Biodesulphurization of diesel fuels, will it work?

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Refineries take on the development of high-quality finished products, according to more and more restrictive regulations, consistently with standards claimed by society. Due to a major concern about effects caused by sulfur oxides and sulfate particulate matter, we are moving towards zero-sulfur fuels. Hydrodesulfurization (HDS) is the most common technology employed in order to achieve these requirements. However, usual HDS presents different limitations in order to reach this purpose. Thus, both HDS catalysts and processes need to be improved, and different technologies should be developed.

Among these alternatives technologies, Biodesulphurization (BDS) consist in the approach based on the employ of microorganisms and their enzymes. This is a promising low-cost and environmentally friendly complementary technology to HDS, due to the capability of certain bacterial strains to specifically remove sulfur from S-heterocyclic compounds present in crude oil.

BDS is a very well-known technology from many perspectives. Firstly, specific desulphurizating pathways, using model compounds (which are recalcitrant to usual chemical treatments) have been widely studied, considering physiological, biochemical and genetic aspects. Secondly, metabolic engineering strategies have been developed taking advantage of these microorganism versatility and their easiness to be genetically manipulated. Thus, several strains have been improved in order to better express desulphurizating operons, enhance the activity of the involved enzymes, control retro-inhibition, improve availability of reducing power and tolerance to organic solvents and metals,…, among other issues. Thirdly, BDS can operate at mild conditions and it offers high selectivity, resulting in reduced energy costs, low emission and no generation of undesirable side-products. Finally, BDS has been studied from process engineering perspective including kinetic modelling, scaling-up, mass transfer considering biphasic systems, biocatalyst separation, etc.

However, BDS has not been developed as an economically viable process yet. On one hand, the activity of biodesulphurization biocatalysts need to be improved in order to achieve commercial requirements, and product-inhibition must be reduced. On the other hand, currently developed biocatalysts must be risen in value for other applications within refineries. Thus, another possibility could be the integration BDS with existing HDS systems. According to all this, current status and future challenges of BDS will be discussed along this presentation.