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NAPHTHA TO ETHANE/PROPANE (NEP)

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CHALLENGES IN THE GLOBAL OLEFIN INDUSTRY

The olefins industry is facing challenges with increasing competitiveness, in terms of cost of production, amidst a growing concern about feedstock security in many parts of the world. While ethane crackers remain the lowest cost to build and operate, many liquid crackers have already been built around the globe. These installations have sought to capture local price discounts for light naphtha and their operation is mainly due to feedstock security. Ethane is not prevalent in many places and is expensive to transport. As the olefins markets continue to grow, firms that operate liquid crackers are coming under increased pressure for profitability and competitiveness, most notably in Asia and Europe.

Projected growth in olefin demand is outpacing the coproduction of ethane and propane with crude oil. As a result, the majority of new steam cracker growth has been focused on liquid feedstocks. In addition, sustainability concerns loom as steam crackers are major carbon dioxide (CO_2) emitters. Achieving greater efficiency in production is vital. Amid changing dynamics in hydrocarbon markets and geopolitical events, the **Integrated Olefin Suite (IOS)** and **Naphtha to Ethane/Propane** technology offers solutions.

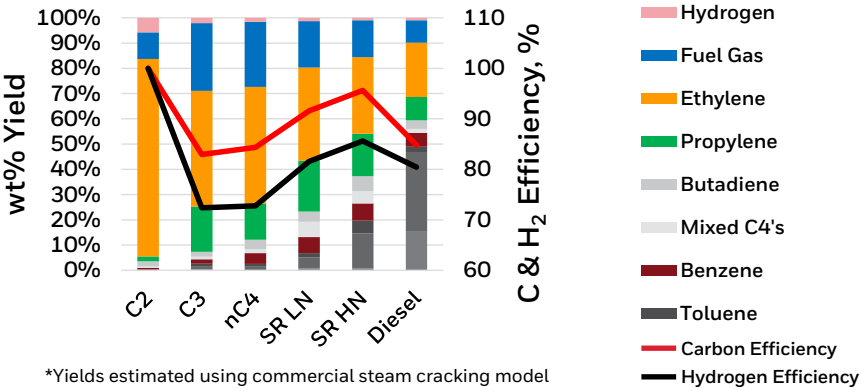
KEY BENEFITS OF NEP

- Reduces cost of steam crackers - C_2 crackers significantly cheaper than MFSC's
- Increase net cash margins
- 5-50%[2] lower CO_2 intensity per metric ton of light olefin
- Wide range of E/P design flexibility
- Feedstock and E/P retrofit ability - future-proof
- Improves feedstock security by relying on readily available feeds such as naphtha and crude
- Reduces SC feedstock up to 55%

WHY ETHANE IS A VALUABLE FEEDSTOCK

Ethane is the optimal feed because of its superior ethylene yield. Compared to other feeds, ethane delivers nearly 80% ethylene yield, while other feedstocks, like propane, naphtha or heavier feedstocks, yield less ethylene and more unwanted byproducts, including fuel gas and pyrolysis oil. Ethane outperforms in both ethylene production and environmental impact[1], making it the preferred feedstock for most ethylene producers.

STEAM CRACKER YIELDS & C/H EFFICIENCIES BY FEED*



*Yields estimated using commercial steam cracking model

CHALLENGES WITH ETHANE

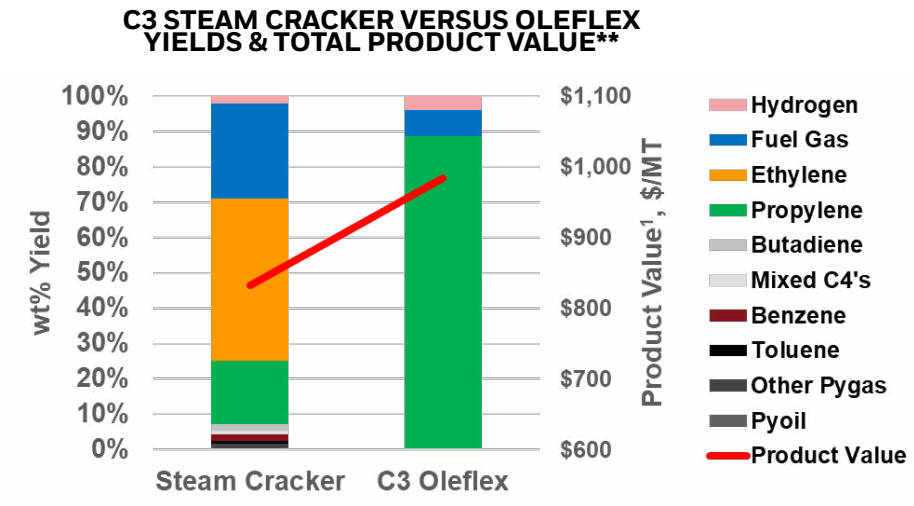
While ethane is a superior feedstock for crackers and results in the lowest-cost installations, the growth in ethylene demand is outpacing ethylene availability in the market. In addition, increasing global demand for ethane against limited supply is projected to drive the cost of ethane upward over time.

CHALLENGES WITH PROPANE

Although the cracker industry has processed propane in steam crackers for decades, it is one of the least efficient molecules to feed to a cracker. This is due to its poor selectivity for ethylene, resulting in excessive loss of carbon and hydrogen to methane production. Considering propane's use, it creates more value when processed in a propane dehydrogenation (PDH) unit, like a Honeywell UOP Oleflex Unit, yielding higher propylene output, increased hydrogen and reduced fuel gas compared to steam cracking. This approach enhances profitability by generating approximately $150.00 more per ton of propane feed, making PDH the preferred route for propane utilization.

PUT THE RIGHT MOLECULES IN THE RIGHT PROCESS UNIT

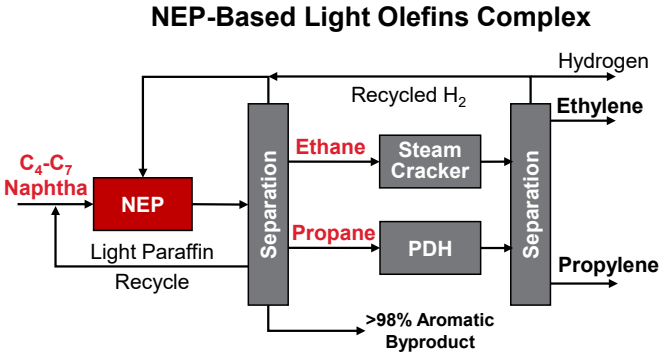
A key element of UOP's design philosophy utilized in its Integrated Olefin Suite is **molecular management**, which simply means efficiently directing the right molecules to the right process units in which they can create the most value. For example, in an olefin complex, ethane is directed to a steam cracking unit to optimize the production of ethylene, whereas propane is directed to a propane dehydrogenation unit to optimize the production of propylene. However, what does one do if access to ethane and/or propane is limited? This problem is precisely why UOP created the Naphtha to Ethane/Propane process.

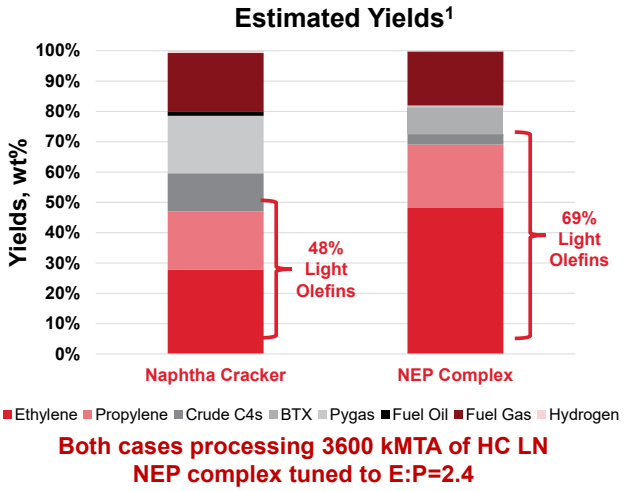


**Complex yields estimated using commercial steam cracking model and UOP proprietary models

NAPHTHA TO ETHANE/PROPANE

NEP presents a versatile solution for on-purpose ethane and propane production. It catalytically converts light naphtha and butanes into adjustable amounts of ethane and propane. Following this conversion, the ethane can feed an ethane steam cracker to produce ethylene, while the propane goes to a propane dehydrogenation unit, like a Honeywell UOP Oleflex Unit, for propylene production. This approach offers flexibility, enabling the adjustment of ethylene and propylene production. It is more cost effective than liquid-feed cracking, as ethane crackers require lower CAPEX. Additionally, it reduces CO_2 emissions by 5-50% per ton of light olefin. The higher end of this range is typical when Scope 3 emissions are included from steam cracker by-products sold into fuel applications. NEP's adaptability and feedstock security make it a promising and sustainable investment, likely enabling higher returns.





Both cases processing 3600 kMTA of HC LN
NEP complex tuned to E:P=2.4

YIELD COMPARISON

The chart above shows that directly feeding hydrocracked naphtha into a steam cracker yields approximately 50% ethylene plus propylene, with the rest comprising various byproducts, including methane, fuel oil and non-target products. In contrast, employing the Honeywell UOP NEP method to convert naphtha to ethane and propane and then utilizing an ethane cracker and a PDH unit can achieve yields of up to 70% light olefins, significantly increasing production efficiency. Further yield improvement is possible through recycling C4 components and pygas, potentially exceeding 80%. It is well known that branched paraffins are undesirable in a steam cracker feed due to poor yields of ethylene. In contrast, the NEP process is iso-tolerant, meaning that the yields of ethane and propane are not significantly impacted by the degree of branching.

HOW IS NEP DIFFERENT FROM IOS?

The NEP process adds another powerful solution to the UOP Integrated Olefin Suite, which aims to optimize the production of light olefins by:

1. Optimizing the feeds used for light olefin production.
2. Generating propylene and butylene using catalytic dehydrogenation technologies to maximize carbon efficiency and profitability.
3. Minimizing loss to lower-valued by-products.

CONCLUSION

The global demand for light olefins is increasing, but limited ethane supply necessitates liquid feed crackers, which often have problems related to profitability and lack of flexibility. The Honeywell UOP NEP process transforms liquid feeds into ethane and propane, enhancing profitability, flexibility and sustainability. Honeywell UOP's Integrated Olefin Suite further augments product versatility and sustainability. flexibility and sustainability. Honeywell UOP's Integrated Olefin Suite further augments product versatility and sustainability.

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[1] Environmental impacts of ethylene production from diverse feedstocks and energy sources"; M.adhav Ghanta, Darryl Fahey, Bala Subramaniam, Applied Petrochemical Research, 4:167-179, 2014

[2] Based on UOP crude to petrochemical studies (ID#0033, ID#0034, ID#0035) using standard UOP simulations models and methodologies to estimate combined Scope 1-3 emissions

For more information

For more information, please contact your UOP representative or visit us online at www.uop.com

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