

Refinery catalysts set for growth

Demand for renewable fuels, need to improve refinery performance will drive market

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The refinery catalysts market is expected to continue growing in 2024, but at a low single-digit percentage rate and with variation across regions. The ongoing transition toward renewable, cleaner fuels is boosting demand for catalysts that improve the efficiency of refining, and artificial intelligence (AI) is emerging as a potential game changer for the industry.

Refined product demand recovered to near pre-pandemic levels in 2023 and is expected to record “limited” growth in 2024, Detlef Ruff, senior vice president/process catalysts at BASF SE told *CW*. “The speed of recovery and further growth is expected to vary by region and the market has recently experienced several challenges such as inflation, regional political conflicts, regional differences in demand recovery post pandemic and shifts in market requirements for products based on regulations and specific product price premiums,” Ruff said.

As a result, BASF expects to see refinery catalyst demand grow slightly in 2024 to support the high utilization of most refining assets, increased regulatory fuel specifications and the startup of new refinery assets, he said.

Michael Simmons, president of Ketjen Corp., a wholly owned catalysts subsidiary of Albemarle Corp., expects more stability in the refinery catalyst market in 2024, following various disruptions in 2022 and 2023, and “some” growth as new refineries in Asia-Pacific, Latin America and Africa will come online in late 2024. “Refiners are returning their focus to optimizing the performance of their assets via throughput and yields. It is a process that most refiners do well and where Ketjen as catalyst supplier has meaningful

contributions to make,” Simmons said.

Several factors, such as the growth of the global oil and gas industry, increasing demand for cleaner fuels, stringent environmental regulations and the need for more efficient refining processes, will drive growth in the refinery catalysts market in 2024, according to Su Pei Lim, principal research analyst/specialty chemicals at S&P Global Commodity Insights.

Refinery catalysts play a crucial role in enabling refineries to meet regulatory requirements by facilitating processes such as catalytic cracking, hydroprocessing and isomerization, Lim said. These processes help convert crude oil into valuable products such as gasoline, diesel and jet fuel with higher efficiency and lower environmental impact, she said. The long-term penetration of electric vehicles (EVs) is, however, expected to have an adverse impact on the refinery catalysts market, she added.

Consumption of refinery catalysts is projected to increase by about 2%-3% in 2024, primarily driven by the hydrotreating, reforming and catalytic cracking processes, Lim said. Strong demand for jet fuel, gasoline and diesel, particularly in regions such as Asia, the Middle East and Africa, will also drive the refinery catalyst market’s growth in 2024, she said.

According to Clyde Payn, CEO at consulting firm The Catalyst Group (TCG; Spring House, Pennsylvania), the outlook for the refinery catalyst industry in 2024, based on production expectations in transportation fuels, looks firm, and the market is expected to grow by about 1%-2% this year, in line with global GDP growth forecasts. The outlook assumes that the impact of expected refinery closures in the EU will continue to be offset by new capacities elsewhere, Payn said.

“The general impression is that the refining industry, that is tightly associated with the refinery catalysts industry, is going to remain

fairly comfortable throughout 2024-2025.

Refinery fuel production and margins spreads are likely to remain comfortable too,” Payn said.

The supply-demand balance for fuels is expected to be solid, as the transport fuel “trilemma,” which has been prominent for the last two years, deepens due to decreased EV penetration, upstream US consolidation and expansion in demand for renewable diesel (RD) and sustainable aviation fuel (SAF), he said.

Refinery operating rates are expected to be “normal” in the US, but in Europe the situation will be different, with more refinery consolidation anticipated in 2024 and a possible shifting of very large investment into chemicals from the refining industry as that sector restructures over time, according to Payn.

Renewables shape catalyst development

The refining industry and, in parallel, the refining catalyst industry are moving increasingly toward renewable fuels and fuels with lower carbon intensity, Payn said. “Co-processing of biogenic feedstocks in fluid catalytic cracking [FCC], hydrodesulfurization [HDS] of biofeedstocks and pyrolysis oil were trending stronger over the last year,” Payn said.

There is also a rebound in the air travel industry, bringing a recovery in demand for jet fuel, with demand for SAFs also on the rise. However, there is currently not enough refining capacity to meet demand, which is reflected in the industry’s 2030 targets for SAF, he said.

Meanwhile, California’s 2035 target of banning internal combustion engine (ICE) vehicles altogether is impractical given market economics and geopolitical factors, Payn said. A similar situation exists in Europe and even in China, the world’s largest EV producer, with demand for EVs dropping rapidly since 2022, when the Chinese government removed subsidies it has been providing to EV buyers.

“With China’s current economic outlook, a rebound in the demand for EVs is not to be expected this year. In fact, China is exploring opportunities to push their excess EV production into Europe and North America,” Payn said.



RUFF: Growth in 2024 will be limited.



SIMMONS: FCC units to produce more propylene.

Meanwhile, the refinery catalysts industry “is moving toward new process catalysts and technologies to improve the cost performance of the production of renewables, but the industry is well aware and very pragmatic, understanding that it will take time to develop the appropriate solution,” he said. Other shorter-term objectives include focusing on lower-carbon-intensity fuel and mitigating core CO₂ emissions such as from FCC units, heaters, distillation units and reformers, Payn added.

The refining industry sees itself as the route to provide liquid fuels for aviation and all types of transportation, John Murphy, president at The Catalyst Group Resources (TCGR), a member of TCG, told *CW*. “The refiners are making sure that they continue to practise traditional technologies so that they can meet jet fuel demand, whether it’s from alternative feedstocks or traditional feedstocks. Nonetheless, the expectations or the mandates for alternatives far exceed the refiners’ capability right now,” Murphy said.

For BASF’s Ruff, several trends are shaping the future of the refinery catalysts market. Growing demand for cleaner and more-efficient refining processes — to support demand for transportation fuels, petrochemicals and other refined products — is the main trend that will drive the market for refinery catalysts in 2024, he said. Meanwhile, global population growth and economic development continue to drive demand for refined products, he added.

Ruff also noted that refiners are required to meet more diverse regional requirements, including environmental regulations, and growing demand for low-sulfur fuels and fuels with bio-content, as well as emissions reductions, more rapid economic changes and increasing competition in the refining industry.

Refinery catalysts play a crucial role in improving the efficiency and environmental performance of refining processes by facilitating chemical reactions and reducing energy consumption, Ruff said. BASF continues to collaborate with customers, licensors and service providers to meet their need for innovative catalytic solutions, he added.

Ketjen sees demand from refiners that are processing more severe crudes, and their desire to maintain the same or improved yields, as the main trend driving the FCC catalysts market. “As the margins have come down from post-COVID, refiners are looking to more opportunistic crudes, which require

higher catalyst addition or higher conversion,” Simmons said.

A shift in the “desire” to produce more propylene from FCC units is another trend affecting demand for refinery catalysts, according to Simmons. In response, Ketjen has invested in expanding capacity for its ZSM-5 additives, he said. The additional capacity is expected to be available in 2025, enabling the company to support refiners in meeting the increased global demand for propylene, he added.

The transition to renewable fuels and decarbonization is also considered by Ketjen to be another key trend. “While the pace of implementation differs across geographies, it is clear that the production of RD and SAF are taking flight,” Simmons said.

AI to improve refinery processes

Advances in the development of catalysts that can improve refinery processes will come from a continuous deepening in the theoretical understanding of catalysts, as modern science advances together with new characterization technologies such as computational chemistry, AI and high-throughput screening, according to Lim.

As a result, catalyst preparation technology will evolve toward the development of advanced catalysts, leading to a significant enhancement in catalyst performance, Lim said. These developments will ultimately optimize the refinery production process, she added.

There are many opportunities to implement AI in a refinery, Alex Attlesey, vice president/refinery catalysts at BASF told *CW*. Some refineries have already implemented AI systems, but there is still significant untapped potential for AI to create value and improve performance in the industry, Attlesey said.

“Overall, the potential for AI in the refinery industry is vast. As AI technology continues to evolve and refine, we can expect to see more advanced and sophisticated AI systems and techniques being implemented in refineries and in refinery catalyst solutions leading to further efficiency gains, savings and improved performance,” he added.

AI is finding its way into monitoring and predicting performance, for the selection and for the optimization of catalysts in refineries, according to Ketjen. The company has made early investments in modeling and is making results available to refiners, Simmons said. “In the area of catalyst manufacturing, we are starting to reap the benefits of AI-supported techniques,” he said.

TCG’s Payn also noted that the implementation of AI by the larger licensors and catalyst producers has already started. Most of these big players have implemented AI combinatorial catalyst discovery automation into their R&D discovery processes internally, Payn said.

“Refiners, especially in North America and Europe, have been transitioning to refineries of the future or to refinery 4.0, which refers to the automation and electrification of refinery sites, with the industry’s big, international players leading the way,” Payn said.

Independent, small refineries are, however, lagging in the transition due to a lack of capital, Payn said. Overall, advancing automation and digitalization will be challenging, especially in cases where infrastructure is more than two decades old, he added.

According to Murphy, another important factor is AI’s potential to provide experimental space for research in new catalysts, which has traditionally been narrow. AI will allow researchers in the field to ponder or consider nontraditional combinations and approaches, or even areas of pursuit, and get feedback more quickly, based on data sets that

may not have been available until recently, Murphy said. “That is a potential distraction, but also a potential strength for a ‘eureka-type’ development as opposed to a more traditional linear- or marginal-type improvement,” he said.

An issue with AI-assisted experiments in the field of refinery catalysts will nevertheless be the difference between what happens in the lab, the theoretical and what happens when a commercial catalyst or automation system is tested, Payn said. There is still no substitute for testing because theoretical chemicals and practical feedstocks are two different worlds, he said.



ATTLESEY: AI has potential to create value in refining.



LIM: Consumption of refinery catalysts will increase.