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INTRODUCTION TO CHAPTER 1: WATER & WASTEWATER TREATMENT

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An adequate supply of wholesome water is essential for life and treatment after use reduces the impact on the environment. There are an increasing number of chemicals and pollutants being released into the environment so there is a need for continued research into new treatment methods both for treatment of water for supply and also for wastewater treatment.

Climate change effects mean the world, as a whole, must aim to reduce the emission of greenhouse gases. As a consequence of pumping, and chemicals used in treatment, the carbon footprint of water can be high and so it is necessary to continue to research and develop improved methods of treatment combined with an efficiency in use both in the home and in industry.

As the industrial processes use an increasing range of chemicals, and domestic sewage contains products of medications, there is a rising need to remove a greater range of chemicals during the treatment process.

This collection of papers covers the topics of water and wastewater treatment for domestic and industry as well as one on the suitability of an effluent for agricultural purposes. They demonstrate and explore the wide range of contaminants needing to be dealt with, whether for potable water or to make effluents from wastewater treatment plants safe enough for release to the environment and the wide range of chemicals and processes needed for and used in treatment works.

The final paper can be related to all the other six because it explores the significant research and development effort, the R&D processes and the collaboration between academia, operating companies and equipment suppliers that are all needed to bring about important improvements and success in the drive for a more-sustainable water future. It is to be hoped that the lessons learned from the paper by Williams et al can be replicated widely in academia and industry.

The lead author for the first paper is ALhajjil on the subject of Bromate removal from drinking water as exposure to high levels of bromate in drinking water can cause serious health issues. Three methods of removal were compared and it was concluded that the bromate in ozonated drinking water samples could be completely removed by biochar composite.

Grabda et al write on the removal of Perfluorooctanoic acid and its salts (PFOA) which are effective fluor surfactants used in many applications. PFOA in surface and drinking waters becomes bio-accumulative and possibly toxic to humans and other living organisms. After testing other methods for removal of PFOA from water they used ionic liquids as extraction agents for the separation of PFOA from the water phase. In this study, 276 different ionic liquids were screened and a few ionic liquids characterized by highest chemical affinity towards PFOA were identified. The selected ionic liquids were investigated for their extraction potential towards PFOA using the liquid-liquid system.

In the third paper Mahfud et al use the adsorption process and sought to find a low cost or free suitable adsorbent to remove the contaminants from aqueous media in industrial wastewater treatment. Specifically, they used Date Balm (DB), Nubk Gaff (NG) and Neem Trees (NT) to remove methylene blue from water. The analysis of the results of the three organics showed that the Freundlich sorption isotherm described the sorption process better than the Langmuir isotherm. NG obtained the optimum percentage removal at 10 mg/L (53.9%).

Mu'azu et al are also investigating adsorbents which could be used for the decontamination of water laden with dyes, phenols and heavy metals. They have focussed on several new novel advanced layered double hydroxides (LDH) nanocomposites with high adsorptive performances for effective wastewater remediation. This demonstrated the potentials of using nanocomposites LDHs as alternative adsorbents for effective simultaneous removal of organic pollutants and heavy metals from contaminated industrial wastewater.

Mu'azu dedicated a separate paper to discuss the possible use of diamond electrodes in an electrochemical advanced oxidation process. This is needed as some industrial wastewaters are hard to treat with biological processes. His study demonstrated the robustness of diamond electrodes and their promising role in effective treatment of industrial wastewater contaminated with bio-refractory toxic organic and inorganic pollutants.

The paper by Al Sulaimi et al describes the health challenges caused by Helminths Ova (HO) and therefore why it is important to remove HO before re-use of an effluent for agricultural purposes. The objectives of this paper are to assess the presence of viable HO in wastewater and to characterize its species distribution by size as well as evaluating the performance of tertiary pressurized sand filtration for viable HO removal. There are many reasons such as sustainability, water scarcity, carbon and cost efficiency as to why effluents should be re-used and this paper assists in safely doing so.

In the last paper of this chapter Williams et al describe how universities in the UK have been tasked with a "third mission" in addition to lecturing and research. This third mission includes University Industry Collaboration (UIC) which for many years has been active in the water and wastewater treatment research and development area. The collaboration between the University of Portsmouth with a large water utility and with a

company supplying package plants is described. The research and development activities include large scale trials based on operating treatment works allowing unique access to real time data and operating conditions. This relies on a good foundation of trust and cooperation being established between the parties involved.

The link between all these papers is the vital topic of water supply and proper treatment of wastewater which is fundamental to all our civilisations. They are all examples of the almost constant human drive for improvement in the way we live, provide services to communities and, with the recent growth in concern about sustainability of the planet and the human race, how we reduce adverse environmental impacts, improve energy, carbon and process efficiencies, and improve quality of life. This last improvement is perhaps one the key drivers for sustainable provision of potable water and wastewater treatment processes.

The final paper describes one way in which all the necessary research and development can be undertaken on a more-collaborative basis than has so far been the norm.

I hope that all these papers stimulate your own ideas for improvement activity, from applying results you have learnt about to your own work to perhaps identifying issues and opportunities for improvement in your own area of work and seeking out collaboration partners to make a positive step towards a sustainable water future.