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Editorial

Chemical engineering in Latin American: Challenges and opportunities

The original concept of 'sustainable development', defined over 15 years ago by an UN commission, suggested pursuing development in a way that respects both human needs and global ecosystems, assuring quality of life for future generations. It was clear even then that current trends in population growth and economic development were not sustainable. Without dramatic changes in the patterns of human activity, there will be severe challenges to the continued growth of global industries (CEPAL, 2020). Examples of these challenges include: a) adverse environmental impacts such as climate change; degradation of air, water, and land; depletion of natural resources, including fresh water and minerals; loss of agricultural land due to deforestation, soil erosion and urbanization; and threatened ecosystems; and b) adverse socio-economic impacts such as widespread poverty, lack of potable water, proliferation of infectious diseases, social disintegration, growing income gaps, and lack of primary education (CEPAL, 2020). The issues of sustainability and environmental, social governance are not new in Latin America and the Caribbean. As a region whose vast natural resources are matched by historic inequality, political discord and social turbulence, the themes of sustainable project development, for both the environment and surrounding communities, have been a long-term focus for the chemical industry (CEPAL, 2019).

When considering the requirements that chemical engineers will need to meet in the future, it is important to bear in mind just how extensive the field in which they work has become. Thanks to a generally broad, relatively unspecialized education, chemical and process engineers are found in the chemical industry, the oil and gas industry, the plastics industry, the food industry, the pharmaceuticals industry, medical technology, environmental technology, the automotive industry, the steel industry, and many others, including in administration. Although many countries are developing in Latin America and the Caribbean, the chemical industry has high competitiveness due to its availability of raw materials and natural resources. The production of quite interesting chemicals such as oil and its derivatives, high value-added metals, pharmaceuticals, perfumes, and cosmetics, have placed Latin America and the Caribbean as an interesting territory for the global chemical industry. However, given the increasing production of several industrial sectors and the inefficiency of several processes, the production of 430,000 tons of waste material in Latin America and the Caribbean has been recorded daily (CEPAL, 2019).

Latin America and the Caribbean are particularly vulnerable to industrial growth, climate change, poor management of hydraulic resources, burning of fossil fuels, contamination of hydraulic and terrestrial resources, high energy waste, which compromise the sustainability of development in many parts of the region. In this sense, research in waste treatment, environmental impact, carbon dioxide capture, energy-saving, and many more issues related to sustainability and circular economy are areas of relevance and current affairs in Latin America and the Caribbean. Sustainability offers a viable path for achieving 'green' goals across the chemical industry in the region (CEPAL, 2020). There is the potential to develop industrial technologies that could provide goods, services, and products in a way that does not reduce the supply chain of resources, harm the environment and human health, or limit the opportunities and choices for future generations. Even though sustainability has already started to make a significant impact on the (bio)chemical industry, there are substantial additional benefits that can be derived.

In this sense, in recent years, in Latin America and the Caribbean there has been a growing interest in reducing waste and increasing energy efficiency. An example of such situation is the growing research areas that are reflected in aspects, economic, energetic, and environmental and safety, in summary chemical engineering applications. In a context of increasing population and growing middle classes, Latin America's petrochemical and chemical industries are well-positioned for significant growth — if the region's political and logistical challenges can be addressed. Global trade dynamics and the looming challenges associated with achieving sustainable operations are also key issues that industry must face, in addition to the particularities of each country in this diverse and dynamic part of the world. Consolidation through an uptick in mergers and acquisitions activity and an increasingly blurred line between distributors and logistical service providers are notable trends across the value chain that suggest competition is heating up in Latin America. The biggest topic of 2022, in the region, has been the acceleration of a global environmental agenda. Sustainability has become the overarching theme touching all facets of the chemical and petrochemical industries,

influencing new forms of energy such as green hydrogen, and creating a new wave of business opportunities on the path towards a circular economy.

The devastation caused by Covid-19 has arguably been felt more acutely in Latin America and the Caribbean than in any other region. While global gross domestic product fell by 3 % in 2020, Latin America and the Caribbean contracted by 6.8 %, the worst of any region. As a result, in 2020 debt to global gross domestic product ratio rose over 60 % in Mexico, and over 90 % in Brazil and Argentina (Global Business Reports, 2021).

However, despite the unprecedented challenges faced since the start of the pandemic, the region has rebounded well in 2021, aided by high commodity prices and pent up demand. In July 2021, the United Nations Economic Commission for Latin America and the Caribbean raised its average growth estimate for the region to 5.2 %. The chemical and petrochemical industries have been key components of this rebound, having managed to weather the storm better than the majority of sectors in 2020, driven by the extraordinary global demand for hygiene-related products (Global Business Reports, 2021).

Thus, the purpose of this special issue is to provide a summary of the current state of the applications of sustainability tools in the chemical processes in research in Latin America and the Caribbean and forecast what additional beneficial contributions might be in the horizon. This special issue will contain original papers, with current and future insights, from leading researchers in the field of Chemical Engineering in Latin America and the Caribbean. We thank and recognize the effort of the authors that have contributed to this important topic.

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