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Editorial

Membrane Engineering in the Hydrogen Generation/Purification

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EDITORIAL NOTE

According to the previsions of hydrogen agencies and associations, in the near future the 'H_2 Economy' will dominate the Sustainable Development under the perspective of a green and decarbonized World [1]. Since the meeting of G20 in Japan, on 2019, a common agreement about the need of depleting the fossil fuels utilization and drastically reducing the greenhouse gases emissions is leading to a kind of revolutionary approach in several sectors, from energy and petrochemical industry to gas separation, refinery and transportation [2]. The core of this strategic revolution deals with industrial, economic and political decisions oriented towards the massive diffusion of hydrogen as the new energy carrier, meanwhile meeting the purpose of zero carbon World's emissions. Consequently, all the industrial and scientific efforts about the hydrogen generation, purification, and utilization will be done under the framework of the "Hydrogen Strategy in the Green-Deal", which will represent, on one hand, the biggest challenge and, in the other hand, the greatest perspective that the World are facing to pursue a reliable and sustainable development [3]. In this regard, the membrane engineering is gaining a growing interest, constituting a valid and alternative approach to produce and separate hydrogen, based on the adoption of the Process Intensification Strategy principles [4].

In petrochemical industry, membrane engineering could play an important role for the separation of hydrogen, as a crucial process in the following:

- Hydrogen/carbon monoxide ratio correction in syngas production
- In ammonia plant, where hydrogen is separated from nitrogen
- Hydrogen recovery in natural gas purification or from hydrocarbon purification from light gases
- Hydrogen purification of catalytically reformed streams for other industries. In particular, membrane gas separation technology results to be the most flexible over the conventional ones (pressure swing adsorption, cryogenic distillation, etc.) under unexpected plant shutdown, or the most adequate in a wider range of hydrogen mixtures (from 30% to 90%) [5]

The dominant membrane materials for the separation/purification of hydrogen-rich mixtures are polymeric, because the inorganic membranes need higher operating temperature and, consequently, higher costs, limiting their industrial utilization, even though supported and unsupported Pd-based membranes ensure superior hydrogen purity (>99%) in the permeated streams [6].

In the field of hydrogen generation, the steam reforming of natural gas represents industrially the most used process. Also in this area, membrane engineering attracted a large scientific interest as addressed by an extensive literature about the Membrane Reactors (MRs) technology [7]. The MRs result a valid alternative to the traditional reformers, shoving several advantages such as:

- The generation of hydrogen and its simultaneous purification in the same device, with a consequent intensification of the whole process
- Higher conversions than a traditional reformer operating at the same conditions
- The same conversion of a traditional reformer but achieved at milder conditions

The interest on hydrogen generation through the membrane engineering is also reflected in the growing number of industrial companies involved in pilot scale MRs development for hydrogen generation [8-10], with the objective of designing catalytic MRs operating under industrial conditions and individuating reliable protocols for their correct maintenance and operation as well.

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