July 26, 2016

Clemson University
310 Klugh Avenue
Clemson, South Carolina 29634

Attn: Mr. W. Robert Newberry, IV
E-mail: wnewber@clemson.edu

Re: Limited Mold Investigation
Advanced Materials Research Lab
Clemson Research Park
91 Technology Drive
Room 202 – Office of Dr. Marek Urban
Anderson, South Carolina
Terracon Project No. 86127158 – Task 62

Dear Mr. Newberry:

Terracon Consultants, Inc. (Terracon) conducted a limited mold investigation in a second floor office within the Advanced Materials Research Lab (AMRL) at the Clemson Research Park in Anderson, South Carolina. This service was conducted in general accordance with our Master Service Agreement with Clemson University.

PROJECT DESCRIPTION

Scope of Services

At the request of Clemson University, Terracon representative Mr. Benjamin Hestir performed limited indoor air quality (IAQ) testing in the 2nd floor office of Dr. Malek Urban on July 19, 2016. Specifically, our efforts focused on identifying levels of mold spores in the offices and measuring temperature and relative humidity in the aforementioned office.

The Advanced Materials Research Lab is a research facility associated with Clemson University. The two-story building was constructed in 2004 and consists of approximately 111,000 square feet. Terracon conducted airborne mold sampling which consisted of collecting air samples in two 2nd floor offices and two additional samples outside for comparison. Temperature and relative humidity measurements were also collected.

Standard of Care

This sampling was conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the same locale. Terracon did not attempt to identify every potential exposure or hazard present in the subject building. The results, findings, conclusions, and recommendations expressed in this report are based on conditions observed during our sampling. Many factors, such as weather conditions, building occupancy, ventilation patterns, and seasonal variations in fungal/bacterial concentrations or local sources of volatile chemicals, can affect the conditions observed. The information contained in this report should not be relied upon to represent conditions that existed prior to or after this sampling. Terracon does not warrant the services of regulatory agencies, laboratories, or other third parties supplying information that may have been used in the preparation of this report.

Mold Sampling

Total (non-culturable) fungal spore trap samples were collected using Air-O-Cell™ spore trap cassettes specifically designed for the collection of airborne mold spores. Air samples were collected using a calibrated Zefon Bio-Pump™ at a flow rate of 15 liters per minute (LPM) for 5 minutes at each location.

After air sample collection, the samples were hand delivered to Southeast Environmental Microbiology Laboratories, Inc. (SEEML), accredited by the American Industrial Hygiene Association (AIHA®) Laboratory Accreditation Programs, LLC under the Environmental Microbiology Laboratory Accreditation Program (EMLAP), Accreditation #173667. Air samples were analyzed by direct microscopic examination and are reported in spores per cubic meter of air (spores/m^3).

To help interpret the sampling results, we compared indoor air and outdoor air measurements. High variability in airborne fungal spore concentrations can exist in different geographic locations, during different seasons, and weather patterns, and over the course of a given day. As a general rule, indoor air fungal spore concentrations in an HVAC-supplied building are typically less than, but qualitatively similar to, fungal spore concentrations found in the outside environment.

There are no state or federal exposure limits established for fungal aerosols. There are currently no regulatory standards or medically based threshold limit or dose-response relationships for exposure to airborne or surface concentrations of mold spores. Terracon relies upon experience, professional judgment, current scientific literature, guidelines and recommendations made by professional organizations and experts, and statistical methods in interpreting mold sampling results.

Temperature and Relative Humidity

Indoor air temperature and relative humidity are physical conditions important to the perception of comfort. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has published recommendations regarding thermal comfort. ASHRAE Standard 55-2004, Thermal Environmental Conditions for Human Occupancy, identifies six primary factors that affect comfort: metabolic rate (affected by the activity being performed); clothing insulation; air temperature; radiant temperature; air speed; and humidity.

Although the relationships are complex, a temperature range between 73 and 79 degrees Fahrenheit (°F) with relative humidity between roughly 20 and 60 percent (%) are recommended for persons in a conditioned setting wearing light summer clothing. Higher temperatures require lower humidity for comfort.

EPA recommends maintaining indoor humidity below 60%, ideally 30-50%, if possible.

Readings of temperature and relative humidity were collected with an Extech Model 445580 IAQ instrument which was calibrated by the manufacturer.

FINDINGS

Mold Air Sampling

On the afternoon of Tuesday, July 19, 2016, Terracon collected three (3) mold spore trap samples on the 2nd floor of AMRL and two (2) outdoor samples for comparison. Two samples were collected in Room 202, the principal office of Dr. Urban and third sample was collected in Room 224, a secondary office being used by Dr. Urban on a different hallway within the facility. A very faint stain was observed on the carpet under the desk of Dr. Urban in Room 202 which was reportedly due to a water leak that had impacted the carpet several weeks ago. Evidence of current water intrusion was not observed during a cursory visual inspection. Sample locations and total spore count samples analyses are summarized in Table 1 below.

Table 1: Summary of Total Spore Count Analyses – June 19, 2016

Sample #	202-1	202-2	202-3	202-4	202-5
Location Description	**Office of Malek Urban – Rm 202**	**Office of Malek Urban – Rm 202**	**2nd office of Malek Urban – Rm 224**	**Outside back door on picnic table**	**Outside front door in parking lot**
Spore Type	**Spores/m³**	**Spores/m³**	**Spores/m³**	**Spores/m³**	**Spores/m³**
Alternaria	---	---	---	169	143
Ascospores	---	39	---	975	338
Basidiospores	39	---	39	3,590	2,890
Bipolaris/Drechslera	---	---	13	13	39
Cercospora	---	---	---	13	26
Cladosporium	13	78	26	1,520	2,850
Curvalaria	---	13	13	26	---
Epiccocum	---	13	13	---	13
Aspergillus / Penicillium	---	39	---	78	1,250
Smuts/Periconia/ Myoxmycetes	---	---	13	39	130
Oidium	---	---	---	---	13
Torula	---	---	---	---	13
Pithomyces	---	---	---	---	13
Total	**52**	**182**	**117**	**6,420**	**7,720**

The highest total spore count inside was approximately 3% of the lowest outside total spore count. The dominant indoor genera were Basidiospores and *Cladosporium sp.* The dominant genera outdoors were Basidiospores and *Cladosporium sp.* The laboratory analytical report is attached.

Temperature and Relative Humidity

The indoor temperature in Dr. Urban's office was 71.4º F and the relative humidity was 59%. The outdoor temperature was 95.0º F and the relative humidity was 64% on a sunny, hot day.

Indoor temperatures were below ASHRAE guidelines and humidity levels were within recommended comfort ranges.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are provided based on our assessment:

- Indoor fungal spore counts were not elevated as compared to outside air. In addition, the types of spores identified from the indoor sampling were consistent with those identified in the outdoor samples.

- Temperature readings were below the recommended ASHRAE guideline. Lower temperatures may be acceptable as long as it does not impact relative humidity within the space. Relative humidity measurements (58%) were within acceptable ranges (30% - 60%) for indoor workspaces at this time of year; however this is a spot measurement. Terracon recommends monitoring the humidity levels to ensure it does not exceed 60% for any length of time. Ideally relative humidity should be approximately 50% in a conditioned space this time of year. In general, if the water vapor content in the space stays the same and temperature is lowered, humidity increases.
- No apparent water intrusion or visible mold growth was observed in the office.

Terracon appreciates the opportunity to provide this service to Clemson University. If you have any questions regarding this limited mold investigation report, please contact the undersigned at 864-292-2901.

Sincerely,
Terracon Consultants, Inc.

Benjamin Hestir, P.E.
Project Industrial Hygienist

Jeffrey A. Gurrie
Senior Industrial Hygienist

Attachments: Laboratory Results

Laboratory Results

SEEML Reference Number:
160720010

Southeast Environmental Microbiology Laboratories
506 Laurens Rd
Greenville, SC 29607
Phone: (864) 233-3770
FAX: (864) 233-6589

The information and data for **Environmental Testing Group/MIT** has been checked for thoroughness and accuracy. The following reports are contained within this document:

- ☐ Direct Exam Report
- ☒ Spore Trap Report
- ☐ Quantitative Fungal Report
- ☐ Andersen Fungal Report
- ☐ Quantitative Direct Exam Report

Lab Manager Review: Rafael Berrios Date: 07/20/16

Thank you for using SEEML laboratories. We strive to provide superior quality and service.
SEEML laboratories are AIHA (American Industrial Hygiene Association) Environmental Microbiology Accredited laboratory for only fungal analysis Air-Direct Examination (EMLAP # 173667).

The data within this report is reliable to three significant figures. The third significant figure is technically unjustified. In this instance, the third figure is reported as an estimate to facilitate the interpretation by the customer.

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Guidelines for Interpretation:
No accepted quantitative regulatory standards currently exist by which to assess the health risks related to mold and bacterial exposure. Molds and bacteria have been associated with a variety of health effects and sensitivity varies from person to person.
Several organizations, including: the American Conference of Government Industrial Hygienists (ACGIH); the American Industrial Hygiene Association (AIHA); the Indoor Air Quality Association (IAQA); the United States Environmental Protection Agency (USEPA); the Centers for Disease Control (CDC), as well as the California Department of Health Services (CADHS), have all published guidelines for assessment and interpretation of mold resulting from water intrusion in buildings.

Interpretation of the data and information within this document is left to the company, consultant, and/or persons who conducted the fieldwork.

Spore Trap Report

Attention: Ben Hestir	Date Sampled: 07/19/16
Terracon	Date Received: 07/20/16
72 Pointe Circle	Date Analyzed: 07/20/16
Greenville, SC 29615	Date Reported: 07/20/16
	Date Revised:
	Project Name: Clemson AMRL
	Project Address: 86127158-Task 62
	Project City, State, ZIP:
	SEEML Reference # : 160720040

TEST METHOD: DIRECT MICROSCOPY EXAMINATION AT 400X (100% OF TRACE ANALYZED) SEEML SOP 7

Client Sample ID	202-1			202-2			202-3		
Location	Dr. Urban's Desk 1- Room 202			Dr. Urban's Desk 2- Room 202			Room 224		
Lab Sample ID	160720040-130			160720040-131			160720040-132		
Detection Limit (spores/m^3)	13			13			13		
Hyphal Fragments	2	26		2	26		2	26	
Pollen				1	13				
Spore Trap Used	AOC			AOC			AOC		
	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%
Alternaria									
Ascospores				3	39	21			
Basidiospores	3	39	75				3	39	33
Bipolaris/Drechslera							1	13	11
Chaetomium									
Cladosporium	1	13	25	6	78	43	2	26	22
Curvularia				1	13	7	1	13	11
Epicoccum				1	13	7	1	13	11
Cercospora									
Fusarium									
Memnoniella									
Nigrospora									
Penicillium/Aspergillus				3	39	21			
Polythrincium									
Rusts									
Smuts/Periconia/Myxomy							1	13	11
Spegazzinia									
Stachybotrys									
Stemphylium									
Tetraploa									
Torula									
Ulocladium									
Colorless/Other Brown 2									
Oidium									
Zygomycetes									
Pithomyces									
Background debris (1-5)3	3			3			3		
Sample Volume(liters)	75			75			75		
TOTAL SPORES/M^3	4	**52**		14	**182**		9	**117**	

Comments: Condition of the sample(s) upon receipt: Acceptable.

1=Total % may not equal 100 due to rounding.

2 = Colorless,other Brown are spores without a distinctive morphology on spore traps and non-viable surface samples.

3 = Background debris is the amount of particulate matter present on the slide and is graded from 1-5 with 1 = very light, 2= Light, 3 = Medium, 4 = Heavy, 5 = Very Heavy. The higher the rating the more likelihood spores may be underestimated. A rating of 5 should be interpreted as minimal counts and may actually be higher than reported.

The reporting limit is 1 Spore/sample.

Disclaimer: This report relates only to the samples tested

Respectfully submitted, SEEML

Rafael Berrios

Rafael Berrios, Approved Laboratory Signatory

506 Laurens Road
Greenville, SC 29607
Phone: (864) 233- 3770
Fax: (864) 233-6589
AIHA-LAP, LLC EMLAP # 173667

Spore Trap Report

Attention: Ben Hestir	Date Sampled: 07/19/16
Terracon	Date Received: 07/20/16
72 Pointe Circle	Date Analyzed: 07/20/16
Greenville, SC 29615	Date Reported: 07/20/16
	Date Revised:
	Project Name: Clemson AMRL
	Project Address: 86127158-Task 62
	Project City, State, ZIP:
	SEEML Reference # : 160720040

TEST METHOD: DIRECT MICROSCOPY EXAMINATION AT 400X (100% OF TRACE ANALYZED) SEEML SOP 7

Client Sample ID	202-4			202-5					
Location	Outside- Picnic Table			Outside- Front Parking					
Lab Sample ID	160720040-133			160720040-134					
Detection Limit (spores/m^3)	13			13					
Hyphal Fragments	2	26		5	65				
Pollen									
Spore Trap Used	AOC			AOC					
	raw ct.	spores/m^3	%	raw ct.	spores/m^3	%			
Alternaria	13	169	3	11	143	2			
Ascospores	75	975	15	26	338	4			
Basidiospores	276	3590	56	222	2890	37			
Bipolaris/Drechslera	1	13	<1	3	39	<1			
Chaetomium									
Cladosporium	117	1520	24	219	2850	37			
Curvularia	2	26	<1						
Epicoccum				1	13	<1			
Cercospora	1	13	<1	2	26	<1			
Fusarium									
Memnoniella									
Nigrospora									
Penicillium/Aspergillus	6	78	1	96	1250	16			
Polythrincium									
Rusts									
Smuts/Periconia/Myxomy	3	39	<1	10	130	2			
Spegazzinia									
Stachybotrys									
Stemphylium									
Tetraploa									
Torula				1	13	<1			
Ulocladium									
Colorless/Other Brown 2									
Oidium				1	13	<1			
Zygomycetes									
Pithomyces				1	13	<1			
Background debris (1-5)3	3			3					
Sample Volume(liters)	75			75					
TOTAL SPORES/M^3	494	**6420**		593	**7720**				

Comments: Condition of the sample(s) upon receipt: Acceptable.

1=Total % may not equal 100 due to rounding.

2 = Colorless,other Brown are spores without a distinctive morphology on spore traps and non-viable surface samples.

3 = Background debris is the amount of particulate matter present on the slide and is graded from 1-5 with 1 = very light, 2= Light, 3 = Medium, 4 = Heavy, 5 = Very Heavy. The higher the rating the more likelihood spores may be underestimated. A rating of 5 should be interpreted as minimal counts and may actually be higher than reported.

The reporting limit is 1 Spore/sample.

Disclaimer: This report relates only to the samples tested

Respectfully submitted, SEEML

Rafael Berrios

Rafael Berrios, Approved Laboratory Signatory

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Greenville, SC 29607
Phone: (864) 233- 3770
Fax: (864) 233-6589
AIHA-LAP, LLC EMLAP # 173667

Southeast Environmental Microbiology Laboratories
Chain of Custody

506 Laurens Rd, Greenville, SC 29607
Phone : 864-233-3770, Fax: 864-233-3779, www.seeml.com, AIHA-LAP, LLC. (EMLAP) #173667

For Lab Use Only			
Condition of samples is acceptable	☑ YES ☐ NO	SEEML Ref #: 160720040	Lab ID: 130 - 134

Company Information		Client Information		Environmental Conditions	
(Project Manager)	Ben Hestir	Date Sampled:	7/19/16	Precipitation in last 16hrs:	yes
(Company Name)	Terracon	Project Name:	Clemson AMRL	Relative Humidity I/O:	/
(Address)	72 Pointe Circle	Project Address:	86127158 - Task 62	Temperature I/O:	71.4° / 95.6°
(City, State, Zip)	Greenville, SC 29615	City, State, Zip:		Wind Conditions	
(Phone)	864-293-7348				
(Email)	ben.kestir@terracon.com				

Sample Type Abbreviations:
A- Allergenco **S**-Swab **AP**-Andersen Plate
AOC- Air O Cell **T**-Tape **W**- Water
M5- Micro 5 **B**- Bulk **D**- Dust

Analysis Type:
1. SporeTrap, Air Sample Analysis-Same Day
2. Direct Exam Surface Sample Analysis -Same Day
3. Culturable Air / Surface Samples -7-10 days

Sample ID	Sample Location	Sample Type	Analysis Type	*Area	**Volume (L)	Notes
202-1	Dr. Urban's desk 1 - Room 202	AOC	1		75	
202-2	Dr. Urban's desk 2 - Room 202	"	"		"	
202-3	Room 224	"	"		"	
202-4	Outside - picnic table	"	"		"	
202-5	Outside - front parking	"	"		"	

Reliquished By:	Date/Time	Recieved By:	Date/Time
Ben Hestir	7/20/16 10:00am	Cameron Lee	7-20-16

* Area is only required for culturable surface samples.
** Volume = Pump setting (L/min) x minutes