

Steward Observatory Safety Committee
April 10th , 2018

Update on Indoor Air Quality Issues

Historic Review of IAQ Issues in Building 65

- History of sewer odors, chemical odors, reports of mold growth and occupants experiencing health problems in the building
- Steps taken to isolate and exhaust sewer odors and modify HVAC balance of mechanical rooms, and update HVAC exhaust in the machine shop
- IAQ Assessment by ATC Environmental Consultants
- Building Systems Assessment by GLHN
- FM Actions to Prevent Rainwater Intrusion
- HVAC Terminal Unit (Mixing Box) replacements
- Deep Cleaning and Analytical Testing in Targeted Areas – SWHC/WT
- Roof Repair, Cleaning, and Testing in the Annex – Bldg 64

Recent Actions

- Four quarterly environmental sampling events scheduled
- Testing performed by RMS, includes swabs and air samples, analysis by Quantitative Polymerase Chain Reaction (qPCR)
- Testing coupled with visual inspection to look for moisture problems
- Schedule intended to evaluate IAQ impacts from seasonal variations
 - Q1 – June 28, 2017
 - Q2 – October 12, 2017
 - Q3 – February 21, 2018
 - Q4 – May 2018 – date TBD

Interpreting Test Results

- qPCR analysis identifies individual mold species in samples
- Environmental Relative Moldiness Index (ERMI) – looks at a panel of 36 mold species which are typically found in mold-impacted buildings
- ERMI divides mold species into Groups I and II
 - Group I – 26 mold species commonly associated with water damage
 - Group 2 – 10 mold species common to indoor environments
- ERMI score is derived by comparing the logarithmic concentration difference in Group 1 and Group 2 mold species
- Scoring is only performed on surface swab samples, not air samples
- Score is being used as a screening tool to evaluate changes over time

ERMI Score	Level or Risk	Likelihood of Mold Problem
-10 to -4	Level 1	Lowest
-4 to 0	Level 2	Lower
0 to 5	Level 3	Moderate
5 to 20	Level 4	High

Q1 results

- Q1 – four species identified
 - Aureobasidium pollulans (Group 1)
 - Cladosporium sphareospermum (Group 1)
 - Aspergillus niger (Group 1)
 - Cladosporium cladosporioides I (Group 2)
- ERMI scores for surface swabs were 3.1, 2.6, 3.4, 0.8 for areas tested. Scores of 0-5 are Level 3 or moderate likelihood of mold issue
- Air sample results were generally low values and unremarkable
- Visual inspection identified some water damaged ceiling tiles, which were scheduled for replacement

Q2 results

- Q2 – nine species identified
 - Group 1 - Aureobasidium pollulans, Cladosporium sphareospermum, Aspergillus niger, Aspergillus flavus, Eurotium amstelodami, Aspergillus ochraceus, and Penicillium spinulosum
 - Group 2 – Cladosporium cladosporoides I, Cladosporium cladosporoides II
- ERMI scores for surface swabs were 10.6, 1.5, 4.8, 1.2, 12.3, -1.0, 6.2 for indoor areas tested. Increases likely attributable to monsoon moisture and higher humidity
- Air sample results were again generally unremarkable
- Visual inspection verified replacement of previously identified water damaged ceiling tiles. No leaks or new water damage noted

Q3 results

- Q3 – 11 species identified
 - Group 1 organisms identified: Aureobasidium pollulans, Cladosporium sphareospermum, Aspergillus niger, Aspergillus fumigatus, Aspergillus versicolor and Aspergillus penicilloides.
 - Group 2 organisms identified: Cladosporium cladosporoides I, Cladosporium cladosporoides II, Alternaria Alternata, and Penicillium chrysogenum.
- ERMI scores for surface swabs were -2.0, 4.7, 0, -9.7, -0.9, **12.8**, -10.3, **1.3**, 2.3, -5.1, for indoor areas tested. Decreases in every area except for room 359 and 358 ceiling tile. The results for the outside swab was -7.5.
- Air sample results
 - Room N-134: Higher counts of Aureobasidium pollulans than outside.
- Visual inspection verified replacement of previously identified water damaged ceiling tiles. Some of them were not replaced, but they were immediately reported and action was taken.
- New leaks or missed stained ceiling tiles in rooms N-122,364, and 360. They were investigated, taken care of and replaced.

ERMI Score	Level or Risk	Likelihood of Mold Problem
-10 to -4	Level 1	Lowest
-4 to 0	Level 2	Lower
0 to 5	Level 3	Moderate
5 to 20	Level 4	High

Q3 results: Focus/Problematic Areas

- Room 358 fallen ceiling tile with visible black patch and room 359 results presented higher results than Q2 and than the outdoors.
 - No sign of water intrusion, smell or other stained ceiling tiles
- Room 466/468/470 (new target area)
 - Room 468 was thoroughly cleaned when first reported
 - Sampled again
 - Lower Result than outside mold swab and lower result than when sampled in 2017
- Stained Ceiling tile in room 370- not from sprinkler

Next Steps:

- Room 358, 359 and 360
 - Mixing Boxes, ductwork, ceiling tiles will be removed
 - All 3 rooms are going to get deeply cleaned.
 - Mixing Boxes, ductwork and ceiling tiles will be replaced
- FM is waiting for a quote for caulking the east side of the building windows and structure
- Room N-134 higher results is under investigation
- Qualtrix Building Occupant Survey



Fungal Analysis by PCR

University of Arizona, Risk Management S
Lorraine Santiago
220 W 6th St. Bldg. 300 B 2nd Fl.

Tucson, AZ 85701

Sample Type: Swab
Analysis: PCR Environmental Relative Moldiness Index Panel
Job ID / Site:

Lab Number	40176918
Sample ID	65-022118-09
Location	Room 369

Group 1				
Organism	Sp Eq	Sp Eq/mg dust	%	Log Conc
Aspergillus flavus	ND	ND	-	-
Aspergillus fumigatus	ND	ND	-	-
Aspergillus niger	3684205	3,700,000	88.8	6.58
Aspergillus ochraceus	ND	ND	-	-
Aspergillus penicilloides	ND	ND	-	-
Aspergillus restrictus	ND	ND	-	-
Aspergillus solerothium	ND	ND	-	-
Aspergillus sydowii	ND	ND	-	-
Aspergillus unguis	ND	ND	-	-
Aspergillus versicolor	ND	ND	-	-
Aureobasidium pullulans	ND	ND	-	-
Chaetomium globosum	ND	ND	-	-
Cladosporium sphaerospermum	1673226	1,700,000	31.2	6.22
Eurotium amstelodami	ND	ND	-	-
Paecilomyces variotii	ND	ND	-	-
Penicillium brevicompactum	ND	ND	-	-
Penicillium corylophilum	ND	ND	-	-
Penicillium crustosum	ND	ND	-	-
Penicillium purpurogenum	ND	ND	-	-
Penicillium spinulosum	ND	ND	-	-
Penicillium variable	ND	ND	-	-
Scopulariopsis brevicautis	ND	ND	-	-
Scopulariopsis chartarum	ND	ND	-	-
Stachybotrys chartarum	ND	ND	-	-
Trichoderma viride	ND	ND	-	-
Walleria sebi	ND	ND	-	-
Total for Both Groups	5,368,000	5,400,000		
Sum of Logs				12.8
LOD				1

Total Samples Submitted:	14
Total Samples Analyzed:	14
Sample Date	2/21/2018
Weight/Area	Not Indicated
Media	

Group 2				
Organism	Sp Eq	Sp Eq/mg dust	%	Log Conc
Acremonium strictum	ND	ND	-	-
Alternaria alternata	ND	ND	-	-
Aspergillus ustus	ND	ND	-	-
Cladosporium cladosporioides I	ND	ND	-	-
Cladosporium cladosporioides II	ND	ND	-	-
Cladosporium herbarum	ND	ND	-	-
Epicoccum nigrum	ND	ND	-	-
Mucor racemosus	ND	ND	-	-
Penicillium chrysogenum	ND	ND	-	-
Rhizopus stolonifer	ND	ND	-	-
Total for Both Groups	5,368,000	5,400,000		1.99
Sum of Logs				1
LOD				1

ERMI [®] Score	
GROUP 1	12.8
GROUP 2	1.99
ERMI[®] SCORE †	12.8
LEVEL	Level 4

Ulodadium chartarum - - - -

† ERMI[®] Score = Group 1 - Group 2



Fungal Analysis by PCR

University of Arizona, Risk Management S
Lorraine Santiago
220 W 6th St. Bldg. 300 B 2nd Fl.

Tucson, AZ 85701

Sample Type: Swab
Analysis: PCR Environmental Relative Moldiness Index Panel
Job ID / Site:

Lab Number	40176921
Sample ID	65-022118-12
Location	Room 368 fallen panel swab

Group 1				
Organism	Sp Eq	Sp Eq/mg dust	%	Log Conc
Aspergillus flavus	ND	ND	-	-
Aspergillus fumigatus	41448	41,000	0.5	4.61
Aspergillus niger	943759	940,000	11.5	5.97
Aspergillus ochraceus	2014	2,000	-	3.3
Aspergillus penicilloides	ND	ND	-	-
Aspergillus restrictus	ND	ND	-	-
Aspergillus solerothium	ND	ND	-	-
Aspergillus sydowii	ND	ND	-	-
Aspergillus unguis	ND	ND	-	-
Aspergillus versicolor	ND	ND	-	-
Aureobasidium pullulans	ND	ND	-	-
Chaetomium globosum	ND	ND	-	-
Cladosporium sphaerospermum	311768	310,000	3.8	5.49
Eurotium amstelodami	ND	ND	-	-
Paecilomyces variotii	ND	ND	-	-
Penicillium brevicompactum	ND	ND	-	-
Penicillium corylophilum	ND	ND	-	-
Penicillium crustosum	397	400	-	2.58
Penicillium purpurogenum	ND	ND	-	-
Penicillium spinulosum	ND	ND	-	-
Penicillium variable	ND	ND	-	-
Scopulariopsis brevicautis	ND	ND	-	-
Scopulariopsis chartarum	ND	ND	-	-
Stachybotrys chartarum	ND	ND	-	-
Trichoderma viride	ND	ND	-	-
Walleria sebi	ND	ND	-	-
Total for Both Groups	8,190,000	8,200,000		
Sum of Logs				22.0
LOD				1

Total Samples Submitted:	14
Total Samples Analyzed:	14
Sample Date	2/21/2018
Weight/Area	Not Indicated
Media	

Group 2				
Organism	Sp Eq	Sp Eq/mg dust	%	Log Conc
Acremonium strictum	ND	ND	-	-
Alternaria alternata	106726	110,000	1.3	5.02
Aspergillus ustus	ND	ND	-	-
Cladosporium cladosporioides I	6883343	6,700,000	81.4	6.82
Cladosporium cladosporioides II	6102	6,100	0.1	3.78
Cladosporium herbarum	ND	ND	-	-
Epicoccum nigrum	ND	ND	-	-
Mucor racemosus	ND	ND	-	-
Penicillium chrysogenum	112829	110,000	1.4	5.08
Rhizopus stolonifer	ND	ND	-	-
Total for Both Groups	8,190,000	8,200,000		
Sum of Logs				20.7
LOD				1

ERMI [®] Score	
GROUP 1	22.0
GROUP 2	20.7
ERMI[®] SCORE †	1.3
LEVEL	Level 3

Ulodadium chartarum - - - -

† ERMI[®] Score = Group 1 - Group 2



Fungal Analysis by PCR

University of Arizona, Risk Management S
Lorrane Santiago
220 W 6th St. Bldg. 300 B 2nd Fl.

Tucson, AZ 85701

Sample Type: Swab
Analysis: PCR Environmental Relative Moldiness Index Panel
Job ID / Site:

Client ID: CH1000
Report Number: F126129
FALI Job ID: CH1000-5469
Date Received: 02/23/18
Date Analyzed: 03/14/18
Date Printed: 03/14/18
First Reported: NA

Lab Number	40176916
Sample ID	65-022118-07
Location	Room N-134 Swab

Total Samples Submitted: 14
Total Samples Analyzed: 14

Sample Date	2/21/2018
Weight/Area	Not Indicated
Media	

Organism	Sp Eq	Sp Eq/mg dust	%	Log Conc
Aspergillus flavus	ND	ND	-	-
Aspergillus fumigatus	ND	ND	-	-
Aspergillus niger	ND	ND	-	-
Aspergillus ochraceus	ND	ND	-	-
Aspergillus penicilloides	ND	ND	-	-
Aspergillus restrictus	ND	ND	-	-
Aspergillus sclerotiorum	ND	ND	-	-
Aspergillus sydowii	ND	ND	-	-
Aspergillus unguis	ND	ND	-	-
Aspergillus versicolor	ND	ND	-	-
Aureobasidium pullulans	2883765	2,900,000	100	6.45
Chaetomium globosum	ND	ND	-	-
Cladosporium sphaerospermum	ND	ND	-	-
Eurotium amstelodami	ND	ND	-	-
Paecilomyces variotii	ND	ND	-	-
Penicillium brevicompactum	ND	ND	-	-
Penicillium corylophilum	ND	ND	-	-
Penicillium crustosum	ND	ND	-	-
Penicillium purpurogenum	ND	ND	-	-
Penicillium spinulosum	ND	ND	-	-
Penicillium variabile	ND	ND	-	-
Scopulariopsis breviculis	ND	ND	-	-
Scopulariopsis chartarum	ND	ND	-	-
Stachybotrys chartarum	ND	ND	-	-
Trichoderma viride	ND	ND	-	-
Wallemia sebi	ND	ND	-	-
Total for Both Groups	2,880,000	2,900,000		
Sum of Logs				6.45
LOD				1

Organism	Sp Eq	Sp Eq/mg dust	%	Log Conc
Acremonium strictum	ND	ND	-	-
Alternaria alternata	ND	ND	-	-
Aspergillus ustus	ND	ND	-	-
Cladosporium cladosporioides I	82	82	-	1.79
Cladosporium cladosporioides II	ND	ND	-	-
Cladosporium herbarum	ND	ND	-	-
Epicoccum nigrum	ND	ND	-	-
Mucor racemosus	ND	ND	-	-
Penicillium chrysogenum	ND	ND	-	-
Rhizopus stolonifer	ND	ND	-	-
Total for Both Groups	2,880,000	2,900,000		
Sum of Logs				1.79
LOD				1

ERMI [®] Score	
GROUP 1	6.45
GROUP 2	1.79
ERMI[®] SCORE †	4.7
LEVEL	Level 3

Ulocladium chartarum
† ERMI[®] Score = Group 1 - Group 2



Fungal Analysis by PCR

University of Arizona, Risk Management S
Lorrane Santiago
220 W 6th St. Bldg. 300 B 2nd Fl.

Tucson, AZ 85701

Sample Type: Swab
Analysis: PCR Environmental Relative Moldiness Index Panel
Job ID / Site:

Client ID: CH1000
Report Number: F125129
FALI Job ID: CH1000-5469
Date Received: 02/23/18
Date Analyzed: 03/14/18
Date Printed: 03/14/18
First Reported: NA

Lab Number	40176914
Sample ID	65-022118-05
Location	Outside Swab

Total Samples Submitted: 14
Total Samples Analyzed: 14

Sample Date	2/21/2018
Weight/Area	Not Indicated
Media	

Organism	Sp Eq	Sp Eq/mg dust	%	Log Conc
Aspergillus flavus	ND	ND	-	-
Aspergillus fumigatus	ND	ND	-	-
Aspergillus niger	ND	ND	-	-
Aspergillus ochraceus	ND	ND	-	-
Aspergillus penicilloides	ND	ND	-	-
Aspergillus restrictus	ND	ND	-	-
Aspergillus sclerotiorum	ND	ND	-	-
Aspergillus sydowii	ND	ND	-	-
Aspergillus unguis	ND	ND	-	-
Aspergillus versicolor	ND	ND	-	-
Aureobasidium pullulans	4360	4,400	0.5	3.63
Chaetomium globosum	ND	ND	-	-
Cladosporium sphaerospermum	ND	ND	-	-
Eurotium amstelodami	ND	ND	-	-
Paecilomyces variotii	ND	ND	-	-
Penicillium brevicompactum	ND	ND	-	-
Penicillium corylophilum	ND	ND	-	-
Penicillium crustosum	ND	ND	-	-
Penicillium purpurogenum	ND	ND	-	-
Penicillium spinulosum	ND	ND	-	-
Penicillium variabile	ND	ND	-	-
Scopulariopsis breviculis	ND	ND	-	-
Scopulariopsis chartarum	ND	ND	-	-
Stachybotrys chartarum	ND	ND	-	-
Trichoderma viride	ND	ND	-	-
Wallemia sebi	ND	ND	-	-
Total for Both Groups	925,000	920,000		
Sum of Logs				3.63
LOD				1

Organism	Sp Eq	Sp Eq/mg dust	%	Log Conc
Acremonium strictum	ND	ND	-	-
Alternaria alternata	198504	200,000	21.2	5.26
Aspergillus ustus	ND	ND	-	-
Cladosporium cladosporioides I	723942	720,000	78.3	5.85
Cladosporium cladosporioides II	ND	ND	-	-
Cladosporium herbarum	ND	ND	-	-
Epicoccum nigrum	ND	ND	-	-
Mucor racemosus	ND	ND	-	-
Penicillium chrysogenum	ND	ND	-	-
Rhizopus stolonifer	ND	ND	-	-
Total for Both Groups	925,000	920,000		
Sum of Logs				11.1
LOD				1

ERMI [®] Score	
GROUP 1	3.63
GROUP 2	11.1
ERMI[®] SCORE †	-7.5
LEVEL	Level 1

Ulocladium chartarum
† ERMI[®] Score = Group 1 - Group 2