Cavitation technologies for marine and groundwater desalination, wastewater treatment

Basic information

Duration (ECTS)	360 hours (10 ECTS)
Starting date	October, 1
Language of instruction	English level B1 (European Framework for Reference of Communicative Skills)
Entry requirements	BSc or MSc degree in Environmental Sciences, Engineering, Chemistry or Physics

Course description

The course ”Cavitation technologies for marine and groundwater desalination, wastewater treatment” is designed to introduce students to the principles of construction and exploitation of cavitation technologies and technological systems used for intensification of heat and mass transfer. Such technological systems are based on thermo-hydrodynamic effects of bubble cavitation and supercavitation principles. During the course students will learn about modern cavitation technology, which is one of the most efficient and productive technologies widely applied in industry.

Special Features

The course provides a detailed understanding of waste water conditioning issues and original research outcomes obtained with underground and marine water desalination (desalting) assays. The challenge of freshwater scarcity, issues of waste water recycling, closed-loop control systems and sustainable development have led to increasing global demand for professionals equipped with special skills developed through study of the course.

Course aim

The aim of the course is to equip students with the range of practical and applied environmental skills, required for managing cavitation technologies and designing energetically and economically efficient desalination equipment using the latest data from experimental studies of supercavitation flows with steam extraction from supercavity.

Course objectives

- to make students familiar with the method of supercavitating evaporation, which is one of the most efficient methods that helps to reduce scaling and contamination caused by heat transfer through a solid thermalconducting wall in the process of water evaporation;
- to give students a detailed understanding of flows simulation techniques applied for systems with supercavitating flows; calculations for supercavitation (SC-) devices with various constructions are demonstrated;

- to provide specific practical recommendations about the usage and application of SC-devices in industry, to propose possible technological schemes for specific branches of industry.

Learning outcomes

After successful completion of the course a student should:

- know theoretical basis of cavitation technology, methods of physical and mathematical simulation and numerical calculation of supercavitation flows in technological devices;

- realize the importance of issues related to provision of population and industry with drinking and technical water;

- practically use methods of calculation and design of SC-devices for various purposes, including desalination of saline water and waste water treatment;

- be able to formulate original ideas and to propose solutions for engineering problems taking into account the latest achievements in hydrodynamics.

Outline of content

Week	Lectures	Seminars	Hours
1-3	Occurrence of cavitation kernels. Properties of water and its cavitation resistance. Non-equilibrium model of cavitating liquid.	Calculation of resistance for different liquids in various environmental conditions (temperature, pressure)	36
4, 5	Molecular structures of water. Nonstationary fields of pressure. Turbulent fluctuations and mixing. Changing physical/chemical properties of under the influence of cavitation.	Experimental study of physical/chemical properties of water under cavitation.	54
6	Types of cavitators. Flow-cavitation reactors, SC-pumps, etc. Methods of calculation and design.	Study of SC-devices structures and methods for their design and calculation.	72
7, 8	Mathematical 3D modeling of supercavitation flows in technological devices. Boundary value problem and the modified similarity rule.	Technology of physical, phenomenological and numerical simulation of supercavitation flows based on modified similarity rule.	36
9, 10	Freshwater conditioning: desalting devices based on SC-evaporators, mathematical models of processes	The influence of cavitation treatment on wastewater, its composition and production of fresh water. Experi-	54

	in a SC-evaporator, analysis of working processes in SC-evaporator, supercavitating evaporating devices for fresh water production.	mental study.	
11, 12	Operation principle of rotary SC-evaporators. Mathematical models of RSCE and selection of cavitator form.	Numerical calculations of rotary SC-evaporators (RSCE) characteristics.	
13, 14	Numerical simulation of supercavitation flow in RSCE. Supercavitation pumps.	Numerical calculations of rotary SC-pumps characteristics.	54
15-18	Technological applications of cavitation technology: production of new nano-materials, dispersion of minerals, emulsification and slurrying of water-fuel mixtures, applications in agriculture, medicine, construction industry, and more.	Application experience of cavitation technologies in various industrial processes.	54

Course assessment

Written and oral examination after completion of the course.

Attendance policy

Organization of individual studies is performed in accordance with the schedule of educational process. Recommended literature should be studied to operate on the topics listed above. Assignments given after lectures are used for the monitoring of the educational process.

Contact information

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