Green Indicator

Deepwater Turmoil

Petroleum. The current source of virtually all chemicals and energy in today's society and a combined blessing and curse to most countries in which it is extracted. Petroleum. The resource that more than any other has played a role in the geopolitical development during the last 120 years and thus shaped the world we live in today. Petroleum. Whether one is a believer in peak oil or not, the price of petroleum is never the less a function of supply and demand and this is an equilibrium that just shifted.

The accident of the Deepwater Horizon oil rig is first of all a tragedy with respects to the human lives lost and injured people. However, the accident as such will forever change the perception of safety in the deep water drilling section of the oil industry. Much more stringent requirements will be put on the personnel safety and operational safety of this type of equipment in the future. This will inevitably increase the per barrel cost of extraction in deep waters, which in effect lowers the amount of proven reserves and thus affects the future supply side of the petroleum supply/demand equation and puts large findings such as the Carioca-Sugar Loaf field of the coast of Brazil into question for near term development. It also yet again proves how difficult it is to move away from the tradition, Middle East major suppliers to other potential oil suppliers.

With this latest development, it is believed that the oil prices that we see today are here to stay. In the short term there may be the possibility for Saudi Arabia to function as a swing producer and leverage the increase in price, but in the long term the prospect of producing chemicals and fuels from non-crude-oil based feedstock's become even more attractive.

/ Jens Hansson

The Answer

What do you percieve to be the major obstacle to commercializing non-fossil based fuels?

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Reactor Miniaturisation

In the traditional chemical and refinery business, reactor concepts are in essence limited to the large scale, packed bed reactors. Very few alternative modes of production are considered than the economies-of-scale driven large chemical and refinery complexes; and this may very well be the correct way of conducting business. In this issue of CatScan we would however like to push for the potential advent of the miniaturised reactor.

The economies-of-scale are naturally very dominating in the chemical industry, but the use of e.g. micro-channel reactors for the production of Fischer-Tropsch liquids become viable due to the effective heat dissipation. This is just one example where additional benefits may be reached in this kind of miniature reactors. Economies-of-scale can naturally never be reached with this type of set-up, but perhaps a state we can refer to as economies-of-numbers may be reached instead. This state is more robust with regards to loss of production as there are always a number of reactors producing even if one reactor should fail for some reason and can be a good reason for investigating

*given by **Dr M Sakib Khan**, Founder, Enerleq (Emerging Markets Energy Consultancy based in Johannesburg, South Africa)*

Within the emerging markets environment there are a number of obstacles to commercialising non-fossil fuel based fuels. Many nations in the emerging markets are still developing and therefore rely on cheaper sources of energy to drive industrialisation and development.

These energy sources are usually natural resources such as coal and/or oil, and therefore available cheaply. Also many non-fossil based fuels require greater technological development in order to be utilised safely and efficiently, and this technological know-how is not readily and cost effectively available in many developing countries.

Deciding on Market Approach

It is a continuous on-going discussion regarding the production of bio-chemicals: what is the optimal product price vs. market size to target when developing these types of products? Will we make more profit if we produce a highly valuable chemical with a limited output e.g. for medical applications? Or a bulk chemical with a virtually unlimited market, but with a limited sales price e.g. ethylene?

The different approaches hold different merit, in the first approach the high profitability of the market will give a fast return on the capital employed in the development and scale-up. The production volume can also be considerably smaller in this case and there is less dependency on economies-of-scale for making break even. In the other case however, the bulk chemical segment, there is a much higher requirement for producing in larger scale, economies-of-scale is very much required. This represents a much higher barrier of entry from an investment point of view; perhaps more development work is required in more than one scale-up stage, higher capital requirement in construction etc. and naturally longer pay-back times on the initial investment.

Another thing that separates the two approaches would be the ability to roll out the production: in the first case there may be a possibility to start production in a small, pilot scale but with profitability and then scale to a more suitable production unit after proving the concept in the first scale. This approach would not be possible in the bulk chemical scale, where few if any pilots are profitable. The large upside with targeting a bulk segment is the close to infinite production volumes that can be envisioned; the first plant can be multiplied numerous times without significantly changing the market dynamics. This indicates a larger possible overall profit potential for the bulk chemical segment due to the scalability and leverage of the initial investment.

So what would be a good approach to leverage these to clear development paths? One suggestion would be to employ a "one-two-punch" method in which the two approaches above are combined. Find a first product where the first market characteristics are fulfilled, a profitable specialty chemical or pharmaceutical and enter into production in this segment. It is important to be careful not to over-saturate the segment e.g. in the way the additional biodiesel industry over-saturated the glycerin market. Then develop an add-on process to the first chemical e.g. a derivative, which occupies a bulk segment. This way the first product can be used for proof-of-concept cases.

A current example of successful miniaturisation is the implementation of NOx abatement. The catalytic reduction of NOx (SCR) has been implemented in large-scale power generation plants for more than two decades. This technology was by few believed to be implemented in another distributed emissions application. This is however what has happened in the case of the heavy-vehicle infrastructure of Europe and the US with the systematic installation of urea dosing systems and SCR-catalysts on lorries and buses.

It is not suggested that the entire chemical and refinery business should switch from the traditional, large-scale packed-bed reactors. But in some niche applications, the application of small-scale multi-reactor concepts could be envisioned and when this is proven as a viable path forward examples show that it is possible to make such a transition.

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generating revenue; while the second product will give high leverage on the invested capital.