



Topics of Master Thesis

Study Programme: Mechanical Engineering – Process Engineering

Academic Year: 2021/2022

| Supervisor | Topic |
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| assoc. prof. Ing. Lukáš Krátký, Ph.D. | <p>Gas membrane separation processes in CCU technologies.</p> <p>Experimental testing of a module with PVC fibers for the separation of CO₂ from emission gases. Alternatively, O₂ from air, H₂ + CO from generator gases. Design of multistage membrane separation to achieve a given gas purity.</p> |
| assoc. prof. Ing. Lukáš Krátký, Ph.D. | <p>Process characteristics of ball-milled materials.</p> <p>Experimental analysis of particle characteristics and energy demand during milling of materials in ball mill. Theoretical modelling of process characteristics.</p> |
| assoc. prof. Ing. Karel Petera, Ph.D. | <p>Modeling microalgae growth in a photobioreactor.</p> <p>This work aims at modeling of microalgae growth a photobioreactor using ANSYS Fluent software. The light is the key factor of algae growth and its permeability decreases with increasing density of algae culture. The light intensity decreases with increasing distance from the illuminated wall in general. It can be affected by the hydrodynamics of the given system which is determined by the geometry and operational parameters. Another factor affecting the growth is the concentration of carbon dioxide and oxygen in the liquid phase. The carbon dioxide is a part of the photosynthesis, and oxygen can inhibit the growth rate in the contrary. The aim of this work is to include both factors into the model, that is the dependency on the light intensity as well as oxygen and CO₂ concentrations.</p> |
| assoc. prof. Ing. Jan Skočilas, Ph.D. | <p>Spray Dryer for gluten free powder production.</p> <p>Special equipment in the spray dryer, by so-called nebulization process, it is possible to produce a powder with a particle size of micro and nanometers. In the case of the water solution made from water algae, the powder can be produced, which is applicable in the food industry for product fortification or gluten-free flour. Design the spray dryer for the given application with the nebulization process. The design will contain the mass and enthalpy balance, flow diagram, auxiliary devices, and construct the design of the dryer.</p> |
| assoc. prof. Ing. Jan Skočilas, Ph.D. | <p>Design of equipment and technology to extend the shelf-life of processed fruits and vegetables.</p> <p>The thesis is focused on the design of equipment for a given technology to increase the durability of fruits and vegetables in modern ways, such as the use of pulsed electric field, pressure pasteurization, microwave field, etc. First of all, it is a literature search concerning the most modern current methods of gently increasing the shelf life of food, even so far on a laboratory scale, the selection of a suitable method for fruits and vegetables and the design of a pilot plant to apply this method.</p> |
| Ing. Jiří Moravec, Ph.D. | <p>Process characteristics of hydrodynamically optimized impellers</p> <p>The aim of the work is to determine the basic process characteristics of two newly developed hydrodynamically optimized impellers, i.e. to</p> |



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| | <p>determine their power, homogenization and suspension characteristics. The work is based on experimental measurements. The scope of work will be adjusted according to the time possibilities of the student. For management that can be put to work and specify parameters using CFD.</p> |
| Ing. Jiří Moravec, Ph.D. | <p>Effect of dynamics of liquid level change on the power consumption of impeller in mixed vessel.</p> <p>The aim of the work is to describe changes in the power required for mixing of liquid in situations where the liquid is discharged from the device or filled into it, i.e. in a state where the liquid level moves around the stirrer. One of the factors whose influence is to be described is the speed of movement of the liquid level. The work should be primarily solved experimentally. It will be necessary to assemble the measuring device from the prepared components, perform measurements with various impellers, evaluate the measured data and discuss the obtained results. The results of work can provide recommendations for the practical operation of the device. The results of experiments can also be supported by numerical simulations. The specific scope of work will be adjusted later.</p> |
| Ing. Jiří Moravec, Ph.D. | <p>Optimization of measuring sensor for rheological properties of fluids.</p> <p>The up to date knowledge in the field of measuring rheological properties of fluids using impellers (literature search) should be used to design a measuring sensor which would enable to measure flow properties of different liquids/suspensions at desired temperature range easily and systematically. The sensor design should be compliant with a rheometer Rheotec RC20 which is used in the rheological laboratory of the department. Except the above-mentioned literature search, the work should contain complete design of the sensor in form of production drawings. The sensor should be produced (ensured by the supervisor) and its usability should be tested in several checking measurements using liquids of known viscosity.</p> |
| Ing. Jiří Moravec, Ph.D. | <p>Rheological properties of fluids.</p> <p>The aim of the work is to measure rheological properties of chosen fluids. The whole work will consist of description of methods and devices that can be used for measuring, selection of a suitable method and configuration of the device, carrying out necessary experiments, their evaluation and discussion of results.</p> |
| Ing. Jiří Moravec, Ph.D. | <p>Free topic.</p> <p>I offer the possibility of supervision of a diploma thesis with an own topic suggested by student. The work can be aimed on any topic from the field of process engineering (engineering or computational proposal of equipment, balancing of processes, experimental works, CFD and others). The final topic and scope of solution will be prepared after consultation with the student.</p> |
| Ing. Jaromír Štancl, Ph.D. | <p>Electric properties of foods.</p> <p>The aim of this work will be the literary review focused on methods of experimental determination of specific electrical conductivity and dielectric properties of foodstuff substances (solid, liquid, pasty substances) - especially apparatus arrangement, design of the electrode system, identification of advantages, disadvantages and problems of individual solutions. Next, for example, a proposal of the design of an electrode system for measuring the specific electrical conductivity and dielectric properties of a selected food sample will be made and the measurement of electrical properties will be carried out in dependence</p> |



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| | on predetermined parameters. A simple model describing the electrical properties of the selected sample will be identified from the measured data. |
| Ing. Jaromír Štancl, Ph.D. | <p>Dependence of deformation on the electrical properties of the biopolymer.</p> <p>The aim of this work is a design of the modification of existing extrusional rheometer, for measuring the electrical properties during flow of the biopolymer material (collagen) through a narrow gap, and measurement of electrical properties depending on the deformation of the extruded material. A simple mathematical model describing the influence of the electrical properties on deformation will be identified from measured data.</p> |
| Ing. Jaromír Štancl, Ph.D. | <p>Proposal of selected processing line in food industry.</p> <p>The aim of this topic is to prepare process flow diagram in several variants of the processing line and perform the mass and energy balances and economical evaluation of proposed variants. The selected processing line should be for food processing industry (not automotive industry or assembly and manufacturing).</p> |
| Ing. Michal Netušil, Ph.D. | <p>Categorization of particulate matter.</p> <p>A topic occurring in many industries. The aim is to design a reliable, fast and undemanding method for determining the particle size distribution. Measurements with real samples will take place within the work. Supporting documents and measuring equipment will be provided. Possibility of paid industrial internship.</p> |
| Ing. Michal Netušil, Ph.D. | <p>Evaluation of separation tests and prediction of results.</p> <p>A database of results and predictions of separation tests will be provided. The aim is to analyze the influence of parameters on the results and to refine the predictions. The student will learn to work with a large data set and statistical computation. An engineering sense and advanced knowledge of MS Excel is required. Possibility of paid industrial internship.</p> |
| Ing. Mgr. Vojtěch Bělohav | <p>Microalgae biorefinery: High-value products perspectives.</p> <p>Elaborate an overview of existing biorefinery concepts processing 3rd generation biomass – microalgae. Describe the process diagram of selected technologies and define the parameters of the key equipment. Describe the final high-value products based on the different concepts of biorefineries. Based on the critical review, select a suitable concept that could be applicable in the Czech Republic and another concept applicable in the selected country. Elaborate a basic process flow diagram for the selected biorefinery concepts. Elaborate the datasheet for key equipment of the technology.</p> |
| Ing. Mgr. Vojtěch Bělohav | <p>Hydrodynamics conditions in a vertical tubular photobioreactor.</p> <p>Based on literature and industrial review, determine suitable hydrodynamic conditions for vertical tubular photobioreactors. For the selected hydrodynamic conditions, develop a CFD model of a pilot tubular photobioreactor. Analytically and experimentally determine the hydraulic characteristics of the tubular photobioreactor. Use the analytical and experimental results to validate the developed CFD model of the photobioreactor. Based on the obtained results, propose the optimization of the operational and design parameters of the pilot tubular photobioreactor.</p> |



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| <p>Ing. Stanislav Solnař</p> | <p>Measurement of thermal conductivity of materials based on oscillation method.</p> <p>The thermophysical properties of materials can also be measured by the thermal oscillation method (ie heat and sine waves). Design and manufacture (manufacture) a measuring device that allows the application of an oscillating method to measure thermal conductivity, and perform verification experiments with known materials. The result of the work should be a small measuring device, a method for evaluating the measured data and recommendations for further measurements.</p> |
| <p>Ing. Viktor Vajc</p> | <p>Image analysis of bubbles in boiling liquid.</p> <p>You will do a review on the topic of dynamics of bubbles in a liquid continuum. Then, you will develop a computer program which is going to be used for image analysis of videos filmed with a high-speed camera during boiling of liquids.</p> |