University of North Dakota

Introduction

The University of North Dakota (UND), located in Grand Forks, was founded in 1883 with a charter calling for the establishment of a liberal arts and letters college and a normal school for the training of teachers. Also charged with providing education in the professional fields, UND added the School of Law in 1889, the School of Engineering and Mines in 1901, and the School of Medicine in 1905. Today, UND, the largest institution of higher education in the region of the Dakotas, Montana, and western Minnesota, has an enrollment of more than 11,000 students. More than 158 degree programs are offered, including 48 masters and 20 doctoral and professional degree programs.

Maintaining strong research programs is a primary concern for the more than 600 full-time faculty and research staff at UND. The University received $54.7 million in external support for sponsored activities in fiscal year 2002 from both private and public sources. Research interests include a variety of academic disciplines, as demonstrated by the number of research groups across the campus (such as the Bureau of Business and Economic Research, Center for Innovation and Business Development, Center for Rural Health, Earth Systems Science Institute, and the Engineering Experiment Station). Because of the long-standing tradition in research at UND, creative partnerships have been developed among the University, federal agencies, and private businesses to bring practical application to research results. Research is also conducted in cooperation with the North Dakota Geological Survey and the U.S. Department of Agriculture's Human Nutrition Research Center.

Research Areas and Programs

The University of North Dakota began its housing research program in 1997 after a catastrophic flood in Grand Forks, North Dakota, that caused structural, chemical, and biological damage to homes. Thus, the main focus of our program is on water-based (and flood damage) mitigation.

The housing research program is a collaborative effort between the College of Arts and Sciences (Department of Chemistry) and the School of Engineering and Mines (Department of Chemical Engineering) and addresses both fundamental and applied aspects of water damage to homes. Given the current expertise of the UND personnel, we are initially focusing on two broad areas—chemical contamination as a result of spills and biological contamination (mold growth) as a result of water intrusion—including the following specific areas:

- Development of field analytical methods to monitor chemical contamination of the houses and building materials
- Fundamental aspects of the remediation of toxic chemical contaminants (organics and metals)
- Applied aspects of the remediation of chemicals (engineering application)
- On-site mold monitoring
- Airborne mold and air pollution mitigation

Future plans include an expansion of this work to the financial, toxicological, and legal aspects of water-based (and flood damage) mitigation.

One specific interdisciplinary project is the development of a probe for lag phase fungal growth to facilitate on-site mold monitoring. This novel instrumental method will be based on a recently developed portable detection device that uses the quenching of porphyrin phosphorescence by oxygen present in air (University College of Cork, Ireland). We will develop a probe that will show the location of mold growing inside walls and other sealed spaces. Such a device will be invaluable not only for establishing the location of mold but also for aiding in remedial efforts.

Department of Chemistry

A detailed study is being conducted on the development of analytical methods for detecting chemical contaminants in air and building materials (such as wood and concrete). The major pollutants under investigation include fuel oil, crop protection chemicals, and explosives. This work will be applied to disaster mitigation and deconstruction objectives.

Studies are being conducted on using bioremediation as a means of removing hydrocarbon contaminants from common building materials such as wood and concrete. Naturally occurring soil bacteria, applied to the surface of hydrocarbon-contaminated materials, remove up to 90% to 95% of the biodegradable volatile hydrocarbons (such as naphthalene) in 1 to 4 days. We will expand this research to other pollutants that may contaminate common building materials (such as pesticides, explosives, heavy metals, and radioactive waste). We will also examine inexpensive chemical alternatives to bioremediation.

Department of Chemical Engineering

We are conducting large-scale bioremediation research that includes both modeling and experimentation with "real-world-size" pieces of concrete and wood. Specifically, we are examining commercial scale transport and reaction properties, issues related to application methods, safety issues, and impacts due to the variability in the properties of concrete and wood being treated. We anticipate that this work will lead towards the commercialization of new technology.

The current paradigm in mold contamination and growth is that it can be prevented when no moisture is available for the fungi. However, what if high moisture conditions, such as those found in flooding conditions, are inevitable? We are addressing these types of situations in mold remediation by cleaning the fungal spores using semi-conductors as photocatalysts. Simply, the right photocatalyst will solve the problem of biological indoor air pollution by using just one effective and inexpensive device.

Research Facilities and Capabilities

Department of Chemistry

The Department of Chemistry is the sole occupant of Abbott Hall, which contains over 27,000 ft^2 of research laboratory space. Major equipment purchases or upgrades in the past five years include a Hewlett-Packard 5890 gas chromatograph with model 5971 mass selective detector; Varian VXR-300 multinuclear FT-NMR spectrometer; four FT-IR spectrometers; Shimadzu UV-260 UV/Vis spectrophotometer; computer-controlled Omnitherm thermal analysis system (TGA and DSC); Spectra-Physics ternary gradient HPLC system; and DEC MicroVAX II minicomputer with Ethernet network to most of the instruments. An electronics shop and machine shop are available on campus.

Research equipment available in the laboratories of professors Tilotta and Kozliak includes a NuAir laminar biological hood, scintillation counting equipment, an autoclave, a Brunswick Scientific R76 reciprocal water bath shaker, Boekel 133000 thermostated oven for growing bacteria, a Plasma-Therm inductively coupled plasma emission spectrometer, a Mattson Fourier transform infrared spectrometer, an ISCO SFX 2-10 SFE extraction system, and a Hewlett Packard 5890 gas chromatograph with FID detector and OI Analytical 4460 purge and trap preconcentrator.

Department of Chemical Engineering

Research in the Department of Chemical Engineering is conducted in a recently remodeled facility with 2,800 ft^2 of laboratory space specifically designed for conducting multidisciplinary projects. The laboratories of professors Seames and Muggli are equipped with shaker tables and chromatographic, photochemical, and biological cultivation equipment. The Department has a machine shop capable of adjusting facilities for large-scale research on remediation of building materials.

Additional instrumentation for fine chemical analyses is available in the UND Water Resource Research Laboratory (WRRL), which is specifically designed for collaborative multidisciplinary projects. It is equipped with facilities for performing atomic absorption spectroscopy (AAS), graphite furnace atomic absorption spectroscopy (GFAA), and ion chromatography (IC).

Outreach activities will involve community education presentations and national and international meetings. Technology transfer/dissemination of information will be through peer-reviewed publications and patents.

Staff and Contact Information

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- Prof. Darrin Muggli (darrin_muggli@und.nodak.edu), Department of Chemical Engineering, Airborne mold and air pollution mitigation.

Links

- Department of Chemistry -- http://www.und.edu/dept/chem/mainpage.html
- Department of Chemical Engineering -- http://www.und.edu/dept/sem/html/chemical_engineering.html

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