POROUS MATERIALS IN FUTURE ENERGY SUPPLY

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ABSTRACT

Current energy supply for the final consumer in our civilized world is mainly electrical power, gas oil or natural gas for heat purposes, and various transportation fuels. The main part of these energy carriers is based on crude oil or natural gas conversion. Facing peak oil production, it is important to increase efficiency of all processes converting crude oil into materials or mostly energy. Besides, quality of available overall reserves is getting poorer. Using hydrogen as a "clean" energy carrier is still far away, because the production routes based on environmental benign technology cannot deliver the high amounts necessary today.

With the invention of the mobile engine by Gottlieb Daimler and the automobile by Carl Benz the individualization of transportation was initiated. Liquids from crude oil have been approved for more than 100 years as an efficient energy carrier for this purpose. With the development of improved engines the request for improved transportation fuel asked for chemical conversion of crude oil fractions. From the very beginning application of porous catalysts played an important role besides process engineering. Today's and future's drivers for improvements of crude oil conversion processes into energy carrier are environmental regulations and economic factors. Existing processes and catalyst are given in table 1.

Long term availability of crude oil is not really clear, but future feed stock will not be easy to convert in value added products. Hydrotreating technology with advanced catalysts will be needed and the availability of hydrogen within the refinery complexes will control the costs of converting the oil. In case these costs will increase more and more, the alternative technologies already developed today will take over.

These alternative technologies can be summarized in the term X to liquids (XTL), which is the breakdown of various carbon containing sources (X) to synthesis gas and a rebuilding of larger molecules ending up in transportation fuels. For the rebuilding two major routes are competing, one is the Fischer-Tropsch process as a direct conversion of synthesis gas into larger molecules, the other is the production of oxygenates and a subsequent conversion into larger molecules. Advantages and disadvantages of these processes are well known, providing the synthesis gas is the most critical factor from an energy perspective. Nevertheless, all these process chains are calling for highly advanced catalysts. Porosity is one of the key functions to handle mass transfer, accessibility of active sites, selectivity, cycle life time.

Table 1: Porous catalysts in refinery industry.

Process	**Catalyst**	**Feed Stock**	**Products**
Fluid catalytic cracking	Zeolite	VGO, various	Light Olefins, Gasoline
Light naphtha isomerization	Aluminumchlorid Zeolite Mixed oxide	Light naphtha	Gasoline
Desulfurization and denitrification	Mixed oxide	All crude fractions and intermediates	Gasoline, Jet Fuel, Gasoil,ULSD,Fuel Oil…
Catalytic reforming	Alumina	Naphtha	Gasoline, BTX-Aromatics
Hydrocracking	Zeolite Silicaalumina	VGO, various	Jet Fuel, Diesel (Gasoline)
Hydrodewaxing	Zeolite, mixed oxide	GO, HGO, light VGO …	ULSD, Jet
Isodewaxing	Zeolite	GO, HGO, light VGO...	ULSD, Jet Fuel,
Alkylation	Zeolite	i-Butene, Butene	Alkylate Gasoline
Butene isomerization	Zeolite	1-Butene	Iso-butene
Oligomerization	Zeolite, SPA	Light olefins	Gasoline, Diesel