Book review

Sustainable green chemistry

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Mark A. Benvenuto (Ed.)
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More than 30 years ago the scientific community started to question themselves about how to create the bridge from the "brown" chemistry towards sustainable chemistry. This discussion culminated with the establishment of Green Chemistry (GC) and its 12 principles. Nowadays, GC is well known worldwide. The principles of GC have remained unchanged over time and in a certain way static. But now is the time to wonder whether it would be necessary to make these principles more dynamic, or to add more in order for the chemical industry to be able to face the new challenges, the more complex processes, and the new techniques that come in the horizon.

This book entitled *Sustainable green chemistry*, edited by Mark A. Benvenuto, provides a broad overview of GC.

Chapter 1 is written by the former president of the American Chemical Society, Dr. Bill Carroll. This chapter distances from being an introduction to GC; rather he describes the unseen role of GC in the history of Chemistry and Chemical Engineering. The author explains how GC principles have been applied indirectly to reduce cost and increase the production of commodity chemicals, contrary to the common idea which stipulates that GC should only be applied to specialty chemicals. In this chapter the reader will also learn to see GC from an economic perspective. He explains how our mindsets are programmed to think that there is no progress without pollution. This argument was refuted cleverly by him explaining that from an economic point of view pollution is waste and waste is equal cost, while progress is equal to benefit and an improvement in quality of life. This way of thinking is also reflected in the way that problems are solved in the industry, where only a solution is found rather than the better solution.

This chapter is followed by the achievements and barriers that GC is facing. Firstly, it is questioned whether GC is a branch of Chemistry or a guideline to define how all chemistry should be done. With this question in mind, it is elaborated the main four reasons of why GC has not been universally applied, despite that it has been decades since it was acknowledged and despite the increasing environmental awareness.

In Chapter 3 is introduced the topic of switchable polarity solvents, their properties, and examples of their application in different areas of the industry. The important role of solvents in chemistry is indubitable, they are used in purification and separation steps; however, their efficiency depends greatly in the selectivity that they can provide. Switchable polarity solvents are solvents that can optimize the material and energy use; moreover, they align with many of the GC principles.

Chapter 4 presents one application of ionic liquids to the recovery of actinide, a valuable and rare material. It is examined the interaction between the actinide and the ionic liquids, and the solvent effect.

Chapter 5 shows the reader that GC is not only about the main process, but also the down streams process that may need to be employed due to the decisions taken during the process design and the selection of the reactants. As a society we depend heavily on plastics, and to make them BPA is used as a precursor. However, it has negative effects on humans and the environment and it is not foreseen that this chemical will be replaced. Thus it is necessary to think about ways of reducing the environmental risk of this chemical. Phytodegradation of BPA is presented here as a novel downstream process to eliminate BPA.

The last chapters, 6–8, focus on the role of GC in the education system. As mentioned before in chapter 2, there are still many barriers that need to be overcome for the full implementation of GC. These chapters discussed the actual situation of GC in higher education and the great value that could be added by incorporating GC in the education. It is presented a detail explanation of how and where GC is being taught both in high school and college. Then it is approached the advantages and reasons of including GC in the curricula of other education fields, i.e. not only chemistry or chemical engineering, to culminate with the greening of the organic chemistry labs.

To sum up, the authors provided with a varied view of GC, presenting not only the possible applications in chemistry but also the role it can play when integrated

into the education. However, this book does not present you with an introduction to GC, nor the techniques and tools applied in CG. I would suggest this book for people that are acquainted with the topic, particularly professors, due to the many chapters devoted to include GC in the academic curricula of many schools.

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