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Preface

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This issue of the Periodica Polytechnica Chemical Engineering is devoted to contributions in connection with the PERMEA 2019 conference, which was held at Eötvös University, Budapest, Hungary between 26–29 August 2019. PERMEA is the Membrane Science and Technology Conference of Visegrád Countries (Czech Republic, Hungary, Poland, and Slovakia) and this was the 8th conference of the series. Budapest University of Technology and Economics, University of Pannonia, and the Hungarian Chemical Society organized this meeting. PERMEA international membrane meetings have gained an international reputation and become one of the creative conferences in the fields of preparation and production of membranes, assessment of their separation properties, utilization of membranes for various separation problems, and introduction of new technological procedures to protect the environment. The goal of the conference series has always been to give an overview of the most exciting progress in the field of membrane technology and researchers and professionals from industry.

The international scientific committee greeted 110 participants coming from 17 countries. Honoured representatives of the organizing organizations: Prof. Dr. Livia Simon-Sarkadi (President of Hungarian Chemical Society), Prof. Dr. János Józsa (Rector of Budapest University of Technology and Economics), and Nándor Nemestóthy, the co-organizer of the conference (University of Pannonia; Head of Membrane Group of Hungarian Chemical Society) welcomed the attendees. In the name of the hosting university Prof. Dr. Péter Szalay, Vice Rector of Eötvös University, greeted the participants. After the welcome session, Prof. Dr. Pavel Izák, Institute Chemical Process Fundamentals of Czech Academy of Science, Prague, Czech Republic opened the scientific part of the conference with his plenary lecture. The forthcoming presentations were divided to two parallel sessions and the overall 60 oral presentations were organized into 16 sessions. Right before the closing ceremony the second plenary speaker of the conference, Prof. Dr. Bart van der Bruggen, Katholieke Universiteit Leuven, Belgium closed the scientific part with his plenary speech. In the mornings of the 2nd and 3rd days two keynote speakers, namely Prof. Dr. Jozef Markoš, Slovak University of Technology in Bratislava, Slovakia and Dr. György Székely, King Abdullah University of Science & Technology, Saudi Arabia held their lectures. Poster presentations were available during the whole term of the conference, especially in coffee breaks. Best lecture and best poster presentation awards were announced during the closing ceremony.

We hereby take the opportunity to thank the sponsors of the conference for their contributions (in alphabetic order): Antor Paar Hungary Kft., CONPART Kereskedelmi és Szolgáltató Kft., European Membrane Society, Inniti ApS, Unitester Kft., and SUEZ Water Technologies & Solutions. Representative of the latter company took opportunity to address the participants with an introduction lecture held prior to the poster session on the 2nd day.

Although the topics were diverse (environmental protection with membranes; membrane development fabrication and technology; drinking and wastewater treatment; modelling; membrane reactors; gas/vapour separation; electro-membrane processes; emerging technologies), we believe that the extended scope of this conference offered an excellent opportunity to support exchanges, to bring together the various areas of applications, and to favour the transfer of new ideas from apparently distant disciplines. Instead of publishing conference proceedings only, we take this opportunity to publish selected contributions and to invite further papers to this thematic issue of Periodica Polytechnica Chemical Engineering. This thematic issue consists of 11 original papers; below we would like to give a brief introduction of the topics in the order they appear in the thematic issue.

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Reverse osmosis is a well-known desalination technique that usually requires high transmembrane pressure. By the surface modification of polysulfone RO membranes by surfactants (either cationic, anionic or non-ionic) performance of the membranes can be increased via modified morphologies and molecular orientation. Thus reverse osmosis can be carried out at lower pressure than usually used [1]. Surface modification is a frequent technique to create new membranes, thus cellulose acetate membranes (which are known as the oldest types of artificial membranes) can act as novel membranes after their surface modification with nano-particles. By coating the membrane surface permeability and selectivity can be simultaneously increased during the purification of clove oil [2]. Polyvinylidene fluoride/polyether glycol ultrafiltration membranes are also subjects of surface modification with surfactants. Using dual surfactants in the PVDF membranes improved the performance properties (flux and retention [3]) similarly to that of polysulfone membranes [1].

Membrane technology is often used in domestic wastewater treatment. One of the representatives is the membrane bioreactor, which could have several technical implementations. A detailed comparison of air-lift multilevel circulation membrane reactor (AMCMBR) and anaerobic/anoxic/aerobic membrane reactor (AOA-MBR) was reported in which the influence of pollutants volume loading rate (VLR), C/N on effluent chemical oxygen demand (COD), ammonium nitrogen (NH_4^+-N) and total nitrogen (TN) were discussed [4].

Process waters can also be treated by membrane separation techniques, in most cases as part of an integrated treatment technology. The efficient application of reverse osmosis for treatment of wastes of food industry has been demonstrated; valuable compounds of juice extracted from peel of beetroot could be concentrated [5]. Other example on the use of membrane technology in the food and beverage industries is the ultrafiltration of milk [6]. Besides producing dairy products, ultrafiltration can also be used to treat dairy wastewaters. Moreover different pre- treatment methods can be applied to increase the efficiency of ultrafiltration such as ozone and Fenton-reaction. Almost 100% of the pollutants can be eliminated by proper selection of pre-treatment methods prior to ultrafiltration, thus combined treatment is favoured in process water treatment [7].

Continuing the row of process water treatment, a successful combination of distillation and pervaporation was demonstrated to remove ethanol and methanol from process waters originating from pharmaceutical industry. The optimization of the hybrid method (the application of two distillation columns followed by pervaporation) to separate water-ethanol-methanol ternary mixture in professional flowsheet simulator environment revealed that 99.5 wt% purity can be reached for each compound [8]. Thus we expect wider applications of membrane technologies as part of combined technologies in food and beverage, and pharmaceutical industries in the future.

Membrane filtration can be intensified by mixers inside tubular membranes aiming to enhance permeation by elongated use of the membrane and a simultaneous reduction of fouling. Static mixers were designed, produced by 3D printing technology and implemented into tubular ultrafiltration membranes. By this improvement, the separation of water from stable oil-in-water emulsion can be increased. Although 3D printed static mixers seem to be as efficient as metallic versions, i.e. similar flux and retention of oil, the pressure drop along the membrane module was lower thus offering a less frequent cleaning [9].

Although poly(vinyl alcohol) (PVA) membranes have been widely used for pervaporation due to their high hydrophilic behaviour, non-toxicity, biodegradability and chemical/thermal stability, their modification is also subject of recent research. A PVA membrane casted with another PVA casting solution can result in a formation of a second PVA film, which then can be cross-linked at elevated temperature during a short term (typically one hour). By the incorporation of a second PVA network improved selectivity and a simultaneous reduced flux can be obtained when testing the membrane for the dehydration of water-ethanol mixture [10].

Transport through a membrane, especially cell membrane is always a complex phenomenon. Relationships between permeability and membrane retention values of the in vitro non-cellular permeability assay are of utmost importance for the prediction of corneal permeability. Corneal- PAMPA model was proven to be efficient to describe these relationships and verified for 50 structurally and physicochemically diverse drugs [11].

We hope that Readers will find the papers interesting and useful. PERMEA series is a triennial event and the next conference will be organized by Slovakia and held in the High Tatras in 2022.

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