

## *Sample Report*

July 9, 2001

XXX XXXX  
Your Company  
123 Main Street  
Anytown, NY 14123

Dear XXX:

Enclosed please find the microbiological results for the Indoor Air Quality (IAQ) analyses performed on the samples received in our laboratory on June 11, 2001.

Thank you for using Analytical Services, Inc. for your testing needs. If you have any questions or if we may be of service in the future, please do not hesitate to contact us at 1-800-723-4432.

Sincerely,

ANALYTICAL SERVICES, INC.

XXXX XXXXXX  
Staff Microbiologist

XX/III

Project No.: 2001-0611-001

# Sample Report

**Client:** Your Company  
**Address:** 123 Main Street  
 Anytown, NY 14123  
**Project:** 45221

**Date Collected:** June 10, 2001  
**Date Received:** June 11, 2001  
**Analyst:** xx

## Zefon Air-O-Cell® Results

Sample ID	Lab ID	Volume Assayed (Liters)	Total Particles per m <sup>3</sup>	Spore Count (Basic and Extended Analysis)			Miscellaneous Debris (Extended Analysis Only)		
				# per m <sup>3</sup>	Description	%	# per m <sup>3</sup>	Description	%
Home Ec. Rm. 108	2001-0611-001	150	2.3 x 10 <sup>4</sup>	1.3 x 10 <sup>4</sup>	Hyaline	69	4.6 x 10 <sup>3</sup>	Carbon-like	ND
					Dematiaceous	5		Fibers	15
					<i>Alternaria</i> sp.	ND		Glass-like Fibers	ND
					Ascospores	ND		Hyphae	60
					Basidiomycetes	ND		Pollen	25
					<i>Cladosporium</i> sp.	26		Insect Parts	ND
					<i>Stachybotrys</i> sp.	ND		Skin	ND
Small Group Rm. 105	2001-0611-002	150	1.5 x 10 <sup>2</sup>	27	Hyaline	ND	30	Carbon-like	ND
					Dematiaceous	30		Fibers	25
					<i>Alternaria</i> sp.	ND		Glass-like Fibers	ND
					Ascospores	ND		Hyphae	45
					Basidiomycetes	ND		Pollen	30
					<i>Cladosporium</i> sp.	70		Insect Parts	ND
					<i>Stachybotrys</i> sp.	ND		Skin	ND
Outside Air	2001-0611-013	150	4.2 x 10 <sup>3</sup>	1.0 x 10 <sup>3</sup>	Hyaline	20	2.9 x 10 <sup>2</sup>	Carbon-like	ND
					Dematiaceous	11		Fibers	5
					<i>Alternaria</i> sp.	12		Glass-like Fibers	ND
					Ascospores	ND		Hyphae	25
					Basidiomycetes	ND		Pollen	60
					<i>Cladosporium</i> sp.	52		Insect Parts	10
					<i>Stachybotrys</i> sp.	ND		Skin	ND
					<i>Epicoccum</i> sp.	5			

ND = None Detected

- Basic Analysis: Total particle counts plus identification and enumeration of the most frequently observed spore types (categorization of other spores).
- Basidiomycetes: This is the largest class of fungi, and includes mushrooms. The vast majority of Basidiomycetes do not sporulate in culture. When found with "clamps" in culture, the isolate is undergoing reproduction. Basidiomycetes cause wood rot, and may be allergenic.
- Dematiaceous: Having structures that are brown to black due to a melanotic pigment in the cell walls.
- Extended Analysis: Total particle counts, plus identification and enumeration of most spore types, plus identification and enumeration of debris types.

Hyaline:  
Hyphae:

Clear, transparent, colorless.  
Filamentous structures of fungi that may lead to the establishment of viable colonies.

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**Analysts:** xx

## Microbiological Aerosol Results

Sample ID	Lab ID	Bacteria			Fungi		
		CFU/m <sup>3</sup>	Colony Type Count	Identification	CFU/m <sup>3</sup>	Identification	%
108-2F, 108-2B Home Ec. Rm. 108	2001-0611-003 2001-0611-004	2.6 x 10 <sup>3</sup>	16	<ul style="list-style-type: none"> <li>• <i>Bacillus megaterium</i></li> <li>• <i>Bacillus pumilus</i><sup>G</sup></li> <li>• <i>Bacillus mycooides</i> or <i>Brevibacterium acetylicum</i><sup>E,G</sup></li> <li>• <i>Clavibacter michiganense</i></li> <li>• <i>Pseudomonas</i> sp.</li> <li>• <i>Paenibacillus gordonae</i> or <i>Bacillus megaterium</i><sup>E</sup></li> <li>• <i>Micrococcus luteus</i></li> <li>• <i>Micrococcus lylae</i> or <i>M. luteus</i><sup>B</sup></li> <li>• <i>Streptomyces</i> sp. (3 types)</li> <li>• <i>Nocardia asteroides</i></li> <li>• <i>Arthrobacter oxydans</i></li> <li>• <i>Staphylococcus aureus</i><sup>D</sup></li> <li>• Unknown<sup>F</sup></li> <li>• <i>Micrococcus nishinomiyaensis</i></li> </ul>	1.6 x 10 <sup>3</sup>	<ul style="list-style-type: none"> <li>• Unknown<sup>A</sup> (white, fluffy)</li> <li>• <i>Aspergillus fumigatus</i></li> <li>• <i>Cladosporium</i> sp.</li> <li>• <i>Penicillium</i> sp.</li> </ul>	40 35 15 10
1F,1B Blank	2001-0611-005 2001-0611-006	ND	NA	NA	ND	NA	--

CFU = Colony Forming Units      NA = Not Applicable      ND = None Detected

Samples were collected using an Andersen microbiological aerosol impact sampler. Calculated concentrations (CFU/m<sup>3</sup>) are based on 2-minute samples at 28.3 LPM.

- Fungi were collected using Malt Extract Agar with Chloramphenicol (MEA/CH), incubated up to 14 days at 25°C, and identified microscopically. Fungi are ranked by type as a percentage of the total colony count.
- Bacteria were collected using R2A agar with Cycloheximide (R2A/CY), incubated for seven days at 28°C, and identified using the gas chromatography-based MIDI Microbial Identification System (MIS).
- Blank control plates were incubated with the samples.

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# Sample Report

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## Microbiological Aerosol Results – continued

Sample ID	Lab ID	Bacteria			Fungi		
		CFU/m <sup>3</sup>	Colony Type Count	Identification	CFU/m <sup>3</sup>	Identification	%
105-2F, 105-2B Sm. Group Rm. 105	2001-0611-007 2001-0611-008	2.3 x 10 <sup>2</sup>	9	<ul style="list-style-type: none"> <li>• <i>Micrococcus luteus</i></li> <li>• <i>Arthrobacter protophormiae/ramosus</i> or <i>A. ilicis</i><sup>B</sup></li> <li>• <i>Micrococcus lylae</i><sup>D</sup> or <i>M. luteus</i><sup>E</sup></li> <li>• <i>Bacillus licheniformis</i></li> <li>• Unknown<sup>C</sup> (3 types)</li> <li>• <i>Streptomyces sp.</i></li> <li>• <i>Staphylococcus aureus</i><sup>D</sup></li> </ul>	53	<ul style="list-style-type: none"> <li>• <i>Cladosporium sp.</i></li> <li>• Unknown<sup>A</sup> (dematiaceous)</li> </ul>	70 30
Outside Air	2001-0611-011 2001-0611-012	1.1 x 10 <sup>2</sup>	4	<ul style="list-style-type: none"> <li>• <i>Bacillus megaterium</i></li> <li>• <i>Arthrobacter oxydans</i></li> <li>• Unknown<sup>F</sup> (2 types)</li> </ul>	2.0 x 10 <sup>2</sup>	<ul style="list-style-type: none"> <li>• Unknown<sup>A</sup> (white, fluffy)</li> <li>• <i>Cladosporium sp.</i></li> <li>• <i>Aspergillus niger</i></li> </ul>	40 40 20

CFU = Colony Forming Units

Samples were collected using an Andersen microbiological aerosol impact sampler. Calculated concentrations (CFU/m<sup>3</sup>) are based on 2-minute samples at 28.3 LPM.

- Fungi were collected using Malt Extract Agar with Chloramphenicol (MEA/CH), incubated up to 14 days at 25°C, and identified microscopically. Fungi are ranked by type as a percentage of the total colony count.
- Bacteria were collected using R2A agar with Cycloheximide (R2A/CY), incubated for seven days at 28°C, and identified using the gas chromatography-based MIDI Microbial Identification System (MIS).
- Blank control plates were incubated with the samples.

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### Microbiological Bulk Results

Sample ID	Lab ID	Bacteria		Fungi	
		CFU/gm wet weight	Identification	CFU/gm wet weight	Identification
HVAC Filter	2001-0611-014	$8.4 \times 10^2$	<ul style="list-style-type: none"> <li>• <i>Bacillus megaterium</i></li> <li>• <i>Bacillus mycoides</i></li> <li>• <i>Micrococcus luteus</i></li> <li>• <i>Staphylococcus aureus</i><sub>D</sub></li> <li>• Unknown (2 types)</li> <li>• <i>Micrococcus nishinomiyaensis</i></li> </ul>	$6.8 \times 10^3$	<ul style="list-style-type: none"> <li>• <i>Trichoderma sp.</i></li> <li>• <i>Cladosporium sp.</i></li> <li>• <i>Penicillium sp.</i> (2 types)</li> <li>• <i>Aspergillus niger</i></li> <li>• Yeast</li> <li>• Unknown<sup>A</sup></li> <li>• <i>Aspergillus fumigatus</i></li> </ul>

CFU = Colony Forming Units

Fungi were grown on Malt Extract Agar with Chloramphenicol (MEA/CH), incubated at 25°C for up to 14 days, and identified microscopically. Bacteria were grown on R2A agar with Cycloheximide (R2A/CY) and incubated for seven days at 28°C. Identification performed using the gas chromatography-based MIDI System.)

Organisms recovered from bulk samples are listed from the most numerous genus to the least numerous genus. Percentages are not expressed, as bulk sampling does not always provide uniform numbers by dilution.

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### Microbiological Swab Results

Sample ID	Lab ID	Bacteria		Fungi	
		Colony Type Count	Identification	Colony Type Count	Identification
108-S Plenum West	2001-0611-009	4	<ul style="list-style-type: none"> <li>• <i>Bacillus licheniformis</i></li> <li>• <i>Micrococcus luteus</i></li> <li>• <i>Staphylococcus aureus</i><sup>D</sup></li> <li>• Unknown<sup>F</sup></li> </ul>	5	<ul style="list-style-type: none"> <li>• <i>Alternaria sp.</i></li> <li>• <i>Aspergillus fumigatus</i></li> <li>• <i>Cladosporium sp.</i></li> <li>• <i>Penicillium sp.</i></li> <li>• Unknown<sup>A</sup> (white, fluffy)</li> </ul>
105-S Plenum South	2001-0611-010	4	<ul style="list-style-type: none"> <li>• <i>Anthrobacter protophormiae/ramosus</i> or <i>A. ramosus</i></li> <li>• <i>Micrococcus luteus</i></li> <li>• <i>Micrococcus lylae</i><sup>D</sup> or <i>M. luteus</i><sup>E</sup></li> <li>• <i>Staphylococcus aureus</i><sup>D</sup></li> </ul>	2	<ul style="list-style-type: none"> <li>• <i>Cladosporium sp.</i></li> <li>• Unknown<sup>A</sup> (dematiaceous - appears to be immature <i>Epicoccum sp.</i>)</li> </ul>

Fungi were grown on Malt Extract Agar with Chloramphenicol (MEA/CH), incubated at 25°C for up to 14 days, and identified microscopically. Bacteria were grown on R2A agar with Cycloheximide (R2A/CY) and incubated for seven days at 28°C. Identification performed using the gas chromatography-based MIDI System.)

Note: Organisms recovered from swabs are listed alphabetically, as no enumeration is performed. Enumeration of fungi is not recommended for swab samples unless a defined surface area was delineated and swabbed, and the measurements of the area provided to the laboratory.

# *Sample Report*

## **End Notes**

<sup>A</sup> Unable to identify due to the lack of reproductive structures.

<sup>B</sup> Similarity Index less than 0.100 between genus or species.

<sup>C</sup> Unknown bacteria could not successfully be identified using Cellular Fatty Acid Analysis.

<sup>D</sup> Low Similarity Index

<sup>E</sup> Low Similarity Index and less than 0.100 between genus or species.

<sup>F</sup> Unable to subculture for identification by MIDI System.

<sup>G</sup> Duplicate identification.

## Sample Report

### Data Interpretation

#### **Fungi**

The number of fungi recovered from the Andersen sample in Home Ec. Rm. 108 ( $1.6 \times 10^3$  CFU/m<sup>3</sup>) exceeds the recommended indoor air quality standards for fungi of  $5.5 \times 10^2$  CFU/m<sup>3</sup> (8, 9 Reference page). *Aspergillus fumigatus*, along with other fungi, was recovered from the Home Ec. Rm. 108 sample site and the HVAC filter sample. According to the American Industrial Hygiene Association,

“the confirmed presence of *Stachybotrys chartarum*, *Aspergillus flavus*, *A. versicolor*, or *A. fumigatus*, requires urgent risk management decisions to be made. ‘Confirmed presence’ means colonies in several samples, many colonies in any sample or, where a single colony was found in a single sample, evidence of the growth of these fungi on building materials by visual inspection or bulk sampling. Appropriate risk management procedures are described in *Guidelines on Assessment and Remediation of Stachybotrys atra in Indoor Environments* and *Fungal Contamination in Public Buildings: A Guide to Recognition and Management*.”

The total number of particles recovered in the Home Ec. Rm. 108 sample ( $2.3 \times 10^4$ ) was higher than the number recovered from the Outside Air ( $1.0 \times 10^3$ /m<sup>3</sup>) or the Small Group Rm. 105 ( $1.5 \times 10^2$ /m<sup>3</sup>) sample. Fungal spores were the predominant type of particulates observed in the sample ( $1.3 \times 10^4$  /m<sup>3</sup>), and a higher percentage of hyaline spores were recovered (69%) than from the Outside Air sample (20%). This may indicate that a reservoir of fungal growth exists in this room.

#### **Bacteria**

Home Ec. Rm. 108 contains a mixture of gram-negative, gram-positive and Coryneform bacteria. *Streptomyces* sp. and *Nocardia asteroides* along with *Bacillus* sp. dominated the Andersen sample collected in this room. These are associated mainly with soil, and although most are not serious pathogens, the number in this room ( $2.6 \times 10^3$  CFU/m<sup>3</sup>) may be an indication of poor air quality.

#### **Recommendations**

Several types of bacteria and fungi were recovered from samples collected in Home Ec. Rm. 108 and the HVAC filter. The high numbers recovered from the Home Ec. Rm. 108 sample site indicate that this room may contain reservoirs for growth of microbiological organisms. In addition, the HVAC system has the potential to amplify and spread the contamination, as high numbers of bacteria and fungi were also recovered from the HVAC filter.

*Aspergillus fumigatus* is recognized as a human pathogen. We therefore recommend the following:

1. Replace HVAC filters, check for build-up of dust and dirt. Note condition of filters and enter this information into a permanent maintenance log.
2. Clean diffuser blades in affected rooms with a 10% chlorine bleach solution.
3. Check for potted plants, carpets, ceiling tiles with apparent water-damage, etc., that may be acting as reservoirs of bacterial and/or fungal growth.

## Sample Report

### Organism Pathogenicity

#### **FUNGI**

##### ***Alternaria* sp.**

**PATHOGENICITY:** Commonly considered a saprophytic contaminant, but occasionally causes phaeohyphomycosis.

##### ***Aspergillus* sp.**

**PATHOGENICITY:** Members of this genus cause a group of diseases known as aspergillosis. The disease may be in the form of invasive infection, colonization, toxicoses, or allergy. Species of *Aspergillus* are opportunistic invaders, infecting various sites in individuals with lowered resistance due to underlying immunocompromising, debilitating disease and/or prolonged treatment with immunosuppressive drugs or antimicrobial agents. *Aspergillus* spp. are widespread in the environment and are commonly found as contaminants in cultures. *Aspergillus fumigatus* and *A. versicolor* produce mycotoxins. *Aspergillus flavus* produces aflatoxin. *Aspergillus niger* is recognized as an allergic sensitizer.

##### **Basidiomycetes**

**PATHOGENICITY:** This is the largest class of fungi, and includes mushrooms. The vast majority of Basidiomycetes do not sporulate in culture. When found with "clamps" in culture, the isolate is undergoing reproduction. Basidiomycetes cause wood rot, and may be allergenic.

##### ***Cladosporium* sp.**

**PATHOGENICITY:** Commonly considered a saprophytic contaminant except for *Cladosporium carrionii*, which may cause chromoblastomycosis, and *Cladosporium herbarum*, which is toxicogenic. In high concentrations ( $3.0 \times 10^3$  CFU/m<sup>3</sup>), *Cladosporium* sp. are reported to cause allergic reactions.

##### ***Epicoccum* sp.**

**PATHOGENICITY:** Commonly considered a contaminant. May be allergenic.

##### ***Penicillium* sp.**

**PATHOGENICITY:** Commonly considered a contaminant, but found in a variety of diseases in which its etiologic significance is uncertain. It has been known to cause keratitis (inflammation of the cornea), external ear, respiratory, and urinary tract infections, and endocarditis after insertion of valve prostheses. Disseminated disease has been reported in a patient with acute leukemia. Some strains produce toxins.

##### ***Trichoderma* sp.**

**PATHOGENICITY:** Commonly considered a contaminant; very occasionally associated with infection in the immunocompromised patient. Reported to also be involved in hypersensitivity pneumonitis.

## Sample Report

### Organism Pathogenicity – continued

#### **BACTERIA**

##### ◆ **Gram-Positive Organisms**

- Human-Associated
  - *Brevibacterium* sp.
  - *Micrococcus* sp.
  - *Staphylococcus* sp.
- Soil-Associated
  - *Arthrobacter* sp.
  - *Bacillus* sp.
  - *Clavibacter* sp.
  - *Paenibacillus* sp.

Several Gram-positive organisms are associated with abscesses, especially in immunocompromised people. As an indoor air contaminant, if found in high numbers ( $>10^3$  CFU/m<sup>3</sup>) these bacteria could be an indication of inadequately filtered air or overcrowding in a room.

##### ◆ **Gram-Negative Organisms**

- Water-Associated
  - *Pseudomonas* sp.
- Human-Associated
  - None Detected

Gram-negative bacteria all produce endotoxins on their cell walls. It is thought that high numbers of this type of bacteria in indoor air may contribute to respiratory distress. There is no consensus as to what concentration of these bacteria (number of organisms per cubic meter) may represent clinical significance.

##### ◆ **Coryneform Bacteria**

- Non-pathogenic
  - *Streptomyces* sp.
- Pathogenic
  - *Nocardia asteroides* (respiratory pathogen)

## Sample Report

### Glossary

<b>Actinomycetes:</b>	Filamentous bacteria; allergenic even in low concentrations.
<b>Ascospores:</b>	Sexual spores of fungi in the Division <i>Ascomycota</i> , commonly referred to as ascomycetes. Includes simple yeasts, <i>Aspergillus</i> , <i>Penicillium</i> , and others.
<b>Chromoblastomycosis:</b>	The infection is chronic and causes the development of warty nodules, tumor-like masses, or raised, rough, cauliflower-like lesions containing the sclerotic bodies. The lesions usually develop in the subcutaneous tissue of the lower extremities but are sometimes on other exposed areas such as the hands, head region, or trunk. On rare occasions, the etiologic agents have been known to spread to the central nervous system, lungs, or muscular tissue.
<b>Dematiaceous:</b>	Having structures that are brown to black; this is due to a melanotic pigment in the cell walls.
<b>Dust Mites:</b>	Microscopic parasites that survive mainly on dead skin particles. Dust mites are well-documented agents that contribute to perennial rhinitis, allergic asthma, atopic dermatitis and keratoconjunctivitis.
<b>Hyaline:</b>	Clear, transparent, colorless.
<b>Hyalohyphomycosis:</b>	Subcutaneous or systemic infection caused by a variety of hyaline fungi that develop in tissue as colorless hyphae.
<b>Hyphae:</b>	Filamentous structures of fungi that may lead to the establishment of viable colonies.
<b>Mycetoma:</b>	A localized, chronic cutaneous or subcutaneous infection that is classically characterized by draining sinuses, granules, and swelling.
<b>Mycosis (pl. mycoses):</b>	A disease caused by a fungus.
<b>Phaeohyphomycosis:</b>	A subcutaneous or systemic disease that is caused by a variety of black fungi that develops in tissue as dark hyphae and/or yeast-like cells.
<b>Zygomycetes:</b>	Saprophytic fungi, which include common bread molds ( <i>Mucor</i> sp.). Several genera, including <i>Rhizopus</i> sp., are potentially pathogenic.
<b>Zygomycosis:</b>	A disease caused by Zygomycetes that can be severe, predominantly in patients who are predisposed by diabetes, leukopenia, immunosuppression, AIDS, severe burns, intravenous drug abuse, malnutrition, etc. Infections have been reported in a wide range of anatomic sites, but are most commonly rhinocerebral (in the nose and head), pulmonary (in the lungs), cutaneous and disseminated. The organisms causing this disease are known for their disastrous ability to invade and block blood vessels.

## Sample Report

### References

Burge, H. Bioaerosols. CRC Press, Inc. Boca Raton. 1995.

Ellis, M.B. Dematiaceous Hyphomycetes and More Dematiaceous Hyphomycetes. CAB International. Kew, England. 1971.

Environmental Health Directorate: Fungal Contamination in Public Buildings: A Guide to Recognition and Management. Health Canada, Tunney Pasture, Ottawa, Ontario, Canada. 1995.

Etkin, D.A. Biocontaminants in Indoor Environments. Cutter Information Corporation. Arlington, MA. 1994.

Field Guide for the Determination of Biological Contaminants in Environmental Samples. AIHA Public, Fairfax, VA. 1996.

Holt, J., N. Krieg, P. Sneath, J. Staley and S. Williams. Bergey's Manual of Determinative Bacteriology, Ninth Edition. 1994.

Johanning, E. and C.S. Yang. Fungi and Bacteria in Indoor Air Environments. Eastern New York Occupational Health Program. Latham, NY. 1995.

Larone, D.H. Medically Important Fungi. A Guide to Identification. Third Edition. ASM Press. Washington, D.C. 1995.

Macher, J. Bioaerosols: Assessment and Control. ACGIH. Cincinnati, Ohio. 1999.

City of New York Department of Health: Guidelines on Assessment and Remediation of *Stachybotrys atra* in Indoor Air Environments. New York, NY. 1993.

Sutton D.A., Fothergill A.W., Rinaldi M.G. Guide to Clinically Significant Fungi. Williams and Wilkins. Baltimore, MD. 1998.