

Dr. Stefan Cenkowski

Bioprocessing Engineering Lab

E1-369 EITC

Phone: 204-474-6293

E-mail: Stefan.Cenkowski@umanitoba.ca

Superheated Steam (SS) Processing and drying of food has several advantages over conventional hot-air drying, including lower energy input and reduction in food oxidation and contamination and is therefore growing in popularity. Mathematical modeling and computer simulation of dehydration processes are used to predict and compare the performances of different drying systems.

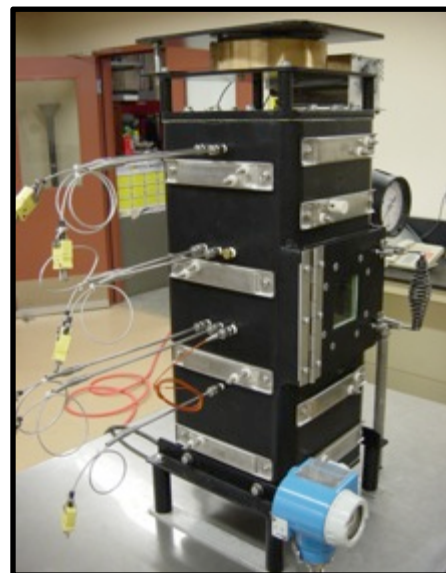
Superheated Steam can be used to strip odour from distillers' spent grain (DSG), a by-product of ethanol production, and can therefore add value to DSG.

SS processing has been evaluated as an alternative to conventional heat treating on *Geobacillus stearothermophilus* spores. Oat grain must be treated prior to human consumption to inactivate fat-splitting enzymes, prevent development of rancidity, obtain desirable flavour, and reduce microbial load.

Work is also done on developing a selective breakdown approach for the recovery of high-value oligosaccharides from waste material left over during the extraction of the valuable portion of flax straw.

Lab Equipment Available

- superheated steam processing drier
- texture analyser
- supercritical fluid extraction system
- instron machine
- satake milling unit
- colorimeter
- scanning differential calorimeter
- aspirator



Dr. Ying Chen
Soil Dynamics and Machinery Lab
E1-351A EITC
Phone: 204-474-6292
E-mail: Ying.Chen@umanitoba.ca

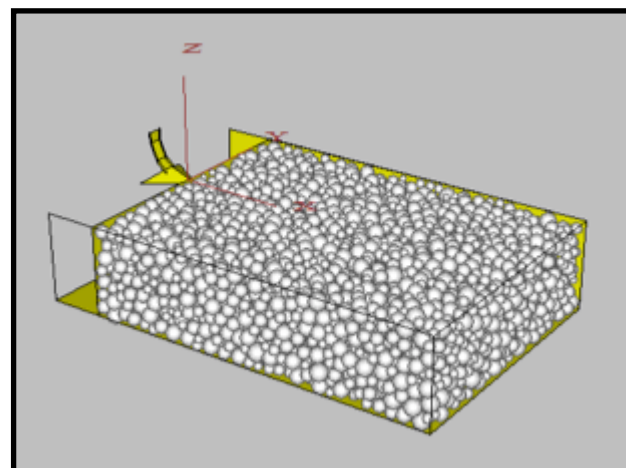
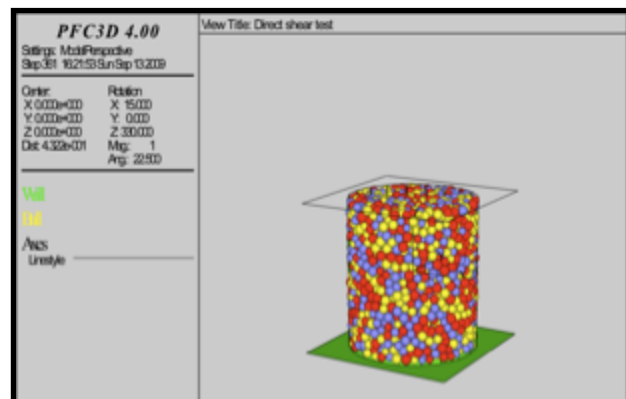
Dr. Chen's main research program is soil-tool-material interaction. Material examples include: manure, crop residue, chemical, seed, and other biomaterials. Tool examples include: tillage tool, seed opener, fertilizer opener, and any other soil engaging tools. Interactions occur when these tools are used to incorporate the materials into soil. Material presence alters soil-tool systems due to the interactions between soil and material movements. Therefore, performance of a tool for material incorporation cannot be predicted by knowledge of traditional soil-tool systems.

Dr. Chen also works on other research areas, such as ag-fibre (hemp), landmine neutralisation, and ag-waste handling. Representative research projects include hemp harvest and processing, demining using pressure, liquid manure injection, and livestock mortality composting.

Both experimental and modeling approaches have been used in conducting research. Dr. Chen's research team has developed models in which the dynamics and kinematics of biomaterials and their interactions with machines are simulated using analytical method, finite element method (FEM), and discrete element method (DEM).

Lab Equipment Available

- soil bin



Dr. Nazim Cicek
Waste Management Lab
E1-251 EITC
Phone: 204-474-6208
E-mail: Nazim.Cicek@umanitoba.ca

Dr. Cicek has two main research areas involving wastewater. The first involves the use of membrane biofilm bioreactors for autotrophic denitrification of water and wastewater, which could be used in groundwater treatment facilities. The second also involves the application of membrane bioreactors in the removal of natural and synthetic hormones from wastewater. Even in small amounts, these hormones can disrupt the endocrine systems of fish.

Another research area of Dr. Cicek's examines how natural freshwater marshes can improve water quality by retaining, removing, and assimilating products such as nutrients, suspended sediments, pathogens, and other contaminants.

Digesters are devices in which wastes are decomposed. Digestion produces methane, which keeps the digester at a proper operation temperature. Research is being done to see if adding a product such as glycerol, having a high calorific value, can increase biogas production.

Lab Equipment Available

- pilot-scale portable membrane bioreactor
- pilot-scale anaerobic digestion facility
- three complete fermentation systems
- water waste sample analysis capacity



Dr. Kris Dick

Alternative Village

20 Service St. 1SW

Phone: 204-474-6457

E-mail: Kristopher.Dick@umanitoba.ca

The Alternative Village is an outdoor laboratory that is dedicated to research, testing, and training related to alternative energy technologies and building envelope systems. The centerpiece of the Alternative Village is the Straw-Bale Building, a structure insulated with straw bales. A number of smaller test buildings are being built on the Village site to contrast the thermal and moisture performance of several residential building systems. These test buildings are available for use by other researchers from industry or academia.

Current research activities include the use of solar energy in building systems, electricity generation, and building system performance (i.e., thermal, moisture, structural).

This facility exists to provide researchers, students, practitioners, industry and the public opportunities to share ideas and learn about alternative energy technologies and alternative building envelope systems. Public workshops are regularly hosted to encourage this exchange of information.

Lab Equipment Available

- universal testing machines
- loading frames for structural testing of wood beams, columns, and trusses



Dr. Digvir Jayas

Grain Storage Research Lab

12 Service St. 3S

Phone: 204-474-9404

E-mail: Digvir.Jayas@umanitoba.ca

The Canadian Wheat Board Centre for Grain Storage Research is a multi-million dollar facility dedicated to research on grain storage and handling. The aim of this research is to preserve stored grain in Canada and around the world.



Research is being done to create mathematical models of heat, moisture, and carbon dioxide transfer in grain bulks. The models can be used to develop alternatives for things such as pesticide use, by developing a modified-atmosphere technology, balancing cost of bin sealing against CO₂ cost for insect control. Research is being done to better understand the physical and biological aspects of stored grain. Machine vision and digital imaging of grain kernels is used to quantify grain characteristics for automation of grain handling and for improvement of grain drying.

The 15,000 square-foot facility, equipped with six research labs and a pilot-scale grain cleaning and handling structure, was designed to allow researchers the ability to solve problems from a multidisciplinary approach, using engineers, entomologists, chemists, and mycologists. Developing cost-effective methods to control and prevent fungal and insect infestations of stored grain will help enhance Canada's global reputation as a supplier of high-quality grain.

Lab Equipment Available

- machine vision equipment
- soft x-ray unit
- near-ambient, high temperature, infrared and microwave driers
- fan testing unit
- instrumentation for measuring loads in grain storage structures
- equipment to measure physical, thermal, biological, and quality characteristics of grains & oilseeds
- thermal disinfestation systems
- environmental chambers
- grain handling equipment
- several full-size grain bins



Dr. Fuji Jian

Stored Grain Ecosystem Lab

120 GSRL

Phone: 204-474-7965

E-mail: Fuji.Jian@umanitoba.ca

A thorough understanding of the interactions among biological and physical elements in stored-grain ecosystems is key to protecting grain from damage caused by insects and molds. Controlled laboratory studies paired with mathematical modelling are used to predict changes in the entire stored-grain ecosystem as storage time progresses for developing scientific solutions for sound grain storage practices.

Current research activities include studies on insect biology, detection of insects and molds, control of insects and molds, measurement of physical properties of grain, and development of mathematical modelling of the stored-grain ecosystem.

This lab collaborates and shares equipment with the Stored-Products Lab (Drs. Noel White and Paul Fields, Agriculture and Agri-Food Canada) and Imaging and Food Quality Assessment Lab (Dr. Jitendra Paliwal, Department of Biosystems Engineering) under the leadership of Dr. Digvir Jayas (Grain Storage Research Lab).

Lab Equipment Available

- Environmental growth chambers
- Over 20 stored grain insect species in cultures
- Small bins (300 kg grain) for pilot scale testing
- FAV units
- Gas chromatograph
- Finite element models (developed by this lab)



Dr. David Levin

Biofuels, Biotechnology, and Fermentation Lab

E3-312 EITC

Phone: 204-474-7429

E-mail: David.Levin@umanitoba.ca

Research into the production of biofuels, such as ethanol and hydrogen, by direct cellulose fermentation is being done by Dr. Levin, together with Dr. Nazim Cicek (Biosystems Engineering) and Dr. Richard Sparling (Microbiology), by using a cellulolytic, anaerobic bacterium, *Clostridium thermocellum*. As this bacterium breaks down cellulosic biomass, such as agricultural residues (hemp hurds, flax shives, wheat straw), ethanol and H₂ gas are produced. A pilot-scale bio-fermentor is used to test growth parameters of the bacteria.

Dr. Levin's research focuses on understanding genetics of bacteria in order to develop strategies which would increase biofuel production, including ethanol, butanol, or hydrogen. Bacteria are cultured on various cellulosic substrates. Gas production is measured, and types of organic acids, alcohols, and sugars synthesized in the process are characterized.

Lab Equipment Available

- bioreactors
- ion chromatography system
- high pressure liquid chromatography system
- gas chromatograph
- gel electrophoresis apparatus
- quantitative PCR system
- centrifuges
- electroporation equipment



Dr. Song Liu

Biomaterials Synthesis and Surface Engineering Lab

W581 Duff Roblin

Phone: 204-474-9616

E-mail: Song.Liu@umanitoba.ca

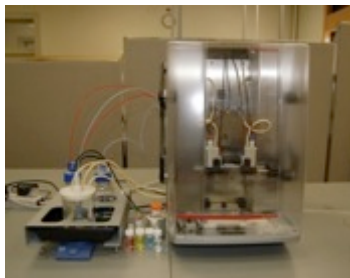
Dr. Liu's research focuses on 1) development of novel surface engineering techniques for chemically inert semicrystalline polymers; 2) development of new biocidal and biocompatible materials; and 3) micro- and nano-encapsulation of bioactive agents for their targeted and controlled delivery.

Dr. Liu's main research program is surface engineering of polymeric materials for medical and biomedical applications. Synthetic semicrystalline polymeric materials such as poly(ethylene terephthalate) (PET), polyurethane (PU), and poly(propylene) (PP) are flexible, resilient, and chemically and mechanically durable. It is these properties that make such polymers desirable for medical uses such as surgical drapes, catheters, vascular grafts, and ligament and tendon prostheses. However, these materials often lack appropriate surface properties essential for minimizing cross-infection in hospitals, or avoiding adverse biological responses such as thrombosis and inflammatory response. Dr. Liu's lab is striving to develop new surface engineering techniques to durably engineer the surface structure of synthetic polymeric materials to enhance their biological interactions.

Molecular designs of novel potent broad-spectrum biocides, "smart" polymeric biomaterials, and amphiphilic block co-polymers capable of self-assembly in aqueous solution to form nanoparticles are also carried out in Dr. Liu's lab. One more important research direction involves micro- and nano-encapsulation of bioactive agents for their targeted and controlled delivery.

Lab Equipment Available

- Anton Paar SurPASS surface zeta potential analyzer
- PerkinElmer elemental analyzer (CHNS)
- Automatic microwave-assisted synthesis system
- Supercritical CO₂ reactor equipped with a UV source
- Automatic apparatus for Layer-by-Layer assembly
- Plasma instrument
- Quartz crystal microbalance
- Cell (mammalian and bacterial cells) culture facility
- Other common equipment for organic and polymer synthesis

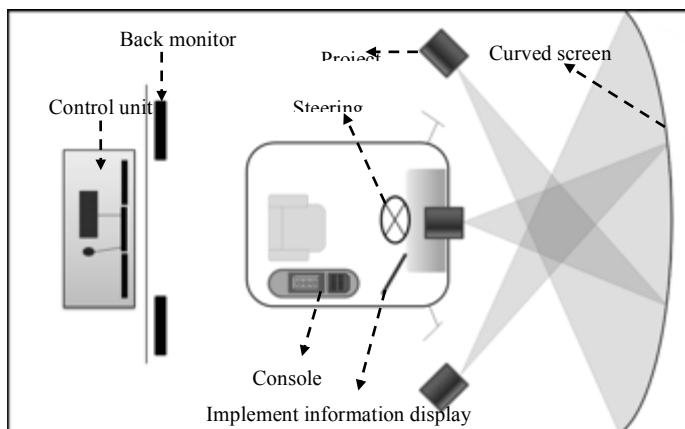


Dr. Danny Mann

Agricultural Ergonomics Lab
115 Agricultural Engineering Building
Phone: 204-474-7149
E-mail: Danny.Mann@umanitoba.ca

The Agricultural Ergonomics Lab is home to the University of Manitoba Tractor Driving Simulator (UMTDS). This simulator is a tool used to research how the human operator functions within the human-machine system for different agricultural vehicles. The lab also features a variety of experimental tools for human factors studies.

The simulator is being used to study semi-automated and fully-automated tractor-machine systems.



Lab Equipment Available

- eye-tracking system
- tractor-driving simulator

Dr. Jason Morrison

Computational Optimization and Geometric Modeling Lab

E3-220 EITC

Phone: 204-474-8496

E-mail: Jason.Morrison@umanitoba.ca

Dr. Morrison is currently working on two main research projects: anatomically and mechanically accurate bone models and advanced computational methods for hyperspectral imaging analysis.

Work has been done on finite element simulation of joint replacement surgeries, with particular interest in creating geometric and mechanical models of bones. With these models, it will be possible to approximate both human anatomy and the surgical modifications required before the prosthetic is implanted. Work has also been done to reverse engineer surgical impacting tools to determine forces applied by surgeons during orthopaedic surgery.

Hyperspectral imaging uses advanced optics to collect a series of images of a subject. Each image is the reflected and transmitted radiation from the object within a narrow band of frequencies. The series of images forms a data cube and provides spectral information for each pixel location. Dr. Morrison, together with Dr. Paliwal, has established methods to reduce blurring across pixels and improve calibration of the focal plane array.

Lab Equipment Available

- Fourier Transformed Infrared (mid IR) Microscope with ATR Imaging
- chemometric analysis software
- finite element modeling (ABACUS)



Dr. Jitendra Paliwal

Imaging and Food Quality Assessment Lab

121 Grain Storage Research Lab

Phone: 204-474-8429

E-mail: Jitendra.Paliwal@umanitoba.ca

Dr. Paliwal's research focuses on providing safe and healthy food to humans and livestock. His areas of expertise include development of hardware and software techniques related to machine-vision, vibrational spectroscopy, and data mining methods as they relate to quality assessment of cereal grains, food products, and animal feed.

Near-infrared spectroscopy (NIRS) provides a fast, non-destructive, and accurate assessment of components such as protein, moisture, fat, starch, and ash of cereal grains. Machine vision can quantify visual characteristics of grains to identify various grain types and contaminants present. The team is working on finding ways to integrate the two techniques to develop a comprehensive quality assessment model.

Another project involves using nondestructive sensing devices to rapidly sort high quality fruits, such as strawberries which are prone to spoilage and bruising. NIR hyperspectral imaging techniques can be used for predicting firmness and bruised spots. Once established, the same technology can be used to assess quality of other fruits and vegetables.

Lab Equipment Available

- Raman microscope
- near-mid infrared hyperspectral imaging system
- IR microscope
- soxtec fat extractor



Dr. Ramanathan Sri Ranjan

Soil and Water Engineering Lab

E1-353 EITC

Phone: 204-474-9344

E-mail: Sri.Ranjan@umanitoba.ca

Dr. Sri Ranjan works in the area of Soil and Water Engineering which covers irrigation, drainage, remediation of contaminated soils and groundwater, instrumentation in soil and water monitoring. Most research projects are conducted in the field with instrumentation fabricated in the laboratory.

Laboratory experiments in the area of electrokinetic/bioremediation have been conducted in fully instrumented laboratory setup to assess the efficiency of different soil remediation protocols.

Instrumentation required for assessing the impact of irrigation/drainage on plant growth and yield is available. New irrigation methods have been developed and tested.

Lab Equipment Available:

- Rhizotron for measuring water and nutrient status within the root zone.
- Permeameters, suction cup lysimeters
- Electrical conductivity meters
- Electromagnetic field survey instruments
- Water flow and level sensors
- TDR and miniprobes



Dr. Qiang Zhang

Odour Research Lab

E1-345 EITC

Phone: 204-474-9819

E-mail: Qiang.Zhang@umanitoba.ca

In order to reduce odour affecting households near swine farms, research must be done to quantify and analyze odour. Dr. Zhang has conducted research measuring instantaneous downwind odour plumes on two 3000-sow swine farrowing farms, one with open earthen manure storage, and one with negative air pressure covered earthen storage. Odour plumes were quantified by human odour sniffers using an 8-point n-butanol scale.

Solar energy greenhouses store solar energy in the north wall and in the soil floor during daytime and release the stored energy back into the greenhouse at night. An earth heat storage system, consisting of fans and buried perforated pipes, was constructed and tested in a solar energy green house for enhancing energy storage. Thermocouples were used to record soil and air temperatures at various locations. Energy balance analyses were conducted to evaluate effectiveness of the earth heat storage system. Solar radiation had more influence on the greenhouse temperature than did the outdoor temperature.

Lab Equipment Available

- olfactometer
- electronic nose
- Jerome meter
- air sampling devices



Dr. Wen Zhong

Medical Textile Lab

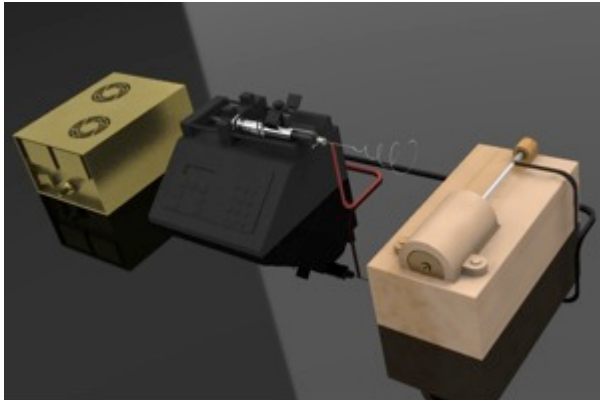
W579 Duff Roblin

Phone: 204-474-9913

E-mail: Wen.Zhong@umanitoba.ca

Dr. Zhong is working on functional electrospun nanofibers for biomedical applications, including wound care and tissue engineering. Electrospun nanofibrous as tissue engineering scaffolds can be good substrates for bioactive molecules and drugs to improve tissue repair process by mimicking native extracellular matrix (ECM).

Polymeric micelles formed from amphiphilic copolymers in aqueous solutions are promising as nanoscale carriers for anticancer drugs. Dr. Zhong is also developing various stimuli-responsive nanocarriers that release drugs with efficacy into tumor tissues upon changes in physical and chemical environments, such as redox potential and/or pH, which are two major chemical stimuli to trigger drug release from cargos.



Lab Equipment Available:

- Electrospinning Apparatus
- Liquid Extrusion Porosimeter
- BET Absorptometer
- Tensiometer
- Viscometer

