Protocol No 10 / 20 June 2016

Two presentations were made on this joint seminar by Indian guests, Prof. Chiranjib Bhattacharjee and his fellow Dr. Ranjana Das. They visit Institute of Mechanics within the frame of an Indo-Bulgarian project, as the Bulgarian side is represented by Prof. R. Kotsilkova and her group of young scientists, most known as OLEM.

Chairman introduced first lecturer, prof. **Chiranjib Bhattacharjee**, who works at Membrane Research Lab within the Chemical Engineering Department at Jadavpur University, India. Presently, his research interests are focused on Environmental Remediation, Novel separation techniques, and production of functional foods from waste materials. He has more than 145 research articles in international journals and numerous papers/presentations at national or international conferences. Prof. Bhattacharjee has supervised more than 30 master degree students, already 18 doctoral degrees have been rewarded to his students and 10 other works are in progress.

The first presentation concerns to "**Advanced technologies for industrial wastewater treatment leading to zero-discharge concept**".

According to "zero discharge concept", the wastewater or any specific mixture, which contains many impurities, can be filtered via different membranes many times till pure water as each membrane separate ingredients, which could be used somehow in the industry. The membranes are semi-permeable materials and some ingredients can pass through the membrane, but any don't pass. It depends on the size of the pores and size of the molecules. A membrane can be electrically charged and this also influences its separation properties. The membranes could fault because the membrane pores could be plugged. This process could be irreversible or reversible – by washing. "How to increase the membrane life?" is an important question. It's better to have more turbulence near the membrane surface. The plugging is smaller when there is a high tangential stress in the fluid near the membrane. A membrane is a thin sheet, or sometimes it is a tube. Rejection of the solute is very important. Prof. Bhattacharjee showed and explained a few pictures of real membrane modules.

The chairman gave the word for questions and comments.

Q: Prof. Kotsilkova asked is it some binder which fixes this TiO_2 on the membrane or there is some impregnation.

A: There are different methods. In one method, the membrane material is dusted with TiO_2 nanoparticles and they exist in the membrane matrix. That is the impregnation. In another method, named "film deposition", where we are spraying a nanoparticle solution to the membrane surface and we are allowing it to dry. The result is different. If we impregnate membrane with TiO2, obviously – the flux is more.

Q: Prof. Kotsilkova: About your "Zero discharge concept", is it only in the laboratory or it is implemented in the industry?

A: It is applied in industry. The membrane technology has a lot of applications.

Prof. Bhattacharjee introduced the next lecturer - Dr. **Ranjana Das**. She is a research associate at the Chemical Engineering Department at Jadavpur University, India. She has nearly 22 international publications. She is having six books, one granted patent and one patent is in application state. The second presentation concerns to "**Valorisation of by-products in vegetable oil industry using membrane technology**".

The oilseed industry is a vast and worldwide growing enterprise. The rapid expansion in oilseed production is reflective of a rising standard of living, with people demanding more fried foods in their diets. Due to the rising world population, the consumption of refined vegetable oils has increased significantly, resulting in an increase in the production of seed by-products. The use of by-products for valuable component production is a very good alternative for earning additional revenue and to solve related environmental disposal problems. The scope of this brief is to present the state-of the-art for obtaining value added components (phytochemicals and nutraceuticals) from by-products of the vegetable oil industry emphasizing the expediency of membrane separation process. In treatment of various life style related chronic disease, phytochemicals and nutraceuticals play significant role as functional food component. Plant protein ingredients, specifically proteins hydrolysates, small peptides and natural phytochemicals (natural antioxidants) are of particular interest to the food engineers to meet the demand of functional foods. These biologically active ingredients from natural sources are claimed to be health-enhancing components and used to reduce the risk of diseases or to enhance a certain physiological function. Bioactive components of food origin can serve as both nutrient and non-nutrient, which may exert regulative activities in the human organism beyond basic nutrition. In membrane separation process, the principle of selective permeability of one or more of the constituents through the membrane according to their molecular weight profile are usually employed to enrich bioactive peptides from protein hydrolysates. Use of electrical potential difference (electro-dialysis, electrophoresis) and coupling of electrical potential gradients with pressure (electro-nanofiltration) improves the yield as well as high peptide selectivity. Use of ultrafiltration membranes in the production process of bioactive peptides in form of membrane bioreactors allows the continuous production of specific peptide sequences with functional and nutritional properties. Furthermore, recycling of the enzyme and elimination of residual proteins results in a much improved enzyme yield and process productivity level. Present research activities aims profitable utilization of agro-industrial waste employing the concept of membrane fractionation and membrane bioreactor emphasizing its potential in the field of food biotechnology.

Secretary: Assoc. Prof. R. Krastev