

## Editorial

# Special Issue: The Application of Microorganisms in Wastewater Treatment

Ivan Kushkevych 

Department of Experimental Biology, Faculty of Science, Masaryk University, Kamenice 753/5, 625 00 Brno, Czech Republic; kushkevych@mail.muni.cz; Tel.: +420-549-495-315

Today, water is an integral part of the course of our lives, from the operation and maintenance of households to extensive industrial and agricultural use. Nowadays, ecological, political, and ethical considerations cause us to constantly think about streamlining processes and managing natural resources as cautiously as possible. However, now it is very important to protect the high quality of water as a renewable resource, since it can be easily lost underground, in landscapes, and watercourses.

This Special Issue (SI) of *Processes*, “*The Application of Microorganisms in Wastewater Treatment*”, focuses on microbial applications in wastewater treatment, the main chemical compounds present in wastewater, and their effect on the microbial respiration activity of sewage sludge, as well as aerobic and anaerobic degradation or utilization via a sewage sludge bacterial consortium in these processes. This Special Issue includes seven very high-quality papers, of which the authors are lead scientists and represent the currently active researchers in this field. The topics are not only current (cutting-edge research), but also of great academic (fundamental phase) and industrial (applied phase) interest. The papers are cited below, with brief comments on each paper concerning their main topics and contributions.

This Special Issue includes one review paper describing methanogenic microorganisms in industrial wastewater anaerobic treatment [1]. The authors of this paper (Vítězová et al., 2020) demonstrate that methanogenic microorganisms have an important role in anaerobic wastewater treatment. *Methanosarcina* sp. and *Methanotrix* sp. were the most abundant acetoclastic methanogens in the anaerobic reactors. A wide species diversity of hydrogenotrophic representatives of methanogens was characterized. The dominants in this group were *Methanoculleus* sp., *Methanobacterium* sp. and *Methanospirillum* sp. The methanogenic communities and the relation of industrial wastewater composition were described in the reactors treating these wastewaters [1].

Nowadays, an important task is ensuring high-quality drinking water sources. In recent years, active substances in these products have been recorded with the growing discharge volume of mobile toilet chemicals. The paper “*Activated Sludge Respiration Activity Inhibition Caused by Mobile Toilet Chemicals*”, authored by Vítěz et al. (2020), describes the topic [2]. The respiratory activity of the activated sludge was showed by the authors to demonstrate the effect of mobile toilet chemicals and their active substances on the biological wastewater treatment process. A higher pollutant concentration may cause the adaptation of the activated sludge microorganisms. The authors [2] demonstrate that for treating mobile toilet wastewater, bacterial degraders can be used and *Ralstonia* sp. prevailed in all samples, which could be a potential mobile toilet chemical degrader [2].

The anaerobic stabilization of the sludge by raising its temperature methanogen diversity during anaerobic sewage sludge stabilization and the effect of temperature is described in next paper [3] of this Special Issue. The authors focus on the description of changes in the community of methanogens at different temperatures during the sludge stabilization. A higher percentage of methane was in the biogas at higher temperatures. The hydrogenotrophic *Methanolia* genus was detected at all the temperatures. The acetoclastic representatives of *Methanosaeta* sp. were a significant proportion of methanogens



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at temperatures up to 50 °C. The thermophilic species *Methanothermobacter marburgensis* that appeared in the fermenter, significantly changed at 60 °C when the composition of methanogens changed. Under these conditions, the diversity of methanogens decreased and the species of *Methanoculleus* genus were no longer detected in the fermenters of biogas plants and anaerobic wastewater treatment plants [3].

The paper by Stachurová et al. [4] describes the formation of a biofilm of bacteria from different phases of wastewater treatment under the effect of tetracycline. The authors used the crystal violet staining method to evaluate the biofilm formation. The isolates from the sedimentation tank produced a biofilm with up to a 10 times lesser intensity compared with isolates from the nitrification tank. Tetracycline from a concentration of 0.03125 µg/mL affected and increased biofilm production. The authors assumed that resistant bacteria are able to form a biofilm and sub-inhibitory tetracycline concentrations induce biofilm formation [4].

The paper in the Special Issue titled “*Physicochemical characterization of home-made soap from waste frying oils*”, authored by Antonić et al. [5], was dedicated to the utilization of waste frying oils and home-made soap production. The authors focus on “the utilization of waste frying oils, originating mainly from households and in home-made soap production, emphasizing the advantages of soap biodegradation in comparison to the biological treatment of oils” [5].

Interesting results were obtained by Houari et al. [6] and published in the paper titled “*Microbial Communities’ and Sulfate-Reducing Microorganisms’ Abundance and Diversity in Municipal Anaerobic Sewage Sludge Digesters from a Wastewater Treatment Plant (Marrakech, Morocco)*”. The authors used and combined both molecular analyses and culture-dependent isolation methods for the investigation of the diversity of sulfate-reducing microorganisms and their role in sulfides production in full-scale anaerobic digesters. The following families, *Peptococcaceae*, *Syntrophaceae*, *Desulfobulbaceae*, *Desulfovibrionaceae*, *Syntrophobacteraceae*, *Desulfurellaceae*, and *Desulfobacteraceae*, were detected and involved in sulfides production [6].

Equally interesting is a paper in the Special Issue under the title “*Real wastewater treatment using a moving bed and wastewater-borne algal–bacterial consortia with a short hydraulic retention time*” authored by D. Kang and K. Kim [7]. The authors describe that the algal–bacterial consortium is a promising technology and wastewater treatment plants, the main mechanism for nutrient removal in a photobioreactor; however, biomass uptake and denitrification were the main mechanisms in the photobioreactor with moving media. Under the moving media conditions, the authors show that the bacterial community has also changed. Such moving media might be an essential parameter for photobioreactors with a short hydraulic retention time enhancing nutrient removal and settleability [7].

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## References

1. Vítězová, M.; Kohoutová, A.; Vítěz, T.; Hanišáková, N.; Kushkevych, I. Methanogenic Microorganisms in Industrial Wastewater Anaerobic Treatment. *Processes* **2020**, *8*, 1546. [[CrossRef](#)]
2. Vítěz, T.; Vítězová, M.; Nováčková, M.; Kushkevych, I. Activated Sludge Respiration Activity Inhibition Caused by Mobile Toilet Chemicals. *Processes* **2020**, *8*, 598. [[CrossRef](#)]
3. Vítěz, T.; Novák, D.; Lochman, J.; Vítězová, M. Methanogens Diversity during Anaerobic Sewage Sludge Stabilization and the Effect of Temperature. *Processes* **2020**, *8*, 822. [[CrossRef](#)]
4. Stachurová, T.; Malachová, K.; Semerád, J.; Sterniša, M.; Rybková, Z.; Smole Možina, S. Tetracycline Induces the Formation of Biofilm of Bacteria from Different Phases of Wastewater Treatment. *Processes* **2020**, *8*, 989. [[CrossRef](#)]
5. AntoniĆ, B.; Dordević, D.; Jančíková, S.; Tremlova, B.; Kushkevych, I. Physicochemical Characterization of Home-Made Soap from Waste-Used Frying Oils. *Processes* **2020**, *8*, 1219. [[CrossRef](#)]
6. El Houari, A.; Ranchou-Peyruse, M.; Ranchou-Peyruse, A.; Bennisse, R.; Bouterfas, R.; Goni Urriza, M.S.; Qatibi, A.-I.; Guyoneaud, R. Microbial Communities and Sulfate-Reducing Microorganisms Abundance and Diversity in Municipal Anaerobic Sewage Sludge Digesters from a Wastewater Treatment Plant (Marrakech, Morocco). *Processes* **2020**, *8*, 1284. [[CrossRef](#)]
7. Kang, D.; Kim, K. Real Wastewater Treatment Using a Moving Bed and Wastewater-Borne Algal–Bacterial Consortia with a Short Hydraulic Retention Time. *Processes* **2021**, *9*, 116. [[CrossRef](#)]