Select Client Study

Polyolefin Catalysts and Process Licensing: Competitive Implications of Industry Consolidation

Study Presentation

(Completed July 2018)
Consolidation in the polyolefin catalyst and process licensing industries has increased in both pace and size over the past several years and the impacts have become material to the competitive landscape.

The nature of the restructurings as a result of these multiple deals/changes are having a broader impact on catalyst product lines, resin grades and margins given the various industry issues moving forward, e.g., US PE capacity increases, China supply/demand growth, etc.

As a result, the question has arisen as to how much farther this can go and what the industry will look like if/as it continues. Among others, two critical issues must be raised:

- At what point does the number and size of competitors reach its minimum, beyond which legitimate competition is adversely affected and can no longer be meaningfully achieved? and;

- Is there now, or will there soon be, the need for additional suppliers, independent of ownership and/or affiliation, in order for 3rd party resin producers and/or those coming off license to obtain the materials (i.e., catalysts, supports, co-catalysts/activators, etc.) and/or process license in order to produce the resins demanded by end user applications?

This assessment documents the recent changes in ownership - of production/supply capabilities and assets, process technology licensing, and intellectual property development (for future market needs) - in order to depict the current state of the competitive landscape and its strategic implications.

**TCGR’s study allows current participants, as well as the industries/customers served by them, to make an independent judgement on the options going forward and what is needed in order to maintain long-term viability in these increasingly competitive times.**
The Study is Unique in Its Objectives, Scope and Methodology…

- **Background**
  - This TCGR Select-Client Study is designed to provide a review of the polyolefin catalyst and process licensing value chain and how it has been affected by recent consolidation events.

- **Objective**
  - Looking at the previous 4-5 years, TCGR set out to document the numerous acquisitions/divestitures (M&A), as well as process licensing additions and/or discontinuations (including ownership changes). TCGR has also documented the profile of the deals (products transferred, capacities, size, types of businesses, etc.) as well as SWOTs for each.
  - Provide actionable guidance to study participants interested in maximizing their opportunities within the industry

- **Scope**
  - Catalysts and catalyst components (e.g., ligands, supports), co-catalysts/activators (e.g., metal alkyls, organometallics, MAO, organoborates, etc.)
  - Process licensing (technologies for license, in-house/exclusive processes) including relationships with partners
  - The supply chain, affecting polyethylene (PE) and polypropylene (PP) resin production, including homo- and co-polymers (e.g., HDPEs, LLDPEs, etc.)

- **Methodology**
  - TCGR has augmented its in-house expertise with polyolefin experts that have >30 years’ industry experience (a mixture of commercial & technical) in completing this study.
  - TCGR also utilized publicly available and in-house information and expertise collected over 35+ years in the polyolefin catalyst industry
  - Commercial and technical literature reviews, and in-field interviews were conducted with catalyst manufacturers, process licensors, resin producers, and end users/convertors

The study’s scope/TofC, on the following page, reflects inputs from “charter” subscribers, industry leaders in polyolefin resin production, process licensing and catalyst supply…
The specifics of each deal – including products/capabilities transferred, consolidation impacts on the PE/PP market, future acquisition/divestiture that is likely and complete SWOTs – result in strategic opportunity and competitive threat identification.
A Depiction of the Polyolefin Value Chain Reflects Impacts from Catalyst Components Through Resin Production…

Polyolefin Technology Business Model

Licensee:
- Access to feedstock
- Market Opportunity
- Capital Investment

Technology Licensing
- Catalyst availability-sales
- Technology Transfer, Engineering Services
- Marketing Services

Polyolefin Process Technology
- Plant Design & Construction
- Plant Commission & Start-up

Operation & Product Supply

Technology and market accessibility are key to growth


From an overall perspective, changes in ownership – in catalysts and process licensing – will continue to have competitive implications across the value chain.
Study Highlights Include…

- Significant consolidation has led to gaps in the polyolefin catalyst space: the alternatives in toll/custom manufacturing are limited beyond Grace; Clariant, Akzo, Lanxess, Evonik (among others) are possibilities, as are new participants (e.g. Designed Chemistry, etc.)

- There may be a retrenchment/shift toward more self-production: e.g., Borealis, Ineos, ExxonMobil, CPChem, Nova

- Concerns over security of supply may lead to support from key players/licensors to develop new sources for components: activators and complexes, etc.

- Silica supports for gas phase and to some extent slurry process technologies – which cross chromium, Ziegler Natta and single site catalyst (SSC) technologies – could justify renewed interest/push for alternatives or multiple sources

- Exit of Ineos from (PP) licensing eases market position for Grace (Unipol) and CBI (Novolen) and may cause others to increase their activity (e.g., LBI, JPP, etc.). With Ineos exit from PE licensing, will LBI now square up to Dow in PE and do more (e.g., via Hyperzone)?

- Dow now has a strong position in LLDPE both in gas phase and solution (not licensed): what are the roles for Nova (Advanced Sclairtech) and Mitsui, LG Chem? CPChem will continue to license Martech (slurry) including (with Total) ADL (double loop)

- Two of the three key licensors of polypropylene (PP) process technology do not manufacture resin. This comes at a time when the trend (EU, US) is to increased resin complexity

- In China, there is an intensification as well as a consolidation happening, as both domestic demand rapidly increases for catalysts and PO capacity over the next five years. Chinese PO catalyst producers may be expected to export and compete more broadly in Asia-Pacific and the Middle East.

Each industry participant’s situation in the value chain will shape the timing and nature of its next steps.
An Indication of the Study’s Value Can Be Seen in Excerpted Pages from the Assessment (1 of 5)

W.R. Grace – Albemarle

Specific details related to products made

- Leader in proprietary and custom-manufactured single-site catalysts as well as metallocenes and activators. This includes the ActivCat technology.
- Includes a comprehensive series of highly optimized Ziegler-Natta catalysts. 
  - Advantage LL77, a catalyst for producing LLDPE octene-1 co-polymers in high temperature, adiabatic solution processes such as 
  - Advantage HD26 and HD46 are used in the production of HDPE in slurry processes, 

Description of future company after the acquisition

- According to Grace, the strategic rationale behind Albemarle acquisition is:
  - Growth/ Profitability High-growth PE catalysts segment. Margins similar to Grace’s Catalysts business.
  - W R Grace had a small growing single site catalysts business where it had intended to make significant investments in over the coming years, both on the R&D side and on the capital side. And Albemarle business is more mature to R&D and innovation capabilities. And so by combining the 2, 
  - Synergies 3.2x reduction to acquisition multiple. The synergies are coming from 
  - Broadens relationships with customers and be a strong innovation partner with existing customers. According to Grace, 

Text Redacted by TCGR
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W.R. Grace – BASF

Comments on directly affected capabilities
• All the synergies from the acquisition of BASF will be obtained by end of 2018 (approximately 10 MM).
• Some capital investments are needed

Consolidation impacts on PE/PP market
• Major impact on the Polyolefins (PE and PP) Ziegler Natta catalyst market
  – For HDPE ZN catalyst, the main remaining suppliers are
  – Grace with the acquisition of Albemarle (small in ZN PE capacity) has moved to nr 1 as independent PE ZN catalyst supplier
  – For LLDPE Ziegler Natta, the impact of the acquisition is more limited. The LLDPE ZN catalyst market is dominated by
    ○ Grace is already a supplier in the LLDPE catalyst market but
    ○ In PP, Ziegler Natta, Grace is taking the number one position with its Polytrack, HYAMPP.
    ○ Grace dominates the ZN custom catalyst market. Other companies

Future consolidation or divesture that is possible/likely
• Early in 2018, Grace acquired
An Indication of the Study’s Value Can Be Seen in Excerpted Pages from the Assessment (3 of 5)

Dow – W.R. Grace: SWOT

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<thead>
<tr>
<th>STRENGTHS</th>
<th>WEAKNESSES</th>
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<tr>
<td>– Grace is not directly a competitor</td>
<td>– With a high number of new licensees, there could be limited</td>
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<td>– Grace is looking for Text Redacted by TCGR</td>
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<td>– Grace has increasing Text Redacted by TCGR</td>
<td>– Lack of operating experience of Grace in</td>
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<td>– Grace has Text Redacted by TCGR</td>
<td>Lack of capability to</td>
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<td></td>
<td>Lack of experience in other process than Unipol PP</td>
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<tr>
<th>OPPORTUNITIES</th>
<th>THREATS</th>
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<td>– Leverage patent estate of Dow with Text Redacted by TCGR</td>
<td>– Internal non phthalate donors of Grace are Text Redacted by TCGR</td>
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<td>– Utilize extensive tool box with the different catalyst technologies acquired</td>
<td>Commercial success of other suppliers in non phthalate catalyst could</td>
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<td>– Offer Lynx, etc. to Text Redacted by TCGR</td>
<td>– Chinese catalyst suppliers are increasingly active in PP catalyst and</td>
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An Indication of the Study’s Value Can Be Seen in Excerpted Pages from the Assessment (4 of 5)

Strategic Implications - Value Chain

- Grace’s position in SSC is

  - will they push merchant SSC business?

- Consolidation may encourage licensors/key players to

  - new entrants may offer

  - will Gulbrandsen develop

- Will Grace’s dominance

  -

- Licensing space for commodity LLDPE is now dominated by

  - Will look to compete

- Others may look to compete with value-add LLDPE either from gas phase or solution

  - LBI, LG Chem... but remember

- CPChem (Martech/ADL), LBI (Spherilene, Hyperzone), Mitsui and others may look to take

  - ADL, Hyperzone will dominate for

  - Dow/Univation Prodigy will most likely

Will a new entrant, an existing supplier or a newly organized/combined entity emerge?
An Indication of the Study’s Value Can Be Seen in Excerpted Pages from the Assessment (5 of 5)

Strategic Implications – China

- The largest producers of PO catalyst in China for both domestic consumption and export include

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- Sinopec and Lihe do export catalysts, mainly for commodity PO plants to Iran, Africa for older off license processes and claim Experience in OECD however has been less, and in some case failures due to

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- We are certain ongoing attempts to export more PO catalysts over the next five (5) years, will occur for the leaders, especially

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- PO catalyst production within China will expand, to meet the drive towards polyolefin production self-sufficiency domestically. With this direction, some domestic consolidation of catalyst producers has and will occur, such as

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- Chinese PO producers will switch to domestic sources of catalyst ASAP after any foreign license is issued.

- In the last three (3) years the most successfully licensed processes within China have been

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- China is basically self-sufficient in generic (commodity) 4th generation polyolefin catalysts but lacks 5th and 6th generation PO specialty catalysts deployed in current licenses which need to be imported, Although has developed SSC PE catalysts and the shift in the packaging and automotive markets is occurring rapidly.
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Please enter our order for the study, completed in July 2018, as follows:

__________ Polyolefin Catalysts and Process Licensing: Competitive Implications of Industry Consolidation, to be delivered as a PDF file containing PowerPoint slides, for $18,000 (post-production); this includes use across locations (i.e. site license).

__________ ***We are subscribers to TCGR’s May 2017 select-client study entitled Polyolefin Catalysts and Processes: Technological and Commercial Impacts on PE and PP, 2015-2025 and are therefore entitled to the $1,000 discount off the subscription rate.

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