Transalkylation Catalyst

The ATA series catalyst is our high performance transalkylation catalyst that utilizes a proprietary zeolite as the active material. Developed in the SK Energy and Zeolyst laboratories, it is especially designed for high conversion and feed composition flexibility.

ATA-11 catalyst was commercialized in 1999 and its performance was enhanced in 2002 leading to an improved ATA-12 catalyst. As per 2010, the ATA catalyst has 14 commercial references. Applying sophisticated catalyst manufacturing technology, the ATA catalyst combines a high activity for conversion of toluene and C9+ aromatics into benzene and low ethylbenzene-content mixed xylenes with superior catalyst stability and yields.

Applications

ATA-11 and ATA-12 catalysts are used in aromatics complexes in the toluene disproportionation unit or transalkylation unit when conversion of toluene and C9+ aromatics to mixed xylenes and benzene is required. Processing C9+ aromatics in a transalkylation unit shifts the chemical equilibrium in the unit away from benzene production and towards xylene production. The transalkylation process provides a means of producing more mixed xylenes from low-value toluene and heavy aromatics. The incorporation of a transalkylation unit into an aromatics complex can more than double the yield of paraxylene from naphtha feedstock.

Feeds

One of the major benefits of the ATA-12 catalyst is its feed flexibility. The ATA-12 catalyst can process feed compositions ranging from benzene-rich feedstocks or 100% toluene to 100% C9+ aromatics. This feed flexibility allows the user to optimize feed sources and effectively capture market price swings.

ATA-12 Advantages

(1) Feed flexibility

100% C9s/C10s fresh feed can be treated, which helps in the upgrading of lower value feedstocks into higher value products. By adjusting the toluene content in the reactor feed, the plant operator can maximize xylene yields as required. This flexibility allows our users to optimize the operational economics of the transalkylation unit.

Impure benzene/toluene can be treated through ATA-12, whilst still meeting the ex-specification benzene product purity.
2) High Efficiency Operation
High aromatics retention is achieved with the use of ATA-12 catalyst. The aromatics loss is very low, which results in very high feed efficiency.

Very little hydrogen is used for aromatics saturation, as it is utilized essentially for olefin saturation and non-aromatics hydrocracking, hence hydrogen consumption is low. This helps to reduce the operating cost.

<table>
<thead>
<tr>
<th>Aromatics loss (mol%)</th>
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<td>0 - 25,000 hours</td>
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(4) High Activity
ATA-12 catalyst can be operated at high weight hourly space velocity (WHSV) of up to 3.5h⁻¹, with no significant changes on yields. Deactivation rate remains low. This allows the plant to reduce the amount of catalyst required. For a grassroots unit, this reduces investment cost.

(5) Low H₂/HC
ATA-12 catalyst can be operated at very low H₂/HC ratio with no significant changes on deactivation rate. This also reduces utility cost or investment cost for grassroots unit.

(6) Excellent Catalyst Stability
Based on our numerous commercial experiences, ATA-12 catalyst has proven to be extremely stable. A typical cycle-length is more than 4 years, and can be as long as 8 years.

The ATA-12 catalyst advantages can improve plant operations by increasing product yields at lower operating cost, throughout the entire cycle-length.

3) Superb Product Quality
Benzene purity is more than 99.85%, and no additional processing through an extraction unit is required.

Ethylbenzene in C₈ aromatics is low, which helps to improve the paraxylene recovery in the adsorption/separation unit, or increase the feed load.

<table>
<thead>
<tr>
<th>Benzene purity and EB in C₈ aromatics (%)</th>
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<tr>
<td>0 - 12,000 hours</td>
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For more information on how Zeolyst International's Criterion Catalysts & Technologies and Shell Global Solutions can contribute to your operations, contact your nearest Criterion sales representative or visit our website at www.zeolyst.com.

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Xylene Isomerization Catalyst - Ethylbenzene Reforming Type

Opars™ series catalyst is a new generation xylene isomerization-ethylbenzene reforming type catalyst with a greatly improved paraxylene (PX) yield over other commercial catalysts. The catalyst combines high activity for conversion of ethyl benzene into xylenes with very low by-product make and superior stability. Approach to equilibrium for paraxylene is close to the thermodynamic limit.

Opars™ catalyst was developed in the labs of IFP/Axens and is manufactured and marketed by Zeolyst International. Grassroots licences are available in conjunction with Axens.

This catalyst has been commercialized since 2001. To date, it has been applied at 14 commercial units, with multiple successful regeneration experiences.

Applications

Opars™ catalysts are used in aromatics complexes where conversion of ethylbenzene to xylenes is required in combination with isomerization of xylenes into the equilibrium composition. Appropriate process conditions can achieve very high ethylbenzene conversion levels while the approach-to-equilibrium for paraxylene is almost at the thermodynamic limit of 100%.

Owing to its very high activity and selectivity, Opars™ catalyst can be used for catalyst replacement when debottlenecking and/or minimum benzene production is desirable.

Ethylbenzene Isomerization to Xylenes

Typical feeds processed over Opars™ catalyst are Cs aromatic streams depleted of para-xylene, and sometimes also of ortho-xylene, usually effluent from a crystallizer or from an adsorption based paraxylene recovery unit.

When Opars™ catalyst is applied, high concentrations of ethylbenzene in the fresh feed to the complex can be used because the high conversion limits build-up of ethylbenzene in the recycle. This gives the user the ability to blend in large amounts of Cs aromatics extracted from pygas streams that are high in ethylbenzene.

Opars™ Advantages

(1) High Selectivity

Improved Process Economics

Performance of Opars™

Xylene loop PX Yield, %

Adsorption-based

Former generation

Crystallizer

PX Separation Recovery Rate, %

The PX yield achieved with an Opars™ based xylene loop is significantly higher than previous generation catalysts, and improvements of more than 10% in yields can be achieved.
(2) Enhanced Isomerization Activity

As compared to previous generation catalysts, Oparis™ catalyst can achieve very high PX approach to equilibrium whilst maintaining low losses. This allows the plant to widen the operating window and optimize based on the various operation scenarios.

(3) Better Operational Stability

After the initial stabilization period, the catalyst activity is very stable. The 1st cycle length is typically more than 3 years.

The activity of the catalyst can be easily restored by a carbon burn-off, and this can be done either in situ or ex situ. Based on numerous regeneration experiences, close to fresh catalyst activity can be achieved after each regeneration.

OparisPlus™ - An Improved Catalyst

OparisPlus™ catalyst was developed with innovative improvements, resulting in an excellent catalyst performance.

Its catalyst activity is enhanced whilst overall Cs ring loss is reduced by 20% as compared to Oparis™. Moreover, there is a 30% drop in gas make, which significantly improves the operational economics.

Intrinsic Catalyst Activity

Performance of Oparis™ after regeneration

Catalyst Life

Performance of Oparis™ vs. OparisPlus™ in C5 ring loss, %

Performance of Oparis™ vs. OparisPlus™ in C5-C7 make

Performance of Oparis™ vs. OparisPlus™ in PX approach to equilibrium, %

Performance of Oparis™ vs. OparisPlus™ in PX approach to equilibrium, %

For more information on how Zeolyst International's Criterion Catalysts & Technologies and Shell Global Solutions can contribute to your operations, contact your nearest Criterion sales representative or visit our website at www.zeolyst.com.

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Xylene Isomerization Catalyst - Ethylbenzene Dealkylation Type

Zataris™ catalyst is the newest xylene isomerization-ethylbenzene dealkylation Zeolyst catalyst with improved paraxylene yield and enables high benzene purity. The catalyst combines high activity for conversion of ethylbenzene into benzene with very low xylene losses.

Zataris™ catalyst was developed in the labs of Shell Technology Centre Amsterdam, leveraging on our experience from former generation dealkylation catalyst (the Z883X series) and other catalyst technologies. This catalyst is manufactured and marketed by Zeolyst International.

**Applications**

Zataris™ catalyst can be used in aromatics complexes when conversion of ethylbenzene to benzene is required in combination with isomerization of xylene into the equilibrium composition. This catalyst can be operated with ethylbenzene conversions of up to 90% whilst achieving low xylene losses.

Zataris™ catalyst is designed to operate at high activity and selectivity, and is suitable to be used for catalyst replacement when deballotenecking.

**Zataris Advantages**

1. **High Activity**
   - High EB conversion (EBC) of up to 90% can be achieved.

2. **Low Xylene losses**
   - Very low xylene losses at high EBC can be achieved. Losses are primarily due to formation of toluene and C9 aromatics with minimal gas make, preserving the aromatics molecules.

3. **High Benzene Purity**
   - On-specification benzene purity is produced using Zataris™ catalyst, which may help to relieve any bottleneck in the sullatone extraction unit.

4. **Stable Catalyst Activity**
   - Zataris™ catalyst is developed from proven technologies. Even under severe operating conditions, minimal deterioration in catalyst activity is observed. Catalyst cycle length is expected to be at least 4 years.

**Feeds**

Typical feeds processed over Zataris™ catalyst are C8 aromatic streams depleted from paraxylene, usually effluent from a crystallizer or from an adsorption paraxylene recovery unit.

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