FCC propylene production

Factors influencing the selection of propylene yield design points and a comparative study of an absorption-based gas concentration unit relative to cold-box recovery design show how refiners can leverage existing assets to close the market gap for propylene production

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Increased propylene production from FCC units has been widely discussed over the past three to five years, with reference to both new unit construction and existing units. One of the primary questions being asked of FCC experts today is how to properly balance the design and operation of the FCCU between maximum gasoline and maximum propylene production. The optimum is typically somewhere between these two extremes.

The average propylene yield from the installed FCC base is around 5.0 wt% on fresh feed (wt% FF) on a global basis. Many of the new FCCUs that will come online over the next ten years will produce even higher propylene yields, some with design points as high as approximately 20 wt% FF.

With the strong market demand for propylene and the capability to achieve elevated propylene yields with an FCCU, there is a natural desire to maximise propylene yields from new FCCUs. However, there are competing economic forces suggesting that the optimal propylene yield from an FCCU is 10–11 wt% FF, which is substantially lower than the current technology can produce.

Yields and operating severity

In comparing operating conditions and yields as a function of FCCU operating severity, the propylene yield pattern behaves as a continuum of operating severity and process design that can be optimised for refinery-specific economics. The optimum process design provides refiners with the flexibility to move up or down the optimal economic range of the propylene yield curve (Figure 1).

While propylene generation from an FCCU certainly varies with feedstock, it is primarily a function of reactor temperature, partial pressure, catalyst-to-oil ratio and total pressure. With a full-range hydrotreated VGO, the technology exists to operate over a range of about 5.0–20 wt% propylene on feed. It is important to note that higher propylene
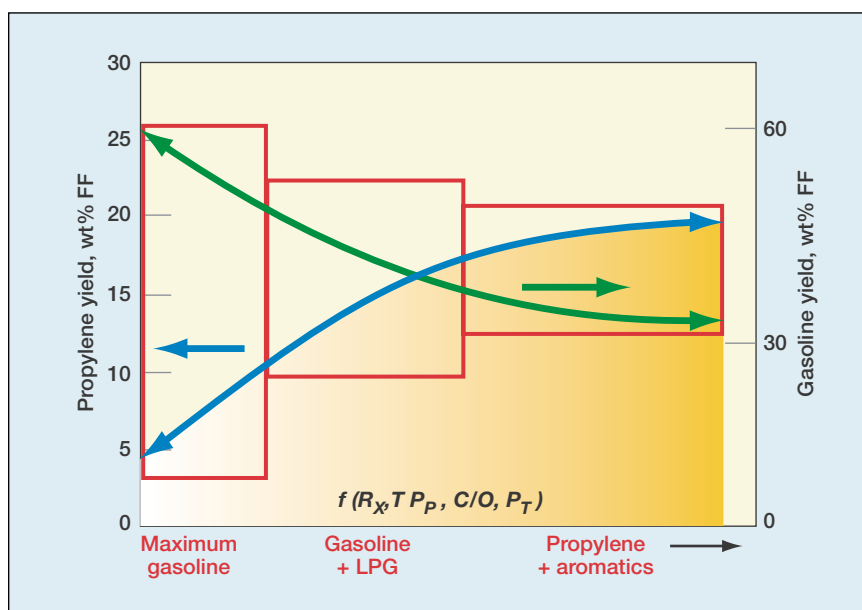

Figure 1 *FCCU design and operating modes*

FCC product yield comparisons across operating modes

| | | Wt% yield on fresh feed | |
Mode	Gasoline	Gasoline + LPG	Propylene
Ethylene	0.83	1.42	7.10
Ethane	0.90	0.94	1.21
Propylene	4.76	10.50	18.10
Propane	1.84	3.52	2.18
Butylenes	6.62	9.62	9.83
i-Butane	3.92	4.87	2.98
n-Butane	1.21	1.51	0.82
Debutanised gasoline	54.36	43.94	35.21
LCO	11.57	10.10	8.32
Clarified oil	7.93	6.89	5.59
Naphtha composition			
Aromatics	34.70	44.00	54.70
Benzene in gasoline	0.46	0.59	1.29

Table 1

production comes at the expense of gasoline. In working with refiners to meet their processing objectives, three design envelopes emerge:
— Maximum gasoline, which is traditional with most North American refiners
— Gasoline + LPG for refiners that want the optimal market flexibility
— Propylene plus aromatics for true petrochemical applications.

The inflection point typically defines the optimum, because any increase above this point requires a greater change

in the operating severity for the same change in propylene yield. It is important to note that the inflection point occurs in the gasoline + LPG mode of operation, not maximum propylene. Table 1 provides the yields for three modes of operation for an FCCU processing a typical 24° API full-range hydrotreated vacuum gas oil (VGO) feedstock.

Yield comparison

As the operation of the FCCU is shifted towards the higher propylene production, there is a coincident increase in ethylene and butylene. Along with this shift towards light products, there is also a decrease in gasoline yield and a change in the gasoline composition. While most refiners expect that higher propylene generation comes at the expense of gasoline yield, what is often not understood is that gasoline quality is progressively reduced at higher unit operating severity. This is due to existing aromatics being concentrated in less gasoline, as well as the production of additional aromatics. In this case, total aromatics increased by 58%, and benzene increased by 280%. With gasoline benzene limits already in force, the high benzene content of the propylene mode is often not suitable for gasoline blending without either extraction or saturation.

For most refiners, maximum propylene operation reduces gasoline quality and devalues the product. Refiners that practise propylene mode operation typically process the FCC naphtha through a naphtha hydrotreater and a Platforming unit as feed preparation upstream from a petrochemical complex for the production of benzene, toluene and xylene (BTX). However, high-severity FCC operation actually reduces the overall aromatics production by reducing precursors that would be more selectively converted to BTX in the Platforming unit. Optimising the overall complex LP is critical to defining the proper FCCU operating envelope.

In addition to high aromatics and benzene issues, the operating severity required to maximise propylene production results in nearly a fivefold increase in dry gas production with a high selectivity for ethylene. Many refiners consider the ethylene market to be outside of their core business objectives and, as such, devalue ethylene to fuel gas. Worse still, refiners can push themselves into situations where higher FCCU operating severity results in a situation where they are "long" on fuel gas, requiring a cut back to severity or capacity.

The gasoline + LPG mode appears to be a reasonable balance between the need for higher propylene production and the need to maintain acceptable gasoline blendstock quality. In the gasoline + LPG mode, it has been shown that it is possible to obtain a 180% increase in propylene production with only a 28% increase in the benzene content of the gasoline. Although the benzene content increases, more than 80% of this increase is due to the concentration of existing benzene production in the gasoline as a result of selectively cracking olefinic naphtha to LPG with the use of ZSM-5 additives. It is also important to note that butylene production hits a plateau around medium severity; so if the FCCU is being operated to produce alkylation feedstock, medium severity operation is good enough.

Production targets

There has been a significant increase in FCC capacity licensed over the past few years, accompanied by a clear trend in refiners' requests for greater propylene production from those units. With these projects, many refiners have embarked with the objective to push propylene yields towards the upper limits of what the equipment, catalyst and feedstock can produce. However, there is substantial evidence that this may be less than optimal. Table 2 shows the initial propylene targets as originally cited in the request for quotation (RFQ), and the final design basis for seven new FCC projects over the past two years. While FCC-based propylene production is desired, information in Table 2 strongly suggests there are economic forces compelling refiners back towards the gasoline + LPG mode rather than towards the maximum propylene production desired at the start.

The optimum cash cost of propylene production from an FCCU is an intricate balance of capital, throughput, operating severity and overall product values. Refiners often optimise their FCCU by maximising converted barrels (throughput), minimising their operating and capital costs, and producing a flexible product slate. The main problem with pushing the limits of propylene production from an FCCU is that all of

Initial RFQ propylene requests vs final design point		
	Wt% propylene yield on fresh feed	
	Initial RFQ	**Final design**
Unit "A"	---	10.5
Unit "E"	20.0	8.0
Unit "J"	20.0	10.5
Unit "P"	18.0	15.1
Unit "R"	21.0	11.3
Unit "S"	15.0	11.1
Unit "T"	16.0	10.0

Table 2

these optimisation factors are negatively impacted. The operating conditions needed to maximise propylene yield as a weight percentage of fresh feed require significantly larger equipment per barrel processed, resulting in a higher capital cost. To move the operation from gasoline to propylene mode derates the operating capacity by approximately 50%. In other words, if a unit is designed for a gasoline mode throughput of 50 000 bpsd, to maximise severity to propylene mode operation in the same equipment the feed rate would need to be reduced to approximately 25 000 bpsd.

The operating costs associated with maximum propylene production are higher than for gasoline mode operation. This further penalises the economics of maximum propylene production. Lower hydrocarbon partial pressure to maximise propylene selectivity requires additional steam use, and maximising propylene ($C_3=$) over butylenes ($C_4=$) requires lower absolute operating pressure, both contributing to larger vessel requirements per barrel throughput. The catalyst systems for maximum propylene production command a premium and, although all patents and royalty requirements for ZSM-5 expired globally as of 1 January 2007, the costs for ZSM-5 additives remain high. Lastly, increased LPG production and the net lower molecular weight of the reaction products increases the overall compression costs for product recovery.

As a net result of detailed Capex, Opex and product value evaluations, it is not surprising to see the market selecting an optimal propylene production that is far less than theoretical limits. While there will always be exceptions, the ideal balance point across a variety of feedstocks and market regions appears to be around 11 wt% FF propylene yield, as previously mentioned.

When determining the optimum design and operating point for a unit, it is important to understand the relationship between propylene selectivity as a function of the percentage of feed processed and yield as a function of the tons produced. Within a fixed unit size, the economic influence of feed rate is much greater than that of operating severity. In almost all cases, it is better to maximise throughput over severity. To help demonstrate this relationship, consider an FCCU that is constrained by maximum cyclone velocity. At this point, there is a trade-off to be realised between operating severity and throughput. If throughput is increased, the operating severity must be reduced; likewise, if severity is increased, throughput has to be reduced. By carefully evaluating this relationship with the refiner, the most economic unit
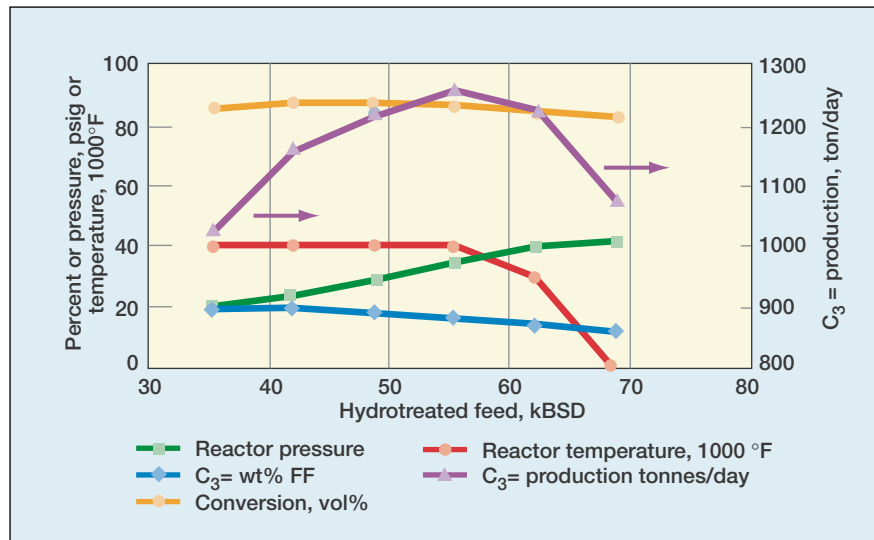

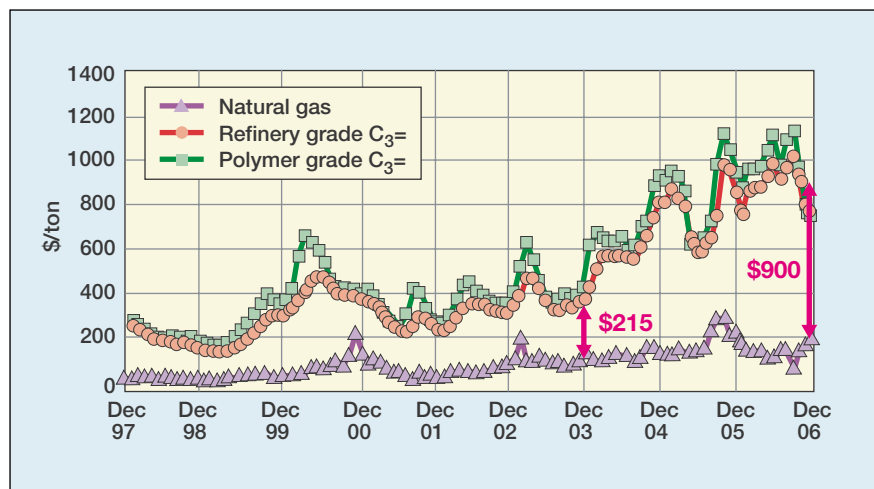Figure 2 Unit size vs throughput and severity

Figure 3 Propylene and natural gas values

design can be determined. This relationship is demonstrated in Figure 2.

Figure 2 shows a set of operating variables for a unit that is constrained by cyclone velocity. This example begins with a unit designed to operate at 35 000 bpd, at a maximum severity to achieve 20 wt% propylene on feed. The combination of operating variables results in a maximum recommended cyclone inlet velocity. As the feed rate is increased, one of the other operating variables (reactor temperature, steam rate or total pressure) has to be changed to maintain the same flowing volume of products to the cyclones. Increased reactor pressure has the least detrimental effect on propylene selectivity. As such, it is the first variable to be moved. The propylene yield from the feed rate outpaces the selectivity loss with increased reactor pressure. Although the wt% propylene on feed goes down, the actual tonnes per day (tpd) of production increase. This relationship can be maintained until the reactor nears a design pressure limit. At this point, any additional throughput requires the reactor temperature to be reduced and

propylene production starts falling rapidly. In this example, we have been able to double the feed rate to the unit and end up with nearly the same tonnes per day of propylene production.

The peak propylene production (tpd) occurs at a propylene yield of approximately 15 wt% FF, which is well under the maximum theoretical propylene yield of the feedstock. Since the other key products such as gasoline have good market value, refiners have the incentive to push capacity higher and accept lower propylene yields.

FCC propylene production

There have been many published market projections over the past few years indicating a shortage of propylene supply to the market. Purvin and Gertz project the worldwide FCC capacity to grow at an average annual rate of 2.7%, while the 2005 CMAI data indicates that propylene production from FCCUs will increase at an average annual rate of 4.3% from 2005–2015. This is consistent with the data presented in Table 2, showing that the wt% of propylene produced from the average new FCCU is
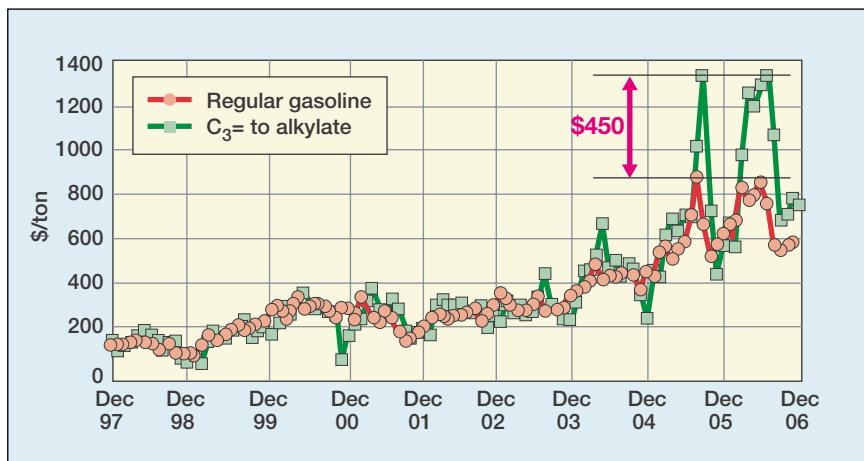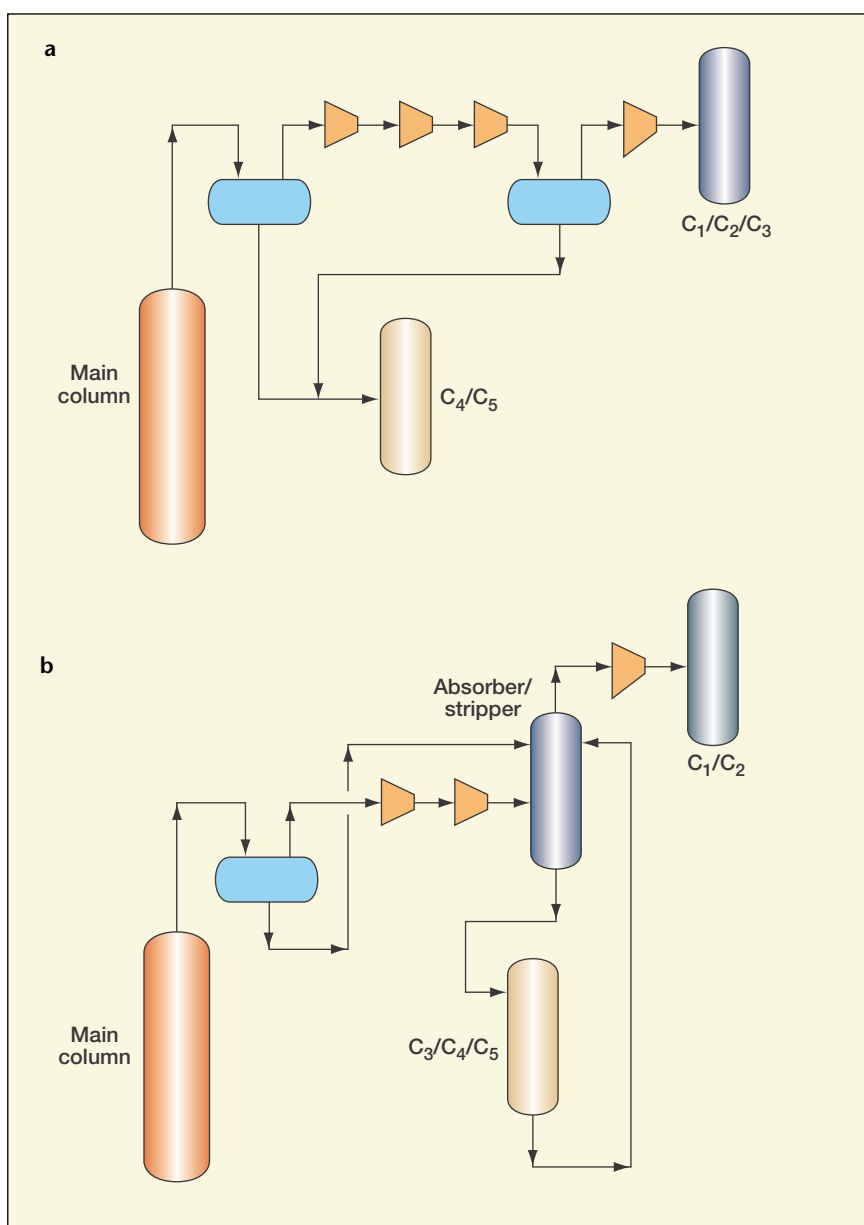
Figure 4 *CMAI US short-term propylene prices*

Figures 5a & 5b *Product recovery system designs*

FCCUs: first, improve the recovery capability of the existing gas concentration unit (gas con), and second, increase the quantity of propylene produced in the FCC reactor. The three primary propylene product outlets are feedstock to a polypropylene complex, feedstock to an alkylation unit and sold as mixed LPG.

CMAI estimates that on average the recovery of polymer-grade propylene from FCCUs across the world is approximately 67%. Irrespective of where the propylene product is sent, the economic incentives to improve recovery have increased dramatically over the past few years. The incentive for the refiner to invest in gas con recovery projects is the value differential between propylene and natural gas. Prior to 2003, the value gap was about only $215 per tonne, which made it difficult to justify recovery projects. However, since then, the value gap has dramatically increased to around $900 per tonne, making C_3 slippage to fuel gas much more costly to the refiner (Figure 3).

An optimised FCCU should operate between 3.0–5.0 mol% C_3+ in the fuel gas. When operating below 3.0 mol% C_3+, there is a risk of over-absorption of H_2S in the gas con unit, which can cause a pH imbalance, possibly resulting in elemental sulphur precipitation in the gasoline and/or accelerated corrosion in the system. Operating the gas con unit above 5.0 mol% C_3+ in the fuel gas results in a downgrade of valuable product. For example, consider the operation of a 50 000 bpsd FCCU at a value gap of $900 per tonne. Slipping from 3.0–7.0 mol% C_3+ in the fuel gas results in a product value loss of about $4.6 MM per year (Table 3).

With respect to increased operating severity, the incentive to move higher on the propylene production curve is the value gap between propylene-to-alkylate feed and regular gasoline (Figure 4). There have been substantial periods of time over the past three years when this differential has been quite significant, extending to around $450 per metric ton. The market does appear to be taking advantage of this opportunity. UOP has recently completed over 500 000 bpsd of revamp designs for existing FCC capacity with the objective of increasing propylene yields in the range of 7.0–10 wt%.

Product recovery system: technology comparison

While refinery economics are driving most refiners towards unit designs in the 10–11 wt% propylene range, there are a few exceptions, as highlighted in Table 2 with unit "P". Although the refiner determined that propylene generation should be reduced slightly from the

expected to increase over historical norms. However, it is also important to note that not all of the future growth has to come from new FCCUs. There is definitely a place for leveraging existing assets to help close the market gap on propylene.

The average propylene production from FCCUs in the US is about 4.8 wt% FF. This is significantly lower than the 10–11 wt% optimum discussed herein. There are two ways to increase propylene production from existing

original target, it was still quite high. The high propylene and coincident ethylene production made UOP question whether the traditional absorption-based gas con unit was still applicable, or whether the design be shifted to a cold-box recovery system similar to those employed on steam cracking units. To answer this question, a detailed study comparing the absorption-based gas con system with a cold-box light olefins recovery system designed for a propylene mode FCCU was completed. A general schematic of each system is shown in Figures 5a and 5b.

The compression-based cold-box recovery system uses straight compression and fractionation to recover light olefins, and is very efficient when there is little or no naphtha in the process. Such is the case with a steam cracker application. However, there are naphtha products that need to be recovered with an FCC system.

The absorption-based system employs an absorbent naphtha circulation that allows the number of compression stages to be reduced. Also, the fractionation section is configured to take advantage of low-cost heat integration with the main fractionator.

Case study

Gas con unit vs cold-box design

The objective of a gas con unit vs cold-box design study was to determine which recovery system provided the best overall product recoveries, operating flexibility, and capital and operating costs. To evaluate these alternatives, the following general work process was used:
— The design basis was set as a 50 000 bpsd FCCU operating in propylene mode
— Simulation models were built for an absorption-based gas con unit and a cold-box light olefins recovery system
— Each process design was optimised to achieve 98% recovery of polymer-grade propylene and ethylene at 99.5% purity
— Preliminary equipment designs were generated for each system
— Capital cost estimates were generated for each design.
— All required product treatment units were considered (ie, guard beds, driers, treaters, mercaptan oxidation (eg, proprietary Merox process), amine unit and selective hydrogenation process (SHP) unit
— Detailed simulation models were used to generate utility costs associated with each design.

Capital and operating costs were estimated for the alternatives based on a +30% error band. A total annualised cost (TAC) was calculated to provide a single metric with which to compare the alternative process designs. A capital recovery of 20% was used to convert
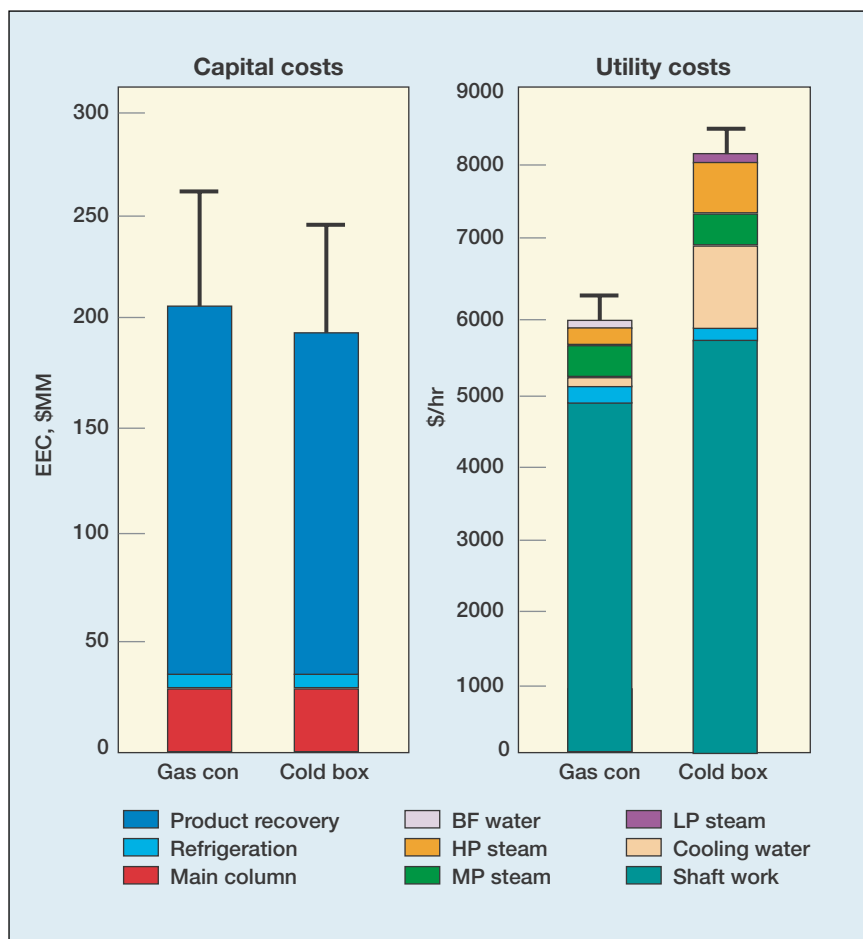

Figure 6 Capital and utility costs

Propylene product downgrade[1]

C₃+ mol% in dry gas[2]	C₃= slippage to dry gas[3] (tonne/day)	C₃= downgrade to natural gas[4] ($/day)	
3 mol%	10.2	$0	
5 mol%	17.4	$6480	△ = $4.6 MM/year
7 mol%	24.8	$13 460	

1 Economics based on a 50 000 bpsd FCCU.
2 Additional slippage of C₃+ was considered at 61.2% C₃= and 38.8% C₃.
3 C₃= was valued at "refinery grade" as a feedstock to an alkylation unit valued at $680 per metric tonne per CMAI for October 2006.
4 C₃= was valued as natural gas at $195 per metric tonne per CMAI for October 2006.

Table 3

erected equipment cost (EEC) into an annual cost.

Capital cost evaluation

In the capital cost evaluation, the cold-box designs had fewer pieces of equipment than the absorption-based design and could arguably be considered to have a lower cost, but the differential fell well within the error bars of the cost estimates, as shown in Figure 6. The economics shown are based on the EEC. Since the design of the reactor, regenerator and the C₃ splitter are common between the gas con and recovery designs, these costs are considered to be the same for both designs and are not included in the EECs represented in Figure 6.

The utility cost evaluation shows that the absorption-based design is a clear winner over the cold-box system, even when considering the error bands for the calculations, as shown in Figure 6.

The higher utility cost associated with the cold-box system is due to higher refrigeration and hence compression load requirement to condense C₃+ from the main fractionator overhead vapour, and higher LP and HP steam consumption. With the absorption-based gas con unit, all of the fractionation and absorption equipment is on heat integration with the main fractionator, and the energy contained within the main fractionator is the cheapest source of energy available.
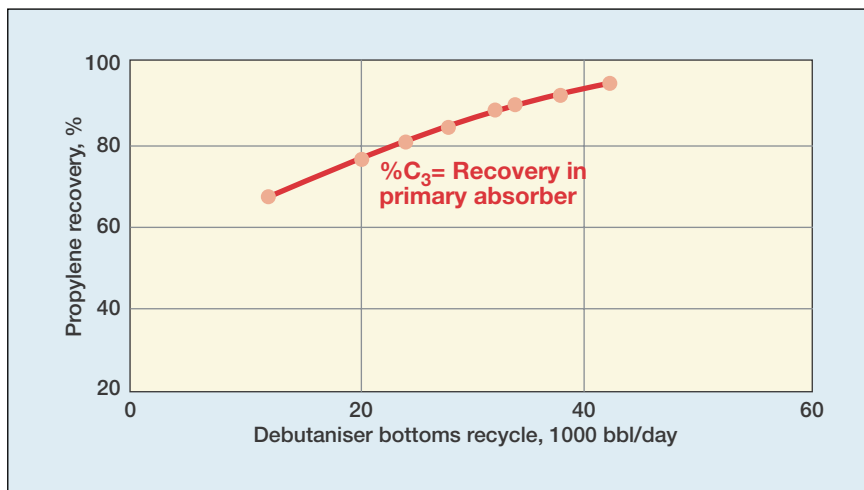
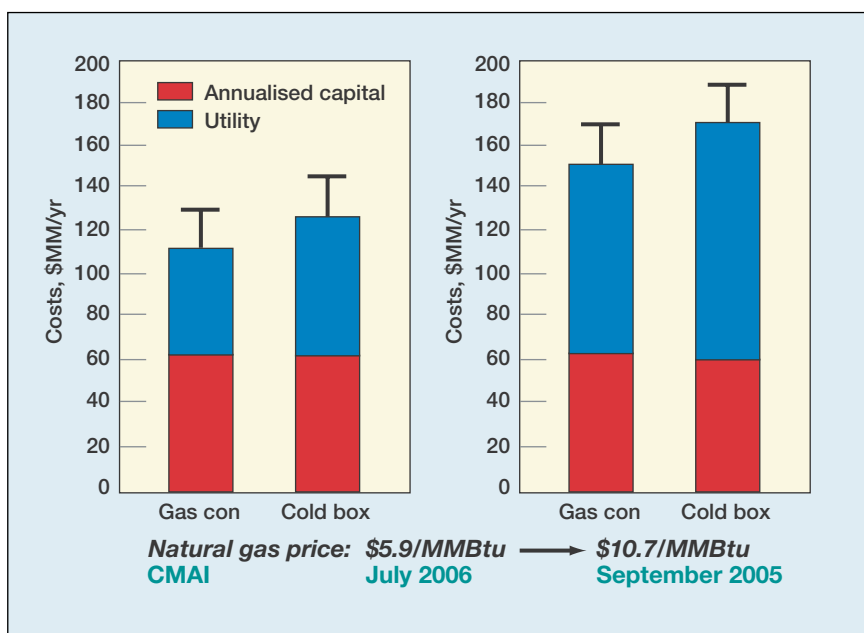**Figure 7** *Propylene recovery in the primary absorber*

Figure 8 *Utility and annualised capital costs*

In addition, naphtha recycle from the debutaniser bottoms to the primary absorber is effective at recovering propylene. Through normal recycle rates, approximately 90% of the propylene is recovered via absorption, which offloads the compression horsepower required to condense the material (Figure 7).

The utility costs are based on a natural gas cost of $5.9/MMBtu, which was taken from the EIA as the price of natural gas in October 2006.

Annualised cost

Since feed consumption is constant between the two cases, the annual feed costs for both cases are identical and can be excluded from the annualised cost (AC) analysis. Figure 8 shows that the lower operating cost of the absorption-based gas con system compensates for any increased capital expenditures.

The annualised costs for each of the systems were compared on a utility basis

pegged to a fuel gas price of $5.9/MM Btu and were found to be arguably lower for the absorption-based system. As a validity check against rising utility prices, the annualised costs were also evaluated at $10.7/MM Btu and, again, the absorption-based system appeared better. The high absorber efficiency beats compression costs across a wide range of utility values.

Based on the results of this analysis, UOP has decided to maintain the absorption-based gas con system as the primary offering for all FCC designs and operating modes. While the capital costs were proven to be essentially the same, the absorption-based gas con unit is more cost-effective to operate. UOP also believes that the absorption-based recovery system provides the refiner with the greatest flexibility across the entire operating range from propylene to gasoline mode, allowing the refiner to better meet fluctuating market opportunities while maintaining efficient operations.

New unit designs

The industry benchmark for FCC product recovery has been the gas con unit. With its traditional design of wet gas compression, absorption and light ends stripping, it has become a standard due to its energy-efficient heat integration with the FCC main fractionator. The heat energy of the main fractionator is simply the lowest-cost energy source available. Even when reactor propylene yields approach the 20 wt% FF range, with some relatively minor improvement to the base design, the gas con unit can efficiently achieve propylene recoveries in the range of 98–99%.

Operating variables in the gas con section that have a significant effect on propylene recovery are pressure, cooling temperature, absorber lean oil circulation and absorber efficiency. These variables can be optimised across a broad shift in product slate to maintain high product recoveries. The addition in equipment and operating cost vs the level of recovery is also a variable that the designer needs to optimise to increase the return on investment. For FCCUs with propylene yields near 20 wt% FF, the UOP gas con unit designs employ the following changes from the traditional design:

— **Increase in absorber pressure** Consistent with the higher overall operating severity of the FCCU, additional dry gas (C_2 minus) is produced. With the increase in dry gas and LPG in the reactor, higher pressure at the absorber is required. However, the increase in pressure is often limited due to heat integration with the main fractionator, which is impacted by the pressure cascade through the stripper/absorber system. The increase in pressure requires an increase in the stripper reboiler outlet temperature. The reboiler heating medium circulations from the main fractionator (LCO & HCO) must be increased to maintain a "delta T" ($\triangle$T) between the circulating oil and reboiler outlets. Based on UOP experience, there is no problem increasing the gas recovery pressure an additional 50 psig over the conventional design

— **Cooling temperature** A chilled water system is required for the absorber intercoolers and lean oil cooler for propylene mode operation in the 20 wt% FF range. The system may cost a few million dollars, but when compared with propylene product value the payout has been seen as less than one year. The chilled water system is simply a cooling system capable of supplying water for certain exchangers at 50°F. This should not to be confused with a cold-box refrigeration system used for light ends recovery. For propylene yields less than 12 wt% FF, gasoline + LPG operating mode, a chilled water system is often not required
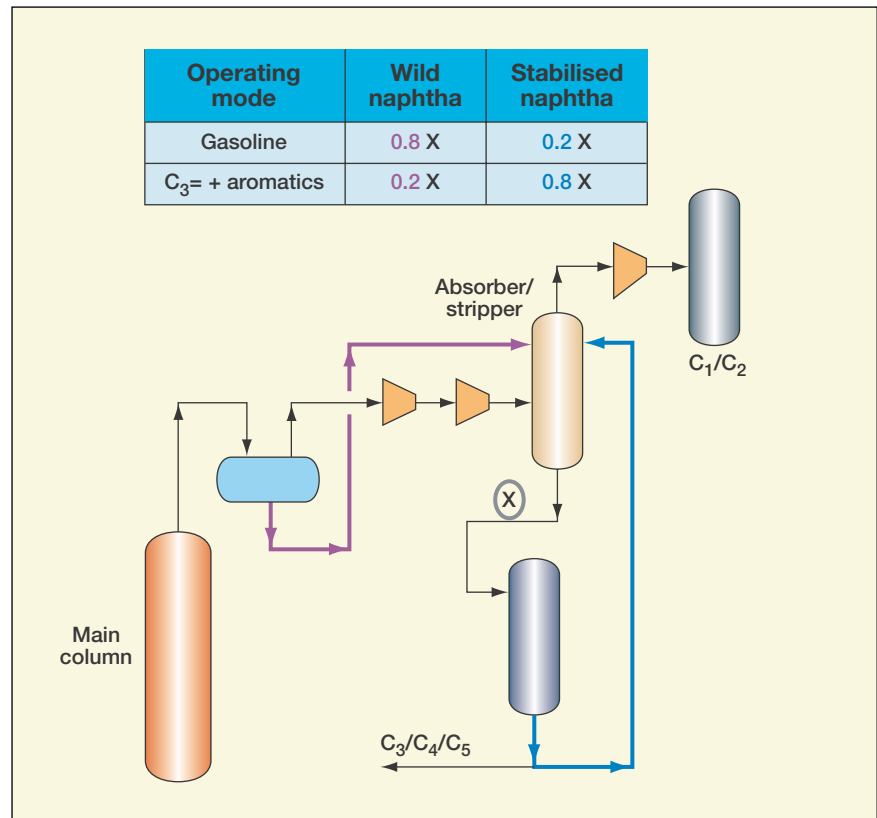
Operating mode	Wild naphtha	Stabilised naphtha
Gasoline	0.8 X	0.2 X
C_3= + aromatics	0.2 X	0.8 X

Figure 9 *Absorption based gas con flexibility*

— **Absorber lean oil circulation** The absorber feed, which is the main fractionator receiver liquid, is routed to the absorber. In the propylene mode (more LPG and less gasoline yield), the feed to the absorber is rich in LPG and contains less gasoline. To achieve a high propylene recovery in the absorber, lean oil circulation from the debutaniser to the absorber must be increased. Lean oil circulation could approach 200% of the net gasoline. However, the actual flowing volume of lean oil is not that different than from the traditional design operating in gasoline mode. For example, the feed to the debutaniser in the propylene mode will contain a small amount of net gasoline and a large amount of recycle. For the gasoline + LPG mode operation, the feed to the debutaniser will contain a large amount of net gasoline and small amounts of gasoline recycle. The net result in terms of heat balance on the debutaniser is no different from the traditional system. This is a big advantage with an absorption-based gas con unit design. The debutaniser reboiler requirement and heat integration with the main fractionator will be little affected when the FCCU switches modes of operation: gasoline + LPG mode to propylene mode, or vice versa

— **Absorber efficiency** The number of absorber trays is a variable that can be used to increase absorption efficiency. For propylene mode operation, an additional 20–30 trays and two more intercooler loops may be required for the absorber to achieve the desired recovery.

Revamp unit designs

The feasibility of employing the absorption-based gas con with high LPG and low naphtha yields has occasionally been challenged, based on a perception that there simply is not enough naphtha absorbent available to maintain system efficiency. There is, in fact, more than enough. The primary absorber is designed to circulate both stabilised and wild naphtha absorbent (Figure 9). In gasoline mode operation, 80% of the absorbent is wild naphtha from the main column overhead receiver and 20% is stabilised naphtha from the debutaniser. As the unit is moved to maximum propylene generation, the absorbent ratio changes towards 80% stabilised naphtha and 20% wild naphtha, but the net liquid leaving the bottom of the absorber stays essentially the same. This is a very important point, as the same equipment capacity is applicable over a large range of operating severity.

This flexibility in the absorption-based FCC gas con design has enabled many refiners in recent years to shift their operations towards higher propylene yields in the range of 7–12 wt% FF within existing main equipment constraints, while maintaining high levels of light olefins recovery. Balancing the target propylene generation, percentage recovery and the cost of modifications to achieve the refiner's objectives is an important part of every revamp study.

When trying to maximise the value of existing assets, the additional capital required to achieve a propylene recovery of 97% may not be economic when compared to that of a 96% recovery case. A single percentage change in design recovery can require substantial equipment modifications or replacement. A process study normally reveals unit limitations and provides the refiner with answers that lead to the most economic case for revamp implementation.

UOP has been involved in many unit revamps with high propylene recovery targets. In one of the more aggressive cases, the refiner achieved a 58% increase in throughput, while simultaneously achieving a 30% increase in propylene yield over the original nameplate design. To achieve this goal, the unit was progressively debottlenecked in stages to identify the true limits of the equipment's components, enabling the best use of capital investment to achieve the refiner's objectives.

While no two units are ever designed or operated the same, there are some typical capacity constraints that require revamping to enable higher severity or higher throughput operation of the gas con unit, including:

— **Wet gas compressor capacity** The increase in light ends and LPG make will increase the load in the wet gas compressor. However, for most revamps, the reactor pressure is normally increased to accommodate the reactor cyclone design within the existing reactor shell constraints. Increasing the reactor pressure results in an increase in the compressor suction pressure, which often offsets the decrease in molecular weight to the compressor. Due to the high cost of wet gas compressor replacement, in many cases the operating conditions for the revamp are set within the maximum capacity of the existing compressor casing. It is important to note that rotating equipment vendors have also improved their technical offerings and can now often re-rate existing equipment beyond previously considered limitations:

— **Fractionators/absorbers capacity** In most revamps, the capacity constraints of trayed columns can be overcome with the use of high-capacity trays, such as the proprietary MD trays or packing. The typical limiting areas are the HCO section of the main fractionator, top section of the debutaniser, the stripper and the absorber

— **Cooling temperature and absorber lean oil circulation** For propylene yields less than 12 wt% FF, a traditional cooling water heat-removal system is generally sufficient to meet the desired propylene recovery. A chilled water system can be applied if the unit has other constraints that cannot be overcome. However, this is not typically required. Absorber lean oil circulation is

"An optimally designed absorption-based gas concentration unit is still the best choice for the entire severity range of operation"

normally the primary variable that can be adjusted for a revamped unit to achieve a higher propylene recovery

— **Heat integration with the FCC main fractionator** Proper design of the main fractionator's heat integration with the gas con is typically the most complex part of most revamps. Different scenarios of heat exchange with the main fractionator are normally identified to stay within the main fractionator's limitations and reduce equipment modifications

— **Alternative absorber configuration** The conventional UOP scheme can be modified to increase propylene recovery to the stripper bottoms and C_2- rejection to the primary absorber lean gas. The traditional recycle of stripper overhead vapour back to the inlet of the high-pressure condenser is eliminated. This offloads the condenser and the high-pressure receiver, allowing for more economic new unit design and greater potential to retain existing equipment in revamp situations. This also provides a means to revamp units for higher throughput or severity of operation that are constrained by plot space to increase high-pressure condenser duty. The stripper feed preheater can also be eliminated to improve feed conditioning to the stripper and give better propylene recovery. These changes can result in greater than 99% propylene recovery and C_2- rejection sufficient to make polymer-grade propylene specification while eliminating the need for a downstream deethaniser column.

Incentives

Global propylene demand trends remain strong, and with the change towards lighter feedstocks in new steam crackers there will be a growing reliance on FCCUs to balance the supply side of the propylene equation. The technology exists today to help make this happen. UOP believes the FCC process is flexible enough to meet the challenge associated with closing the global market gap for propylene. We believe this will happen through a combination of new units designed for elevated propylene yields and revamps of existing facilities to increase propylene yield and recovery within logical equipment constraints.

UOP has determined that an optimally designed absorption-based gas

concentration unit is still the best choice for the entire severity range of operation. It provides a lower cash cost of production relative to a cold-box design due to lower utility consumption and gives additional flexibility across a broad range of propylene yields, allowing the operator to adjust FCC yields to meet changes in the marketplace while maintaining efficient operations. This capability is especially important during times of volatile energy prices.

Competing economic forces and real market data that suggests the optimal yield of propylene from a FCCU is 10–12 wt% FF, which is substantially lower than the theoretical limits associated with most feeds and operating systems. The premium propylene and butylene command over other products, such as gasoline, is enough to give many refiners the incentive to invest in their existing assets.

Platforming, Merox and MD are marks of UOP.

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