Innovation

Downstream | Innovation

Refinery and Petrochemicals technology innovations are aimed to

- maximize efficiency;
- minimize utilities consumption;
- improve the environmental quality or finished products;
- maximize yelds on higher added valued products;
- process unconventional crudes;
- use remote natural gas and bio-fuels.

1. Innovation in Refinery

The objective is to increase flexibility and efficiency of refining cycles, to process unconventional crudes and to produce fuels, biofules, high performance lubricants, with minimal environmental impact.

Below, a short description of the main efforts in the downstream R&D and Innovations.

1.1 Advanced control and analysis

technologies

Advanced control and analysis technologies are necessaries for ensuring the optimization of operations and of blend of products. Refineries, in fact, have to be able to

- control and manage optimally their process units
- obtain products exactly as specified (no fire-away) at the minimum costs.

At this aim operating systems are yet developed, based on very complex and sophisticated models, which allow to manage automatically units or even several units connected among them.

The use of retails of microcomputers connected with a central processor allows to reach very high safety and efficiency in the plants operations.

These systems need sensors which measure continuously both quantitative (temperature, pressure, flows, levels..) and qualitative parameters (gravity, TBP, chemical composition…).

In this contest, companies are developing and implementing many applications for characterizing components, based on near-infrared spectroscopy (NIR). This technology is a spectroscopic method which uses the near-infrared region of the electromagnetic spectrum (from about 800 nm to 2500 nm) and which satisfies relevant requirements. It:

- is cost-effective;
- is rapid;
- minimize analyzer maintenance;
- increases blending operations throughput.

1.2 *Fuel specifications*

The refining industry faces considerable challenges, in accordance with the European Union’s environmental regulations on petrol and diesel quality.

General goals are to:

- Minimize sulphur content on gasolines, gasoils and heavy fuel oil;
- Reduce aromatic components in gasolines and in gasolis.

These goals could be reached through several technologies, the majority of which based on high pressure hydrogenation processes (desulphurization, hydrocracking, mild hydrocracking).

The R&D objective is the improvement in catalyst which has to be cheaper, with better performance and capability.

The improvements have also to reduce investment and operations costs.

The technological frontier is to produce very high quality gasoil (tendentially without aromatics) from synthesis gas through the Fisher Tropsch reaction.

A few processes have been developed based on cobalt catalysts which allows to use as feed-stocke natural gas. At moment only Shell have realized industrial unit.

1.3 *Heavy oil production and upgrading*

The aim to upgrade as much as possible heavy oil into distillates is traditionally the main one or refinery.

In the same time the intent is to produce both distillates and not upgraded residue at minimum content of sulphur.

Upgrading of heavy distillates through FCC and HDC and of residue through thermal processes like as visbreacking, thermal cracking and delayed cocking are yet conventional technologies.

The innovation of technology is now focused to heavy residue catalytic conversion in high pressure of hydrogen (deep conversion).

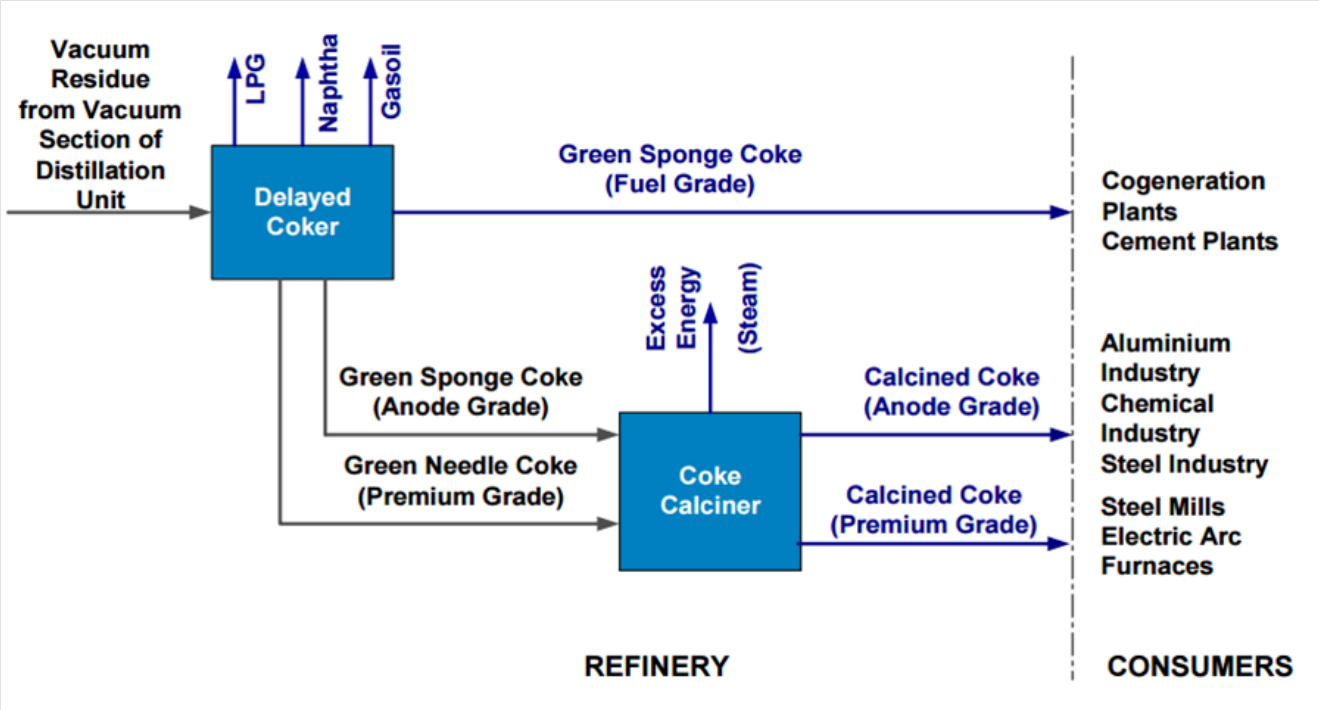
In this technologies group the frontier are the processes based on catalysts in slurry phase.

A nike technology is Coke calcination that in fact it is more a metallurgical process than a refining process.

It is a process whereby green or raw petroleum coke is thermally upgraded to:

- Remove associated moisture and volatile combustion materials
- Improve critical physical properties like electrical conductivity, real density, oxidation characteristics.

The feedstock, “Green Cock”, is a by-product of the coker process in oil refineries.



Coke Calcining Scheme

1.4 Additives

The development of new lubricants and fuels require the use of additives which have to be increasingly advanced and competitive with the continuous market demands related to higher performance, cost-efficiency and environmental value of the products. Dispersants and detergents are respectively the main elements of lubricant and fuel packages.

The innovation in this context is aimed to realize a flexible technology for the production of additives which allow products to be exploited for different uses in both fuel and lubricants by changing operating conditions or characteristics of the reagents.

Detergent structures for fuels have been identified which can prevent the formation of deposits from combustion or allow the removal of those already formed.

Eni has developed a dispersant for lubricants called “PIBSI” (Polyisobutylene-succinimide) used for the formulation of the new Eni Sint lubricants. The potential offered by PIBSI, the internally developed know-how, and the results obtained so far have led to evaluate the construction of a plant producing 6,000 ton/year of dispersants at an Eni site.

1.5 *Lubricants*

In the automotive sector, research has long been focused towards

- the reduction of CO2 and pollutant emissions;
- the optimization of fuel economy;
- the reduction of the impact of the lubricants on the exhaust gas treatment systems with reduced content of ash, phosphorus and sulphur.

- **Shell**

Shell has developed a new catalyst to be used in its heavy oil/bitumen catalytic conversion process (Hycon) which provides rapid and efficient reactions of the heavy oil coming from tar sands processed in Canada. It can upgrade up to 35% more than the catalyst used up to a few years ago. Moreover Shell developed a new GTL technology (based on Fischer Tropsch reaction) to produce high quality gasoil from natural gas and commercialized a new top quality gasoil with the brand of *V Power*.

In Canada’s oil sands, Shell replaced naptha with a paraffin-based solvent that removes more water, fine solids and heavy carbon from the froth. The payoff is an increased volume: for every 100 barrels of bitumen, upgrading yields about 103

barrels of synthetic crude, a 21% gain over a traditional coking process.

Shell developed new wastewater treatment technology. Almost 90% of liquid and solid waste is recycled or re-used for power generation in its Nanhai petrochemicals plant.

- **Eni**

Eni has established an integrated research programme called Sulphur and H_2S Management in E&P Operations which aims is the storage of sulphur with cheaper technologies and low environmental impact through

- sulphur box confinement;
- the permanent elimination of sulphur by re-injection in slurry phase.

Eni developed the *Eni Slurry Technology* (EST), a highly innovative technology for very advanced conversion of heavy oils/bitumens in high-quality light products (distillates), so eliminating the production of heavy oil in refineries.

This process may represent the optimal solution for upgrade traditional crudes but also to upgrade unconventional sources such as the ultra-heavy crudes and the bitumen from tar sands. This last point could play in the next few years an important role.

ENI‘s Integrated Research Programme Clean Diesel Fuel aims to identify optimum formulations for diesel fuel that can improve engine performance and significantly reduce the emission of particulates, using GTL Fischer-Tropsch as a benchmark.

The new lubricants (the Sint Evolution line) developed by Eni’s Refining & Marketing Division as well as matching the performance requirements of a wide range of customers, also

have a “more sustainable” environmental impact than the market average.

- **British Petroelum**

BP Downstream Research program’s aim is to develop tools that will help refiners understand how feedstocks have to be optimally processes in the refinery before they are purchased or processed helping refiners maximize value and to reduce maintenance risks while the feedstocks will be subsequently processed.

2. Innovation in Petrochemical

Researches carried out in this sector are mainly focused on increase the flexibility of technologies to ensure production continuity using different feedstocks, both fossil or from renewable sources, improve chemical and energy efficiency, to reduce environmental impact.

The main activities are:

1) New technologies for the production of high performance elastomer

Companies are exploring new solutions in the fields of elastomers for car tires in line with the strict European standards. One of the these innovative solutions consists on the use of oils of vegetable origin, with low environmental impact and high performance. The oils can be used as rubber extender oils.

2) *High-performance styrenic polymers from new production processes*

The challenge is the production of compact polystyrene resins used for packaging, coating and household items, which replaces the traditional ones in aqueous suspensions. This process, in fact, is performed without the addition of water which must be separated after the reaction section.

3) High-performance polyethylene from catalytic or radical processes

The objective is the improvement of processes efficiency and the development of products with high added value, like:

- Ethylene vinyl acetate EVA;
- Linear polyethylene LLDPE;
- Catalysts for homo and co-olymerizations of ethylene/alpha olefins.

4) New catalytic processes for the production of olefins and intermediates

The main challenge is to ensure the availability of monomers (benzene, butadiene, ethylene) that cover the needs of downstream sector. The aim is:

- Defining new processes that can integrate the current production and which follow the evolution of the market;
- Containing costs and improving the efficiency of the plants;
- Patenting new products/processing.

5) Green chemistry

The objective is the development of a production chain from biomass feedstocks.

The priority targets of the companies researches are:

- Vegetable oils with high compatibility with elastomers for the tire industry;
- New processes and transformation of sugar into fatty acids;
- New biofillers for the paper industry;
- Production of natural rubber extracted from alternative plants;
- New high performance lubricating bases containing oil from renewable sources.