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Editorial

Biofuels and green chemistry - a common journey ahead

Research on innovative fuels and fuel-related areas represents one of the most intriguing and challenging arena in which academia, industry, and governments are converging joint efforts to find alternative and sustainable sources of energy. It is evident how critical and important is, for the entire society, to replace fossil fuels (e.g., oil, charcoal) by focusing on biomass-derived compounds.

With the appearance of the concept of sustainability and sustainable development in the '80s (Brundtland, 1987; US Congress, 1990; Linthorst, 2010), it has become clear the urgent need for reducing waste, pollution, and limiting the CO_2 emissions associated with human activities. More specifically, it has become evident the key role of chemistry in the definition of a more efficient chemical production based on what are nowadays known as the twelve principles of Green Chemistry, first propounded by Anastas and Warner (1998).

One of the twelve principles is built around the preference for renewable feedstocks featuring an intrinsic lower CO_2 consumption (Anastas and Warner, 1998), thereby making clear the close relationship between green chemistry and the research on biomass-derived fuels (or biofuels).

Actually, biofuels (and biofuel additives) have been known since ancient times. In fact, more than 100 years ago, the two giants of modern car engine, Henry Ford and Rudolph Diesel, strongly believed in the future of biofuels, and began with ethanol and vegetable oils to run the Ford Model-T and the diesel engine, respectively. With the significant increase in the importance of oil, the technologies based on the use of biofuels were set aside.

Nowadays there is an urgent need for the reduction of fossil fuels consumption, as already mentioned, but at the same time, innovative chemical production is fundamental for keeping the level of civilization high and opening new job positions. Accordingly, in many countries, governments have initiated specific programs. For example, the European Union (EU) has adopted a mandate based on which 10% of the fuels used in the transportation sector should be of renewable sources by 2020. Moreover, fuel suppliers are also required to reduce the greenhouse gas intensity of the EU fuel mix by 6% by 2020 (European Union, 2009).

To effectively reduce greenhouse gas emissions, biofuels must be produced in a sustainable manner (European Union, 2009). First, sustainable feedstocks (e.g., lignocellulosic residues from agriculture and forestry, fast-rotation non-edible crops, organic fractions of urban waste, algae) must be chosen to provide at least 35% net CO_2 emission savings in comparison with fossil fuels (European Union, 2009). Second, biofuels production should also lead to some benefits for local communities (including food availability, new job opportunities, biodiversity perseverance, quality of water and soils used). In addition, a sustainable and efficient biofuel production should be based on clean and safe manufacturing processes featuring minimal production of wastes too.

The current issue of Biofuel Research Journal features a set of contributions that are well representative of the importance of the Journal in this arena. Solid state fermentation, waste valorization, and biogas are all topics of fundamental importance in the field of biofuels. They also prove how important it is to combine all the principles of green chemistry to meet the criteria required for a new production of biofuels. In fact, as well described in the previous issue of the journal (Yang, 2017), it is crucial to thoroughly evaluate the efficiency of a process through advanced tools such as life cycle assessment (LCA) and even beyond. For instance, in addition to comprehensive LCA evaluations, the use of metrics evaluating the waste associated to a process (e.g., E-factor, etc.) (Sheldon, 2017) should also be promoted to support the quality of contributions to this area.

Overall, it will be certainly strategic for the future research on biofuels to develop heterogeneous and recoverable catalytic systems able to operate in safer media and to allow the isolation of the desired materials with the minimal production of waste and consumption of energy. These can be accomplished by exploiting all the modern reaction technologies such as ultrasounds (Fang et al., 2015), microwave (Cravotto and Carnaroglio, 2017), and continuous-flow reactors that represent an effective and promising set of key tools for innovating the future of green chemistry and biofuels.

In conclusion, green chemistry and biofuels represent two faces of the same medal that will certainly go together for a long route sharing many exciting journeys.

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