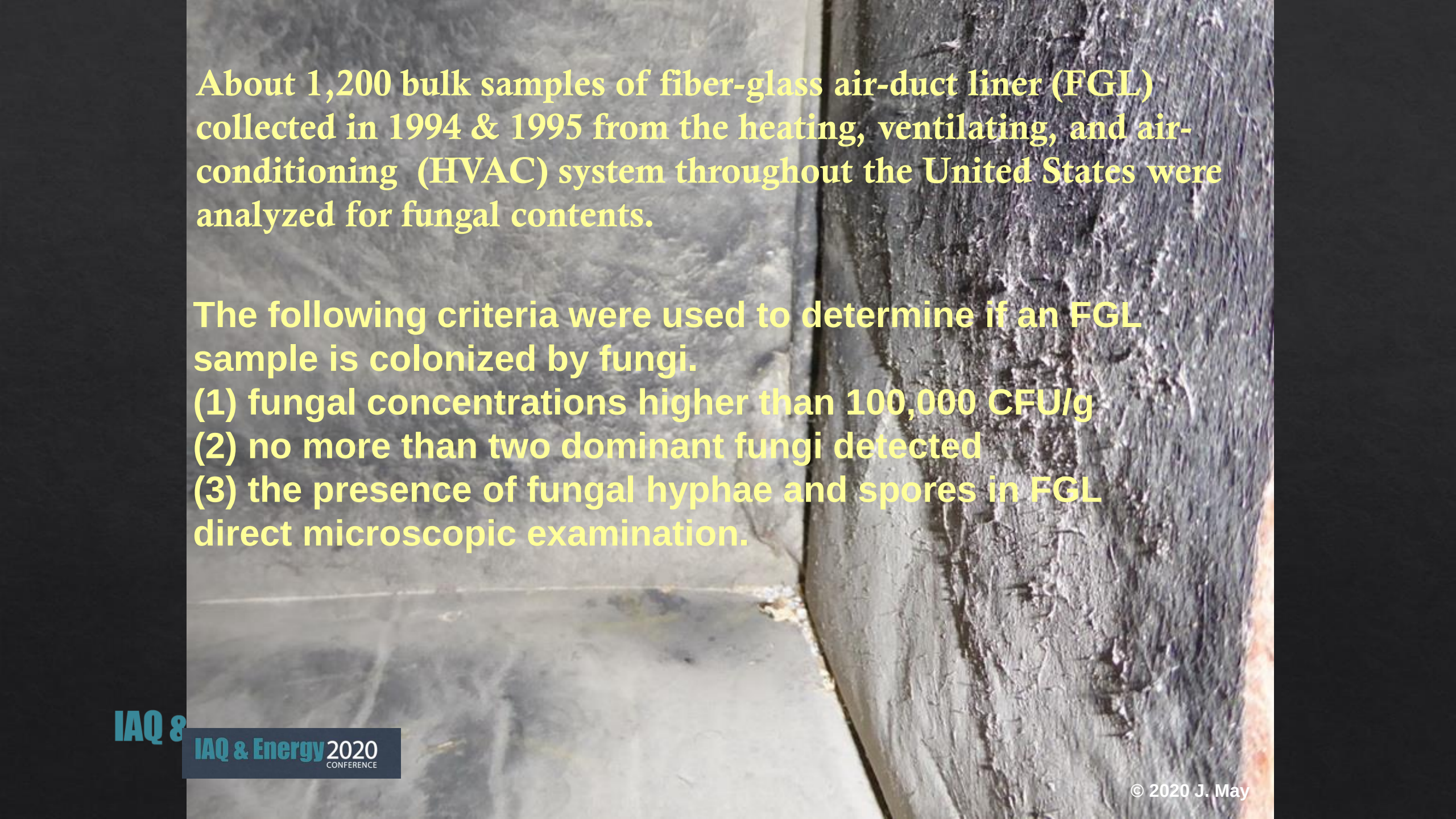


About 1,200 bulk samples of fiber-glass air-duct liner (FGL) collected in 1994 & 1995 from the heating, ventilating, and air-conditioning (HVAC) system throughout the United States were analyzed for fungal contents.

The following criteria were used to determine if an FGL sample is colonized by fungi.
(1) fungal concentrations higher than 100,000 CFU/g
(2) no more than two dominant fungi detected
(3) the presence of fungal hyphae and spores in FGL direct microscopic examination.

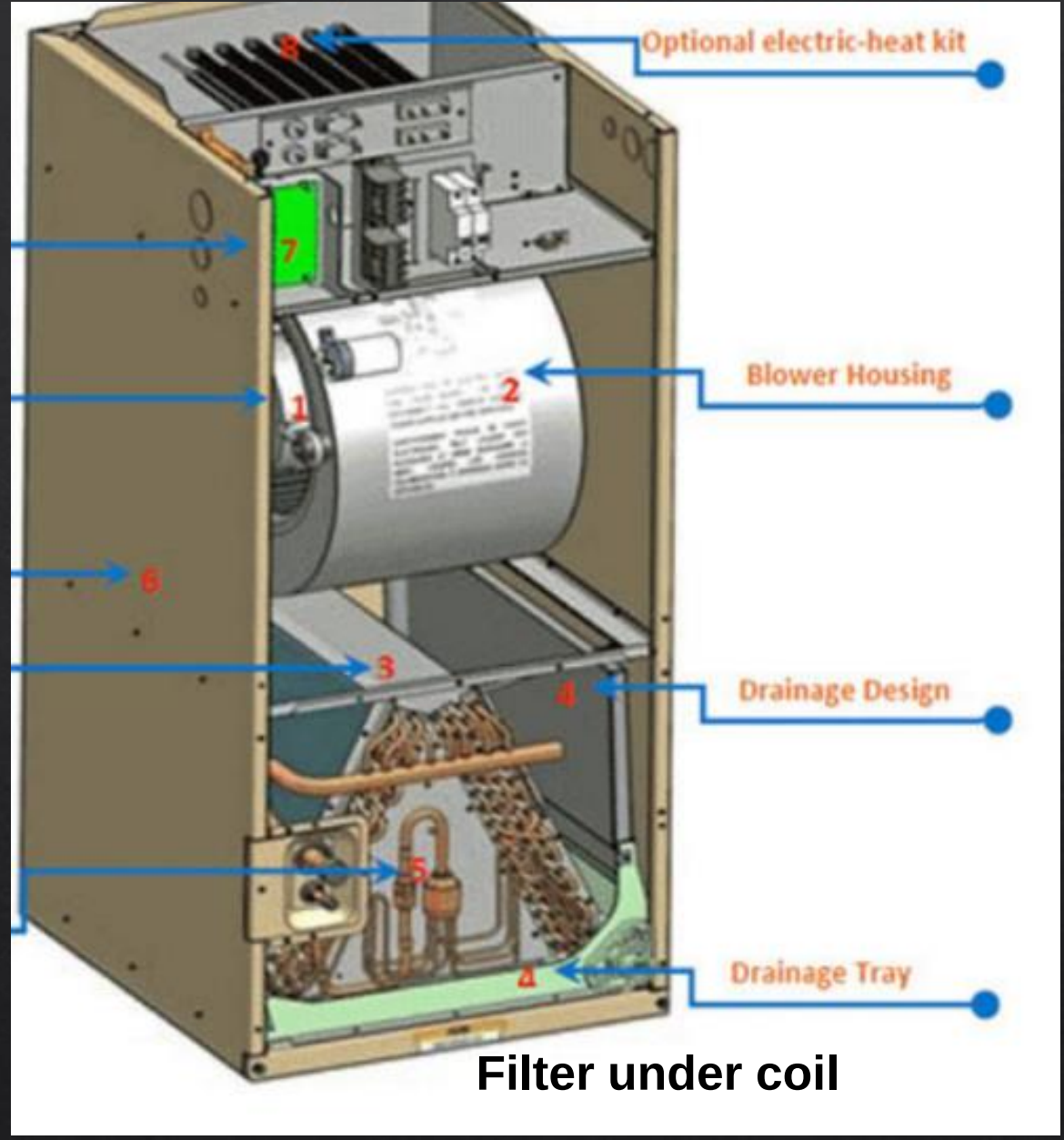
Approximately 50% of the samples evaluated were considered to have fungal growth and colonization. Species of *Cladosporium* and *Penicillium* were the most frequently encountered colonizers. Usually recovered from FGL samples taken from locations with high relative humidity, such as air ducts downstream from the coils).

FGL samples taken from locations where liquid water is often present, such as at cooling coils or drain pans, were dominated by high water activity fungi, such as *Acremonium* spp., *Aureobasidium pullulans*, *Exophiala* spp., *Paecilomyes marquandii*, *Phoma* spp., *Rhodotorula* spp., and yeasts.

Common Arrangement for A/C for Fan Coil

Filter is directly beneath the cooling coil

Condensate may drip from coil onto filter



Filter under coil

Water in Return Plenum Under Coil Drip

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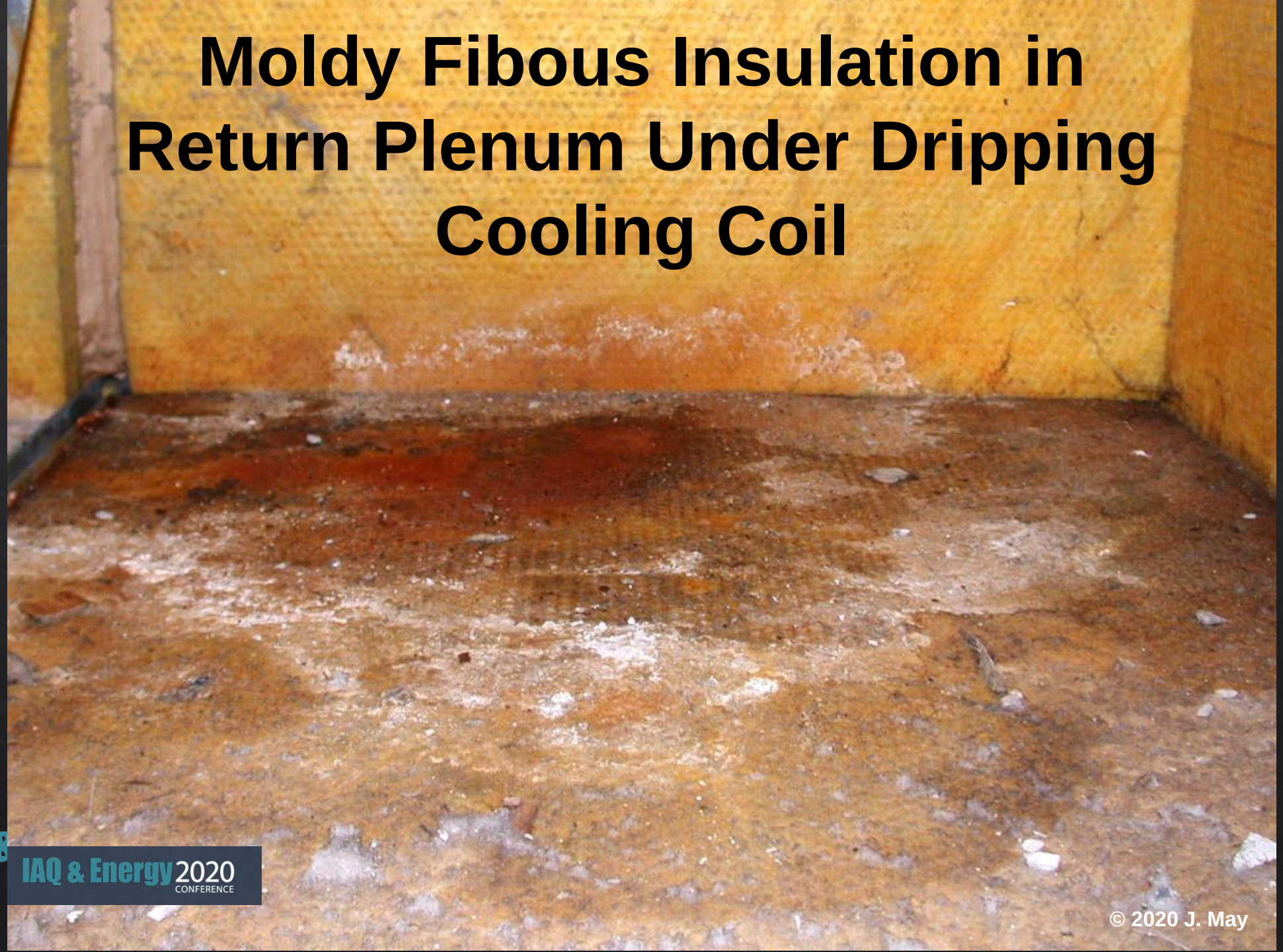
Moldy Fibous Insulation in Return Plenum Under Dripping Cooling Coil



CONCLUSIONS:

Avoid exposed fibrous insulation in air handlers and ducts

Use foil-coated fiberglass or closed-cell foam insulation

Use minimum MERV-8 pleated-media filters

Do not position filter under coil

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Thanks to:

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