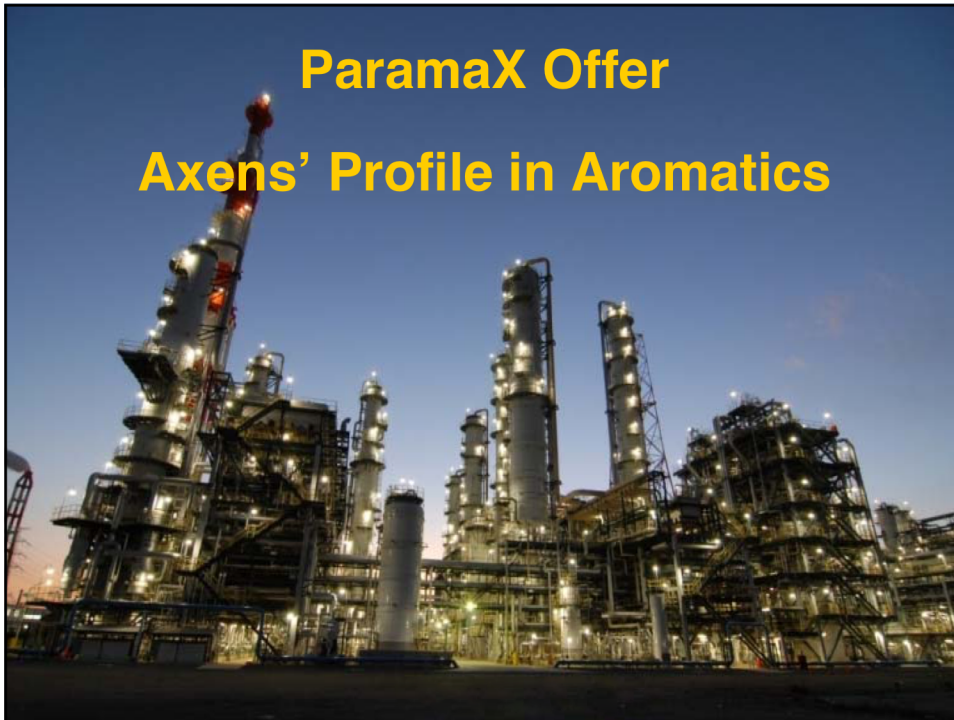


ParamaX Offer

Axens' Profile in Aromatics



Agenda



- **BTX Business outline**
- **ParamaX offer**
- **Commercial Experience**
- **ParamaX experience**



- **Strong demand for PET fiber and resin**
- **PX demand catches-up with production**
- **Margins started recovering in 2004**
- **Declined in 2008...**
- **Numerous projects have been launched since Q4 2003**

**End of a tremendous peak for
petrochemicals?**



- **Asia: how to calm China's appetite for aromatics?**
- **Europe: how to deal with excess aromatics in Gasoline pool ?**
- **Middle East: competitive position for intermediates export**
- **South America is now breeding projects**



- **Technology**
 - *Low profitability: maximize selectivity*
 - *High profitability: maximize activity*
 - *Reliability: be on-stream*
- **Organization skills**
 - *Feed tank to Products tank scope*
 - *Highly integrated projects*
 - *Strong project management from bidding to commissioning*

Axens has proved efficient on both Technology and Organization sides



- BTX Business outline
- **ParamaX offer**
- Key technologies outline
- ParamaX experience



Axens' single source service offer

- an overall optimization of the complex
- a single agreement with overall guarantees
- a single contact point from design through start-up and to the end of the operating life of the plant

**From March 2005 to December 2008,
Axens has been awarded nine full scale
ParamaX Complexes**



Arofining™ - reformate purification

Aromizing™ - continuous catalyst regeneration reforming

Crystallization - combined with Eluxyl for very high purity PX

Eluxyl® - Stand-Alone and Hybrid - ParaXylene purification

HDA - C₇+ aromatics hydrodealkylation for benzene production

XyMax - xylenes isomerization with EB dealkylation

Morphylane - aromatics extractive distillation

MTDP-3 - toluene disproportionation

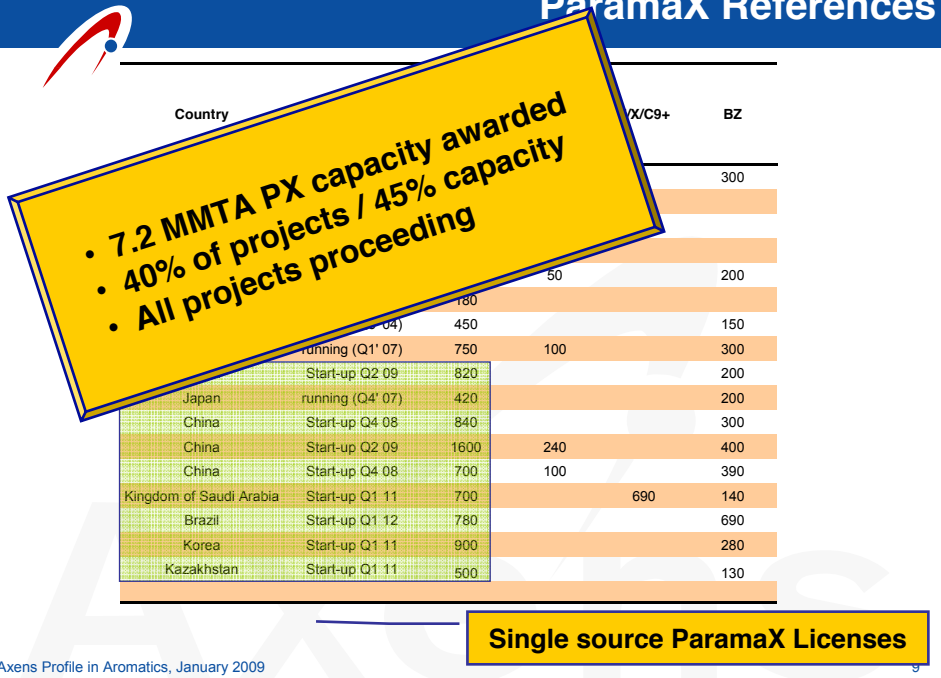
Oparis™ - C₈ aromatics isomerization

Sulfolane - aromatics extraction

TransPlusSM - toluene/heavy aromatics transalkylation

PXMax - toluene selective disproportionation

ParamaX References



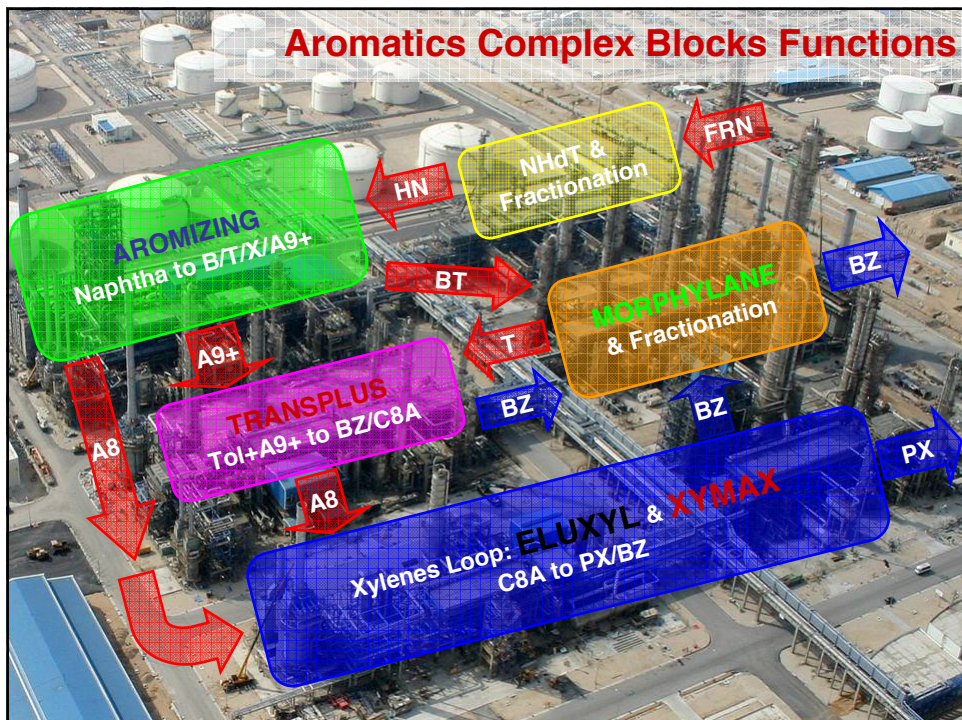
2005-2008 Market Penetration

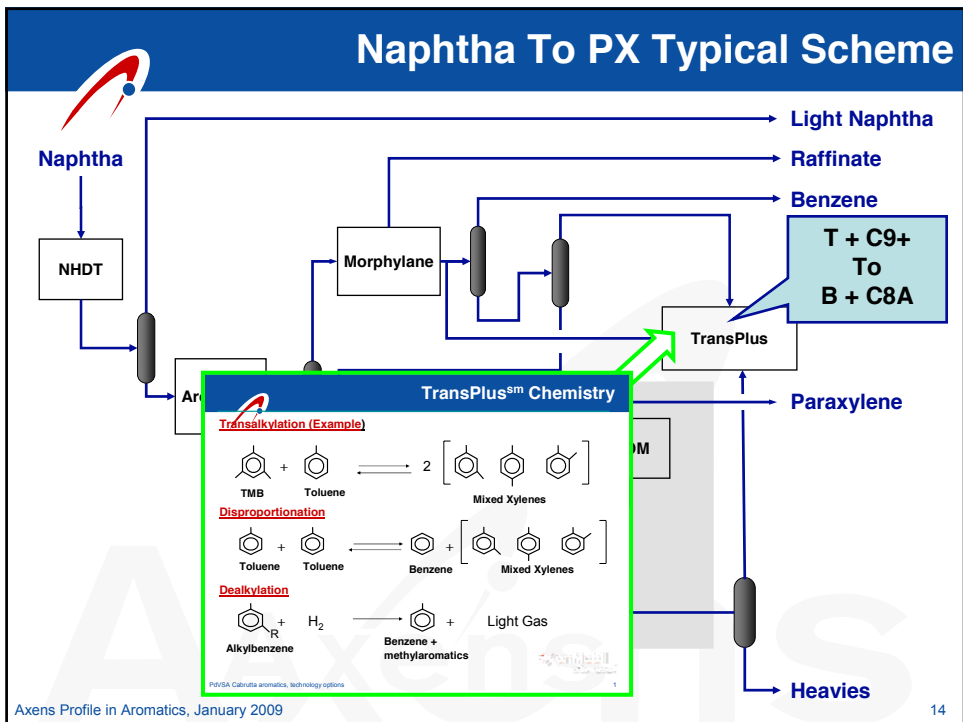
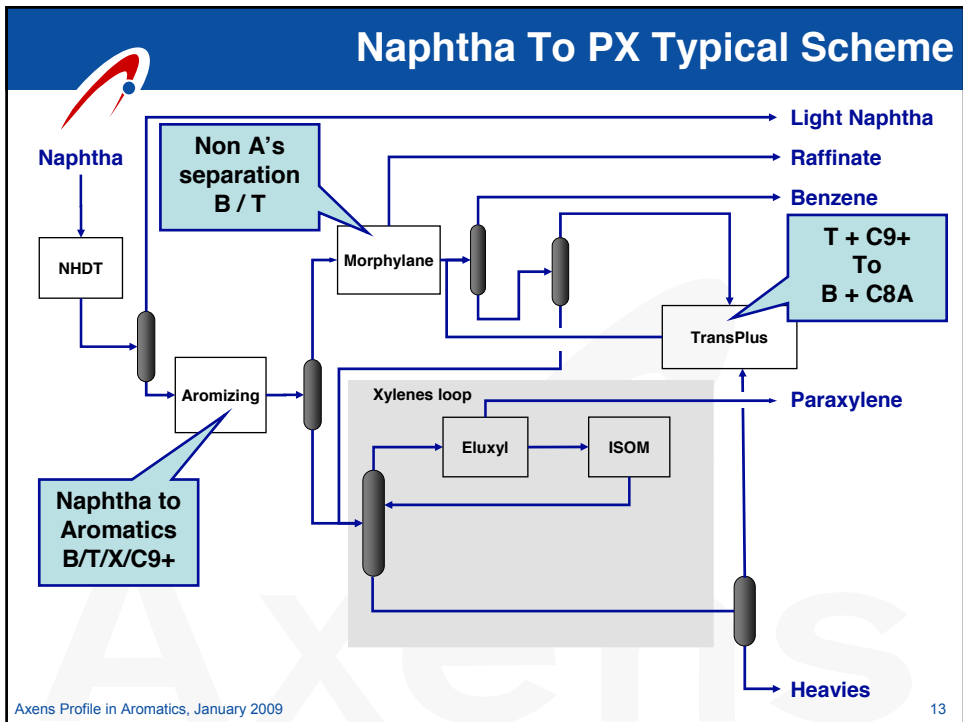


- **Axens' Market Share on 2005-2007 :**
 - ✓ 40% of the awarded projects
 - ✓ 45% of the total licensed PX capacity
 - ✓ Total ParamaX PX capacity: 7.2 MMTA
- **100% of Axens projects proceed to execution**
- **All Axens projects include ParamaX Isomerization and Transalkylation technologies and catalysts**

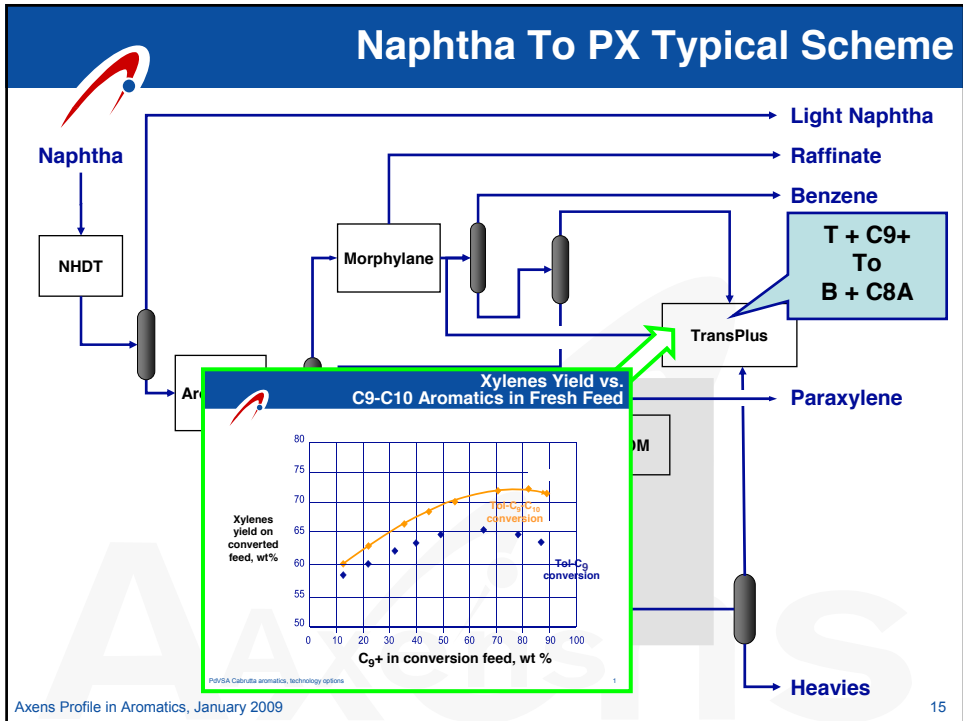


- BTX Business outline
- ParamaX offer
- **Key technologies outline**
- ParamaX experience

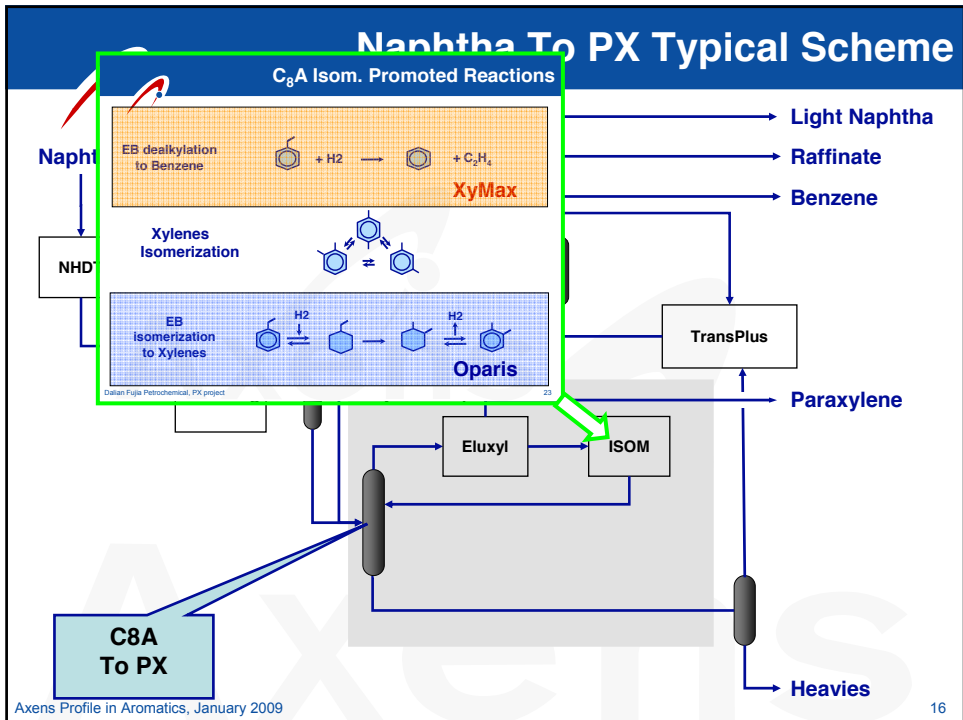




Naphtha To PX Typical Scheme

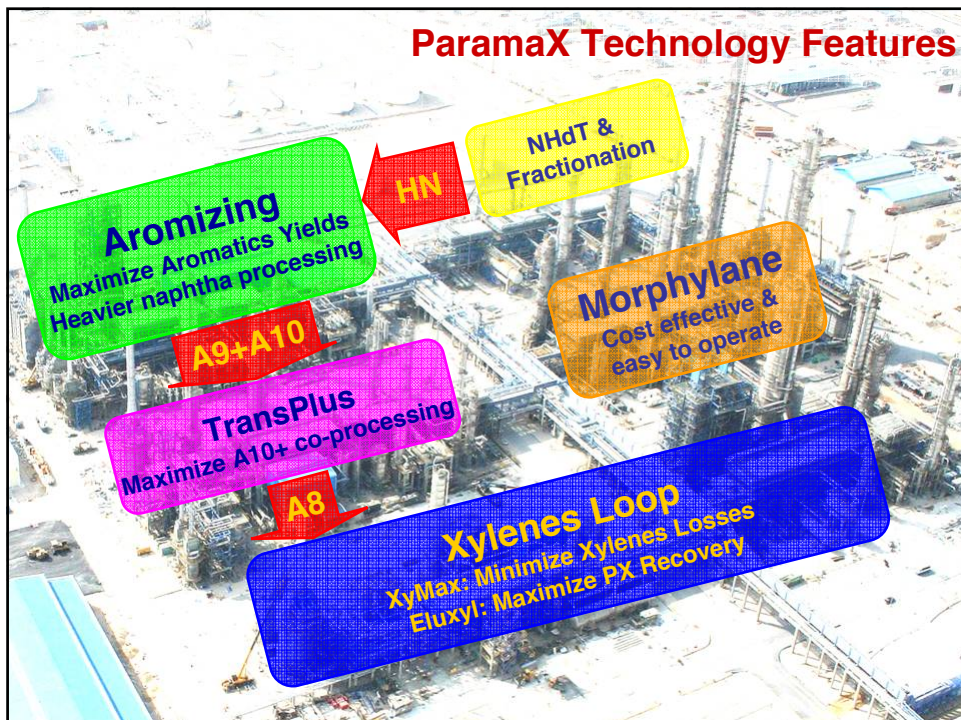


Naphtha To PX Typical Scheme





- BTX Business outline
- ParamaX offer
- **Key technologies outline**
- ParamaX experience





Axens' CCR: **Naphtha to Aromatics**



- State-of-the-art CCR technology, 30 references since 2005
- Catalyst / Regen combination: long life, stability, low attrition
- Low CAPEX Side by Side arrangement
- Competitor's technology users switch to Axens' CCR

>50% market share over last 3 years

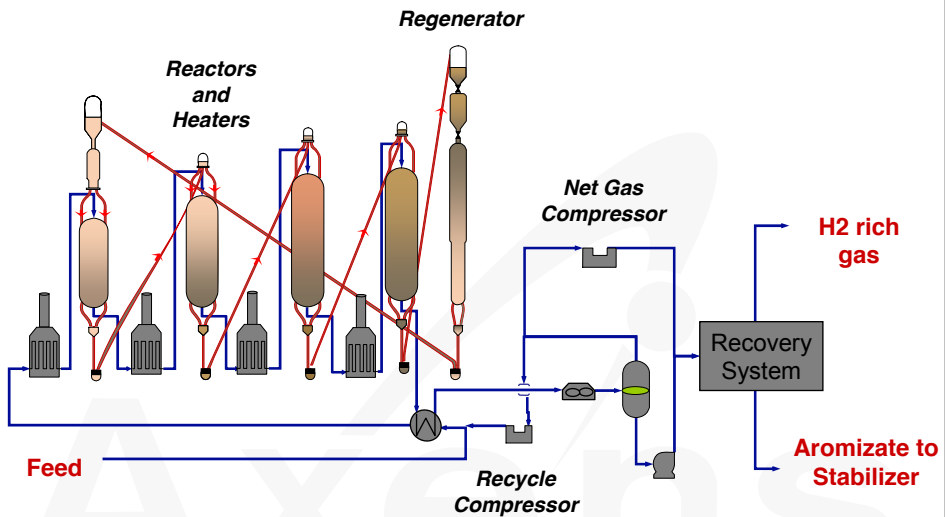
Axens' CCR recent references



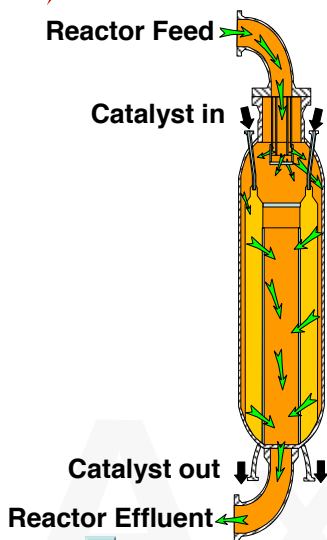
CUSTOMER	LOCATION	CAPACITY (BPSD)	START-UP DATE	SEVERITY RON clear
FCFC	Malliao (Taiwan)	40 000	2007	104 (Aromizing)
SK Energy	Ulsan (S. Korea)	30 000	2006	105 (Aromizing)
NIOEC	Arak (Iran)	20 000	2009	100
ENOC - EPCL	Dubai (UAE)	36 000	2008	102
SAFRA	Yanbu (Saudi-Arabia)	10 000	2008	104
OMAN OIL COMPANY	Sultanate of Oman	40 000	2008	105 (Aromizing)
Japan Energy Corporation	Kashima (Japan)	20 000	2007	106 (Aromizing)
NIORDC	Esfahan (Iran)	33 000	2009	100
NIOEC	Bandar Abbas (Iran) N°1	20 000	2009	100
NIOEC	Bandar Abbas (Iran) N°2	20 000	2009	100
NIOEC	Bandar Abbas (Iran) N°3	45 000	2009	100
HoodOil	Bandar Abbas (Iran)	15 000	2009	102
DRAGON AROMATICS	Bandar Abbas (Iran)	15 000	2009	106 (Aromizing)
PETRONAS & Republic Of Sudan	Port Sudan (Sudan)	13 500	2009	102
KNPC	Mina Al-Bahloul (Saudi Arabia)	18 000	2009	102 - 104
HELPE	Mina Al-Bahloul (Saudi Arabia)	15 000	2009	100
DFPC	Bandar Abbas (Iran)	15 000	2009	100
NIORDC	Bandar Abbas (Iran)	45 000	2009	100
TOTAL / Saudi Aramco	Bandar Abbas (Iran)	67 000	2010	104 (Aromizing)
NIOEC	Bandar Abbas (Iran)	15 000	2010	100
WEPEC	Bandar Abbas (Iran)	15 000	2010	102
KMG	Abadan (Iran)	25 500	2010	104 (Aromizing)
Petrochina	Qinhuangdao (China)	15 000	2010	102
PDVSA	Maracaibo (Venezuela)	24 500	2010	104
QPCC	Messaleed (Qatar)	40 000	2010	104 (Aromizing)
Egyptian Refining Co	Cairo (Egypt)	14 000	2011	102
GG SRL	Bathinda (India)	12 600	2012	100
PETROBRAS Comperje	Rio de Janeiro (Brazil)	20 000	2012	106 (Aromizing)
NIOEC	Abadan (Iran)	45 800	2012	100
S-Oil	Onsan (S. Korea)	45 000	2011	105 (Aromizing)
Saudi Aramco	Ras Tanura (Saudi Arabia) N°1	50 000	2012	104 (Aromizing)
Saudi Aramco	Ras Tanura (Saudi Arabia) N°2	50 000	2012	104 (Aromizing)
NIOEC	Shahriar (Iran)	20 000	2012	100
NIOEC	Hormuz (Iran)	58 000	2012	99

References awarded since January '08 250 kbpsd capacity

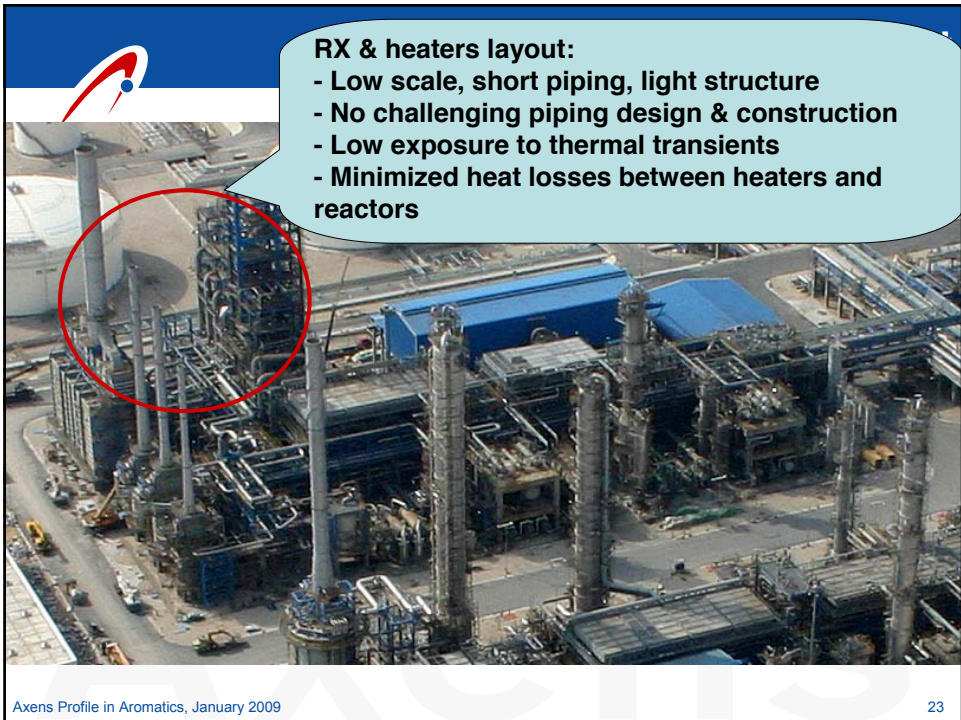
Aromizing Process Scheme



Reactor Design



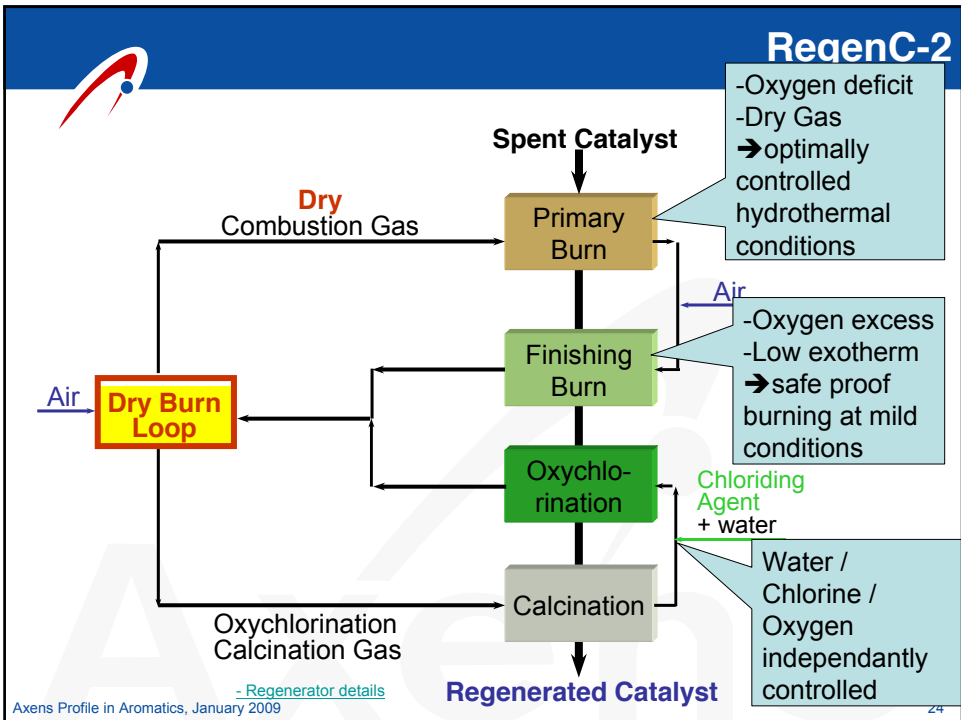
- **Simple reactor concept**
 - Metal thickness based on process conditions
 - Basket type internals
 - Low-scale structure
 - Straightforward layout
 - Easy engineering
 - Easy maintenance
- **Design tailored to the process**
 - All reactor design criteria independently optimized (away from pinning limit)
 - Optimal catalyst use and circulation



RX & heaters layout:

- Low scale, short piping, light structure
- No challenging piping design & construction
- Low exposure to thermal transients
- Minimized heat losses between heaters and reactors

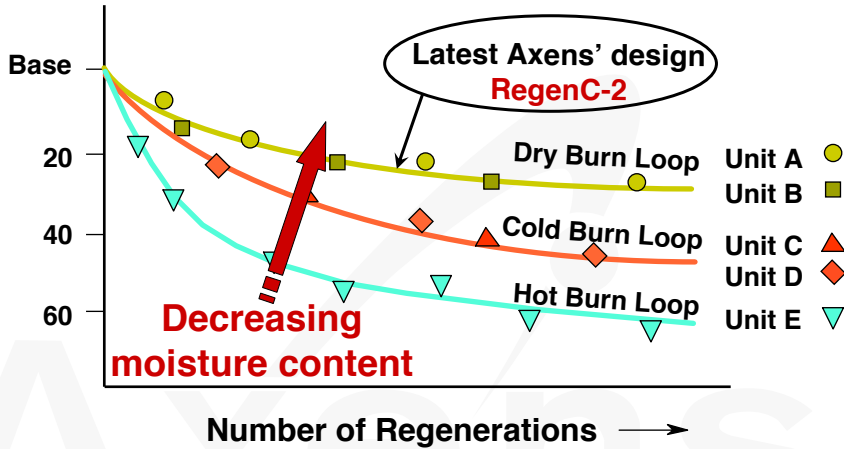
Axens Profile in Aromatics, January 2009 23



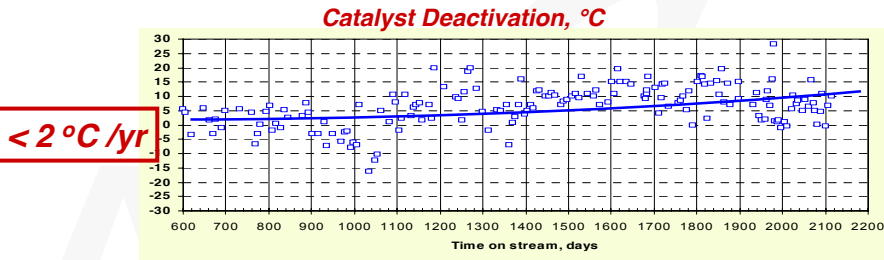
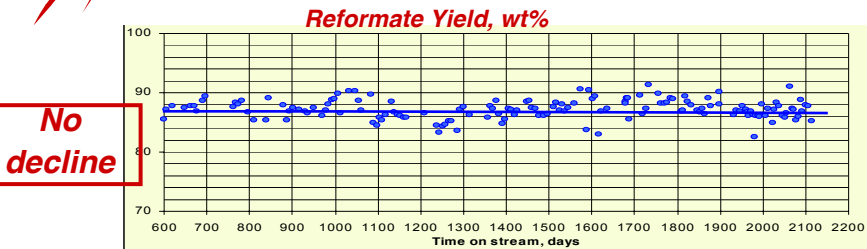


CR 201 Surface Area Decline vs. Regenerations in Commercial Units

Relative Surface, m²/g



Yield Stability & Catalyst Deactivation



6 years Operation



CR 611

CR 617

Low density

Benefit versus...

Same

liquid yields

CR 607 successful on its first competitive pilot testing
Selected to replace competitor's catalyst in competitor's design

AR 701

AR 707

bonus at high coke

lower change out cost

3

12

Pressure, bar

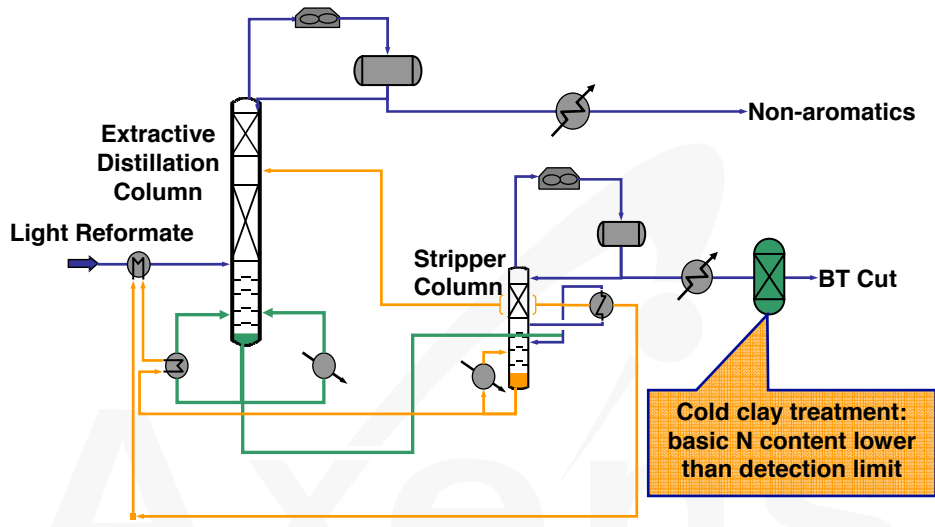


Aromizing: state-of-the-art technology for aromatics production

- **Cost-effective technology implementation**
- **Unique combination of catalyst activity and regeneration quality**
- **Over 60 industrial reference**



Morphylane Flowscheme

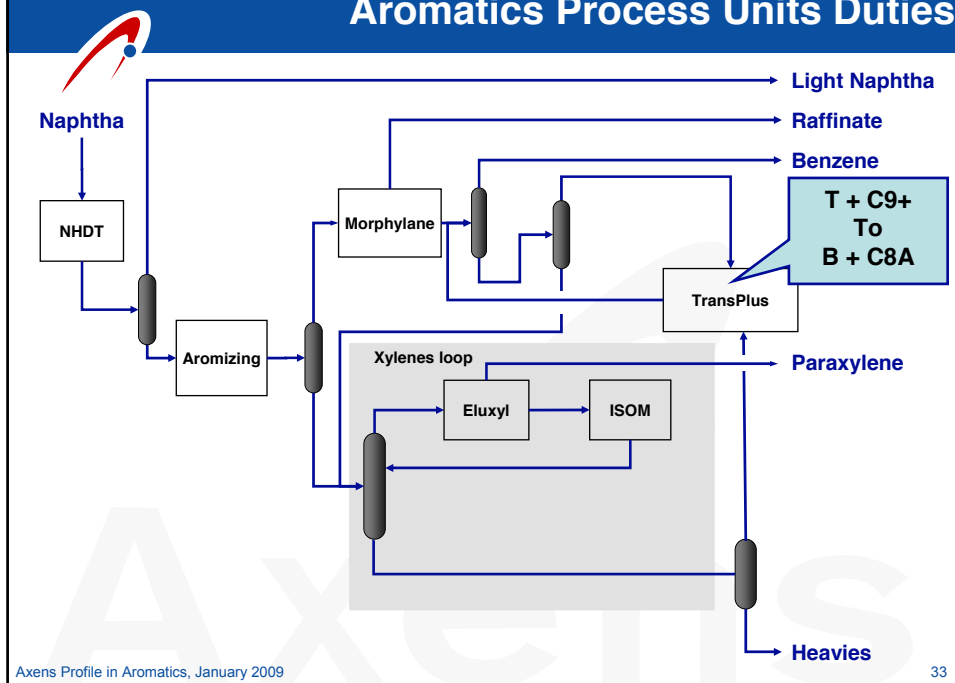


MORPHYLANE References

Start-Up	Company	Feed	Process	Process Data	Aromatics Capacity	Licensor
2009	Xingtai Risun Coal & Chemical LTD Yanjiaotun (Xingtai), P.R. China	Coke Oven Light Oil	MORPHYLANE	Benzene Toluene	74,000 t/y	E
2009	JERP Jubail Export Refinery Project Jubail (Saudi Arabia)	Reformate	MORPHYLANE	Benzene Toluene	100,000 t/y	E (in cooperation with Axens)
2009	Tabriz Oil Refining Company Iran	Reformate	MORPHYLANE	Benzene Toluene	100,000 t/y	E (in cooperation with Axens)
2009	Jiangsu Huaiyin Petrochemical China	Reformate	MORPHYLANE	Benzene Toluene	100,000 t/y	E (in cooperation with Axens)
2009	Shell Eastern Europe Germany	Reformate	MORPHYLANE	Benzene Toluene	210,000 t/y	E (in cooperation with Axens)
2009	Shell Eastern Europe Germany	Reformate	MORPHYLANE	Benzene Toluene	310,000 t/y	E (in cooperation with Axens)
2007	Shell Eastern Europe Germany	Reformate	MORPHYLANE	Benzene Toluene	350,000 t/y	E (in cooperation with Axens)
2006	Acosteel International Taiyuan, P.R. China	Coke Oven Light Oil	MORPHYLANE	Benzene Toluene	56,000 t/y	Uhide E
2006	Repsol S.A. Tarragona, Spain	Reformate and Pyrolysis Gasoline	MORPHYLANE	Benzene	221,000 t/y	Uhide E (in cooperation with Axens)

Major Players are repeat Morphylane users:
 Shell (3 references, sulfolane inventor)
 Dow Chemical (4 references)
 BASF (3 references)
 Total (3 references)
 Chevron (2 references, 1 at 1 MMt/y BT)

Aromatics Process Units Duties



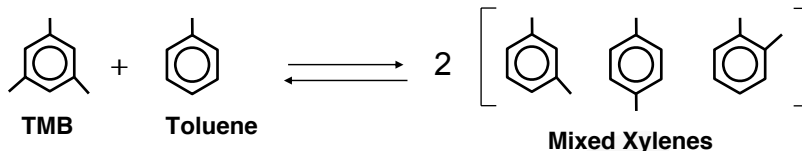
TransPlus

TransPlus: Toluene + C9-C10A to C8A & BZ

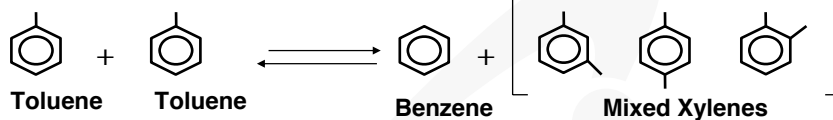
- Processes most of the aromatics yielded in Aromizing, inclusive of C10 Aromatics
- Low investment and operating costs: high WHSV, low H₂/HC
- Highly stable: first cycle over 6 years demonstrated
- In-situ regeneration demonstrated
- Fourteen industrial reference

TransPlusSM Chemistry - Desirable

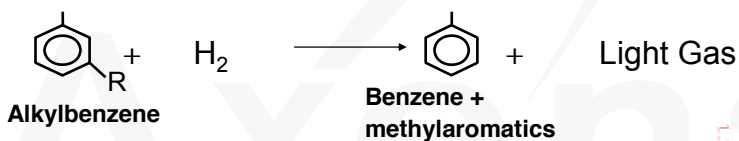
Transalkylation (Example)



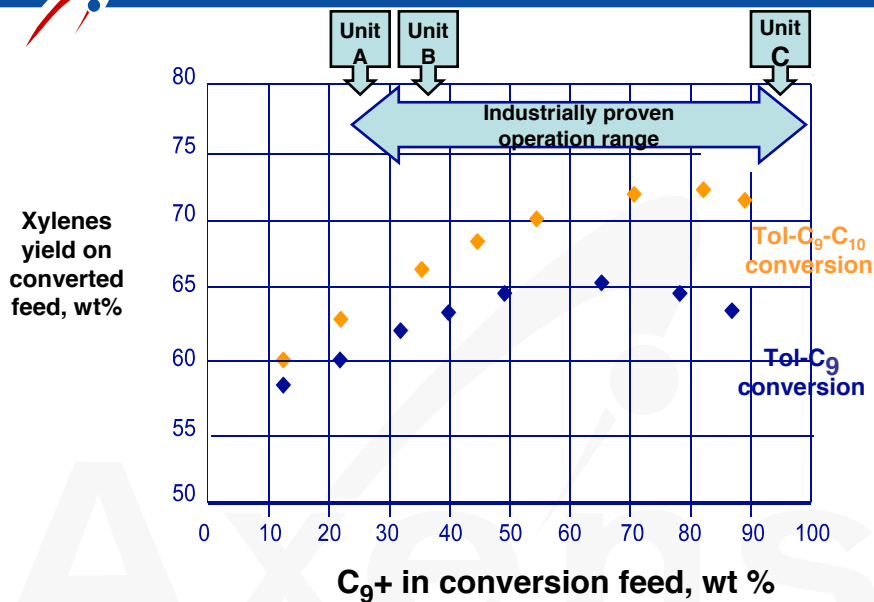
Disproportionation



Dealkylation



TransPlus Xylenes Yield vs. C₉-C₁₀ Aromatics in Fresh Feed

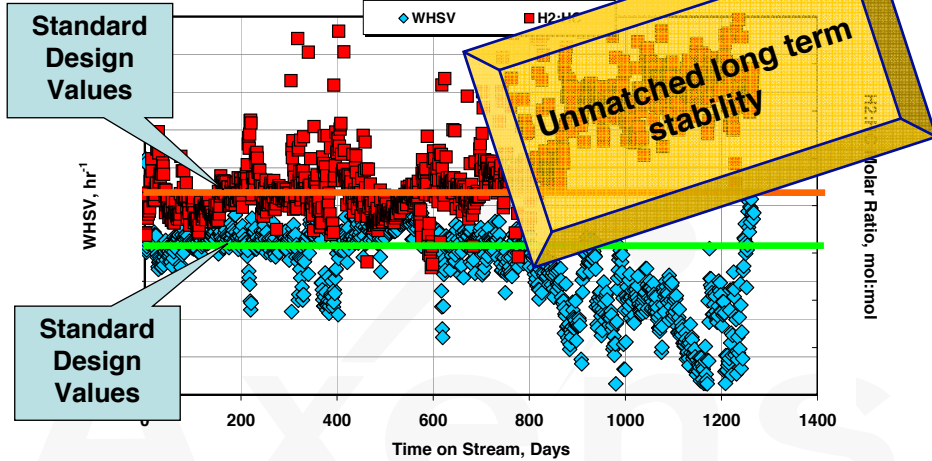


TransPlus™ Catalyst Performance Unit B



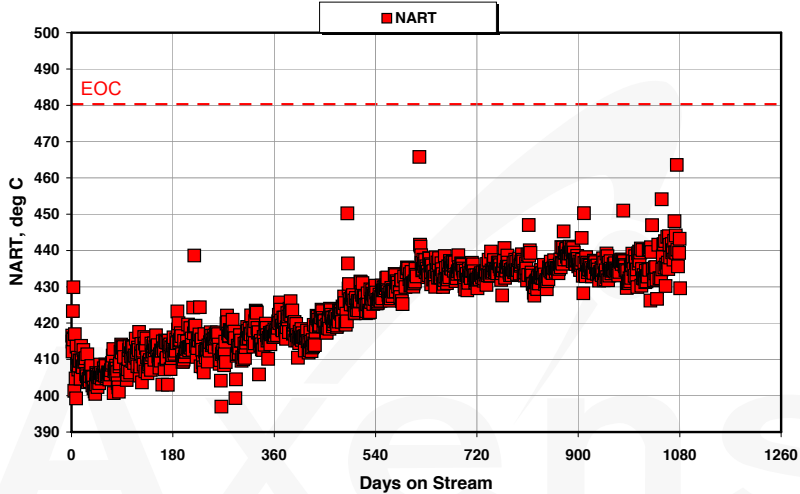
TransPlussm Catalyst Performance - Unit B

- Operating Conditions similar to ones proposed



TransPlussm Catalyst Performance - Unit B

- Normalized to design operating conditions



TransPlus™ References

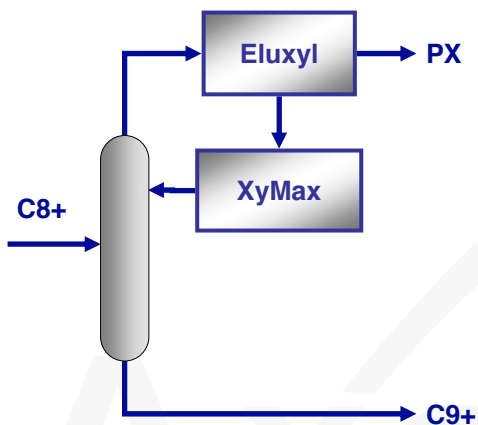
<u>Location</u>	<u>Unit Type</u>	<u>Start-up</u>
Taiwan/CPC	Retrofit	1997
Asia	Retrofit	2003
Thailand/EM	Retrofit	2004
Europe	Retrofit	2005
Asia	Grass Roots	2006
Asia	Retrofit	2007
Japan/JEC	Grass Roots	2007
Asia/Oman	Grass Roots	2009*
Asia	Grass Roots	2008*
Asia	Grass Roots	2009*
Asia	Grass Roots	2010*
Americas	Grass Roots	2012*
Asia	Grass Roots	2011*
Asia	Grass Roots	2011*

TransPlus performance judged striking enough to replace incumbent catalyst

ParamaX Projects under commercial operation

39

Xylenes Loop Efficiency



Maximize PX/X

Minimize Xylenes losses

Minimize hydraulics

Maximize EB conversion

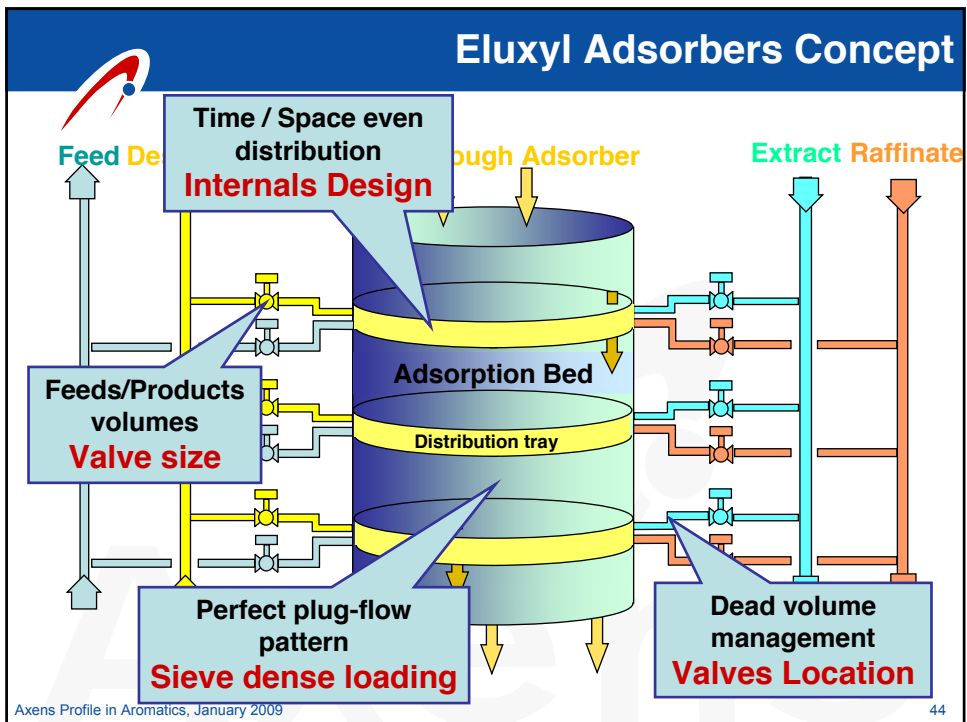
Maximize PX/X (PX_{ATE})



Eluxyl Licenses

Location	Capacity / line kMTA	Start-Up	
Asia	600 000	Eluxyl references in 'Mix-and-Match' plants	
USA	450 000		
Middle East	180 000		
Asia	650 000		
Asia	450 000		
Middle East	430 000		
Europe	80 000		on hold
Middle East	750 000		Q1 2007
Middle East	820 000		2009
Far East	420 000		ParamaX Project under commercial operation
Far East	840 000		
Far East	800 000		
Far East	700 000		
Middle East	700 000		
South America	780 000	2012	
Far East	900 000	2011	
Asia	500 000	2011	

Eluxyl Adsorbers Concept



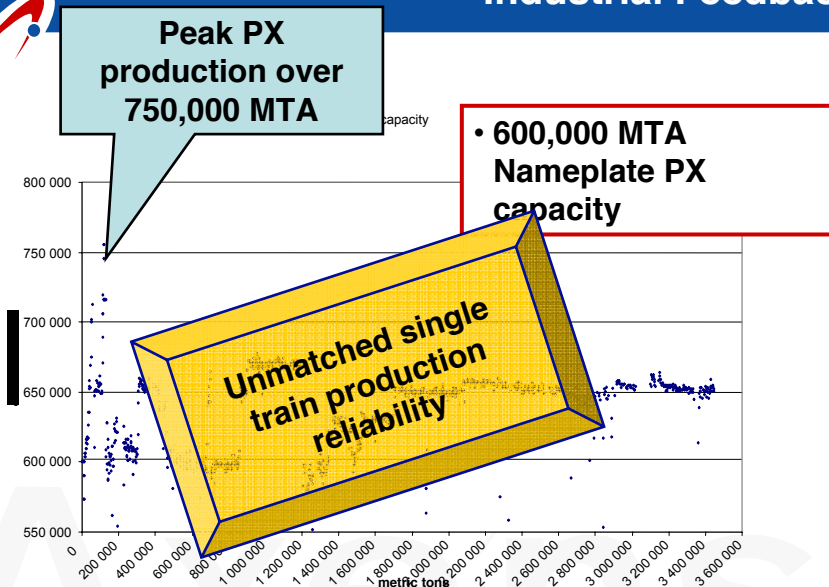
Eluxyl On/Off Valves & SCS

- Ability to handle large streams
- Valve management cancels pressure hunting
- Mechanical ruggedness
- Separation Zones configuration is an operating parameter
- Zones allocation disconnected from actual number of beds

On/Off valves concept open new operational horizons

Only the 'software' changes

Industrial Feedback

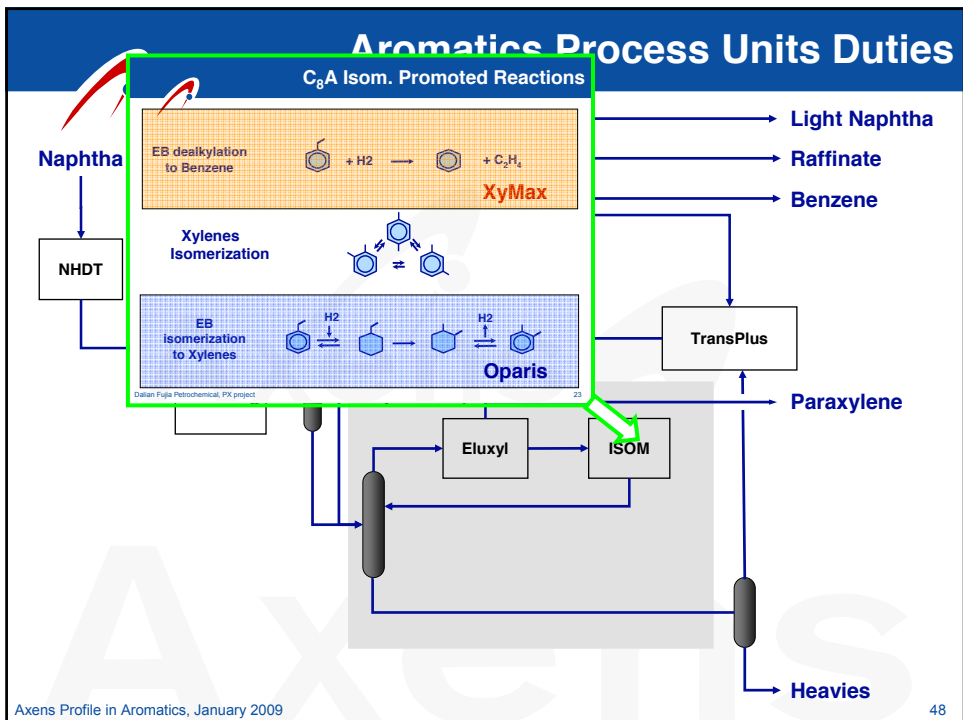


Today exceed 5500,000 MTA PX



- ✓ Large single train capacity
- ✓ SCS / PLC / Valves reliability and flexibility
- ✓ Overall hydraulic control of adsorption section
- ✓ Mechanical resistance

Eluxyl Development Challenges Are Met



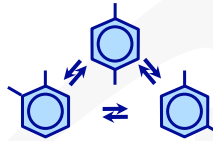
C₈A Isom. Promoted Reactions

EB dealkylation
to Benzene



XyMax

**Xylenes
Isomerization**

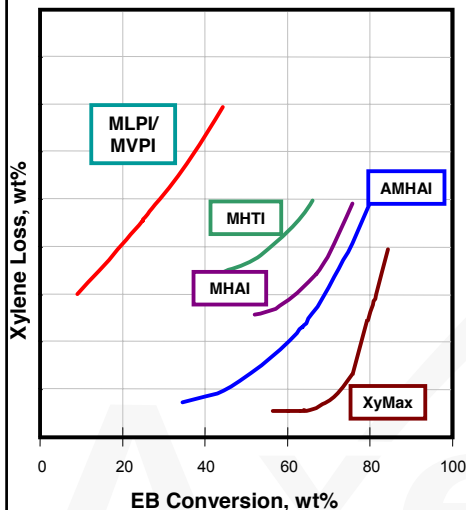


EB
isomerization
to Xylenes



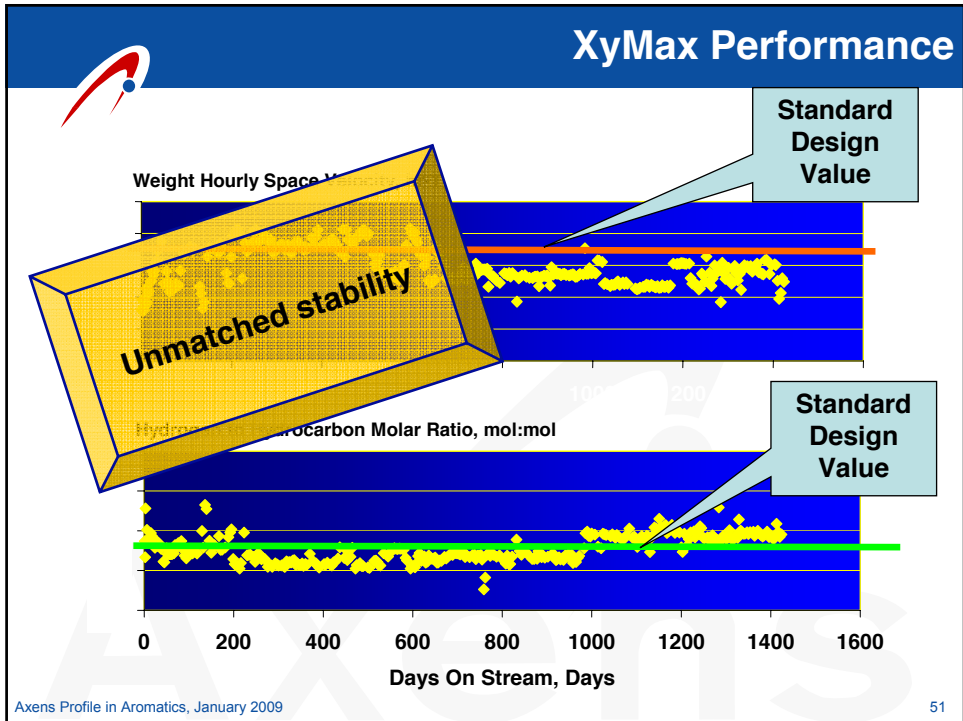
Oparis

XyMax Performance

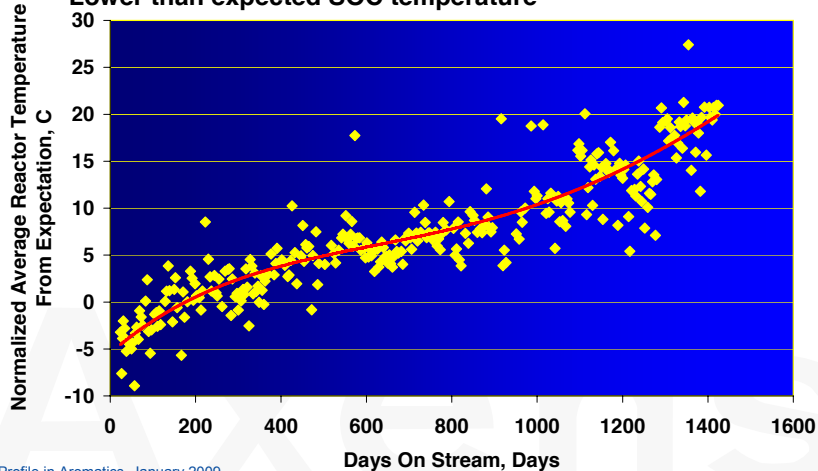


- Xylenes isomerization
- EB dealkylation to benzene
- 15 Industrial references
- EB conversion from 60% to 85%
- PX / X ~ Thermodynamic equilibrium at reactor outlet
- Xylenes loop PX/X > 96%
- High WHSV, low H₂/HC, Highly Stable

XyMax Performance



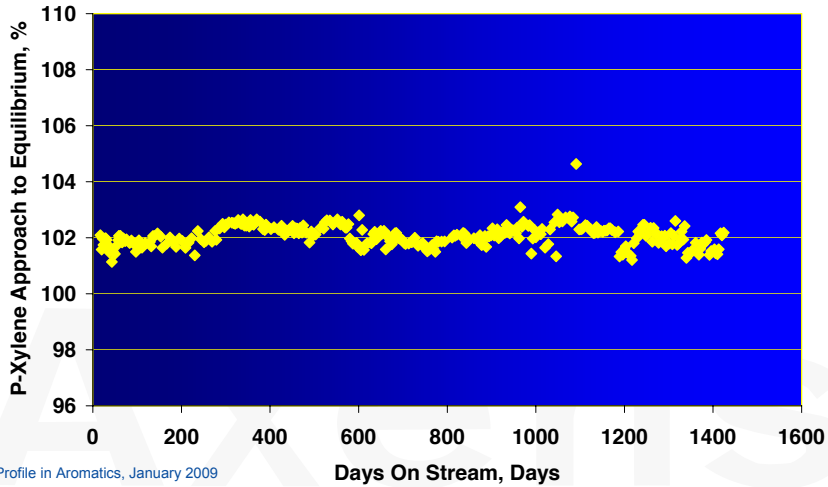
- Currently on stream for over 3.5 years
- Very Low aging rate - less than 5°C/year
- Lower than expected SOC temperature





Jurong XyMax

- Higher than expected PXAE
- Stable throughout the cycle



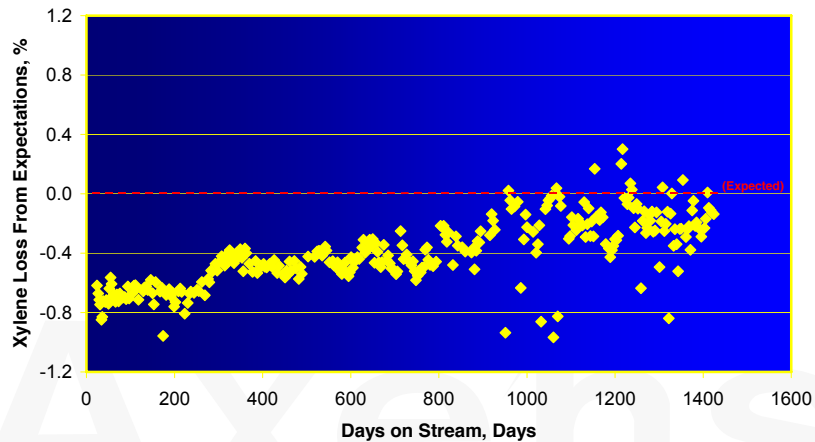
Axens Profile in Aromatics, January 2009

53



Jurong XyMax

- Lower than expected xylene loss



Axens Profile in Aromatics, January 2009

54



XyMax™ References

<u>Location</u>	<u>Unit Type</u>	<u>Start-up</u>
Singapore/EM	Retrofit	2000
Netherlands	Retrofit	2002
Licensee	Retrofit	2002
Baytown	Retrofit	2003
Total	Retrofit	2004
Asia	Retrofit	2004
Asia	Retrofit	2005
Asia	Retrofit	2007
Japan/JEC	Grass Roots	2007
Asia/Oman	Grass Roots	2009*
Asia	Grass Roots	2008*
Asia	Grass Roots	2010*
Asia	Grass Roots	2010*
Americas	Grass Roots	2012*
Asia	Grass Roots	2011*
Asia	Grass Roots	2011*

XyMax performance judged striking enough to replace incumbent catalyst

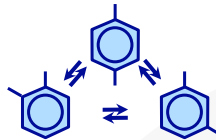
ParamaX Projects under commercial operation

55



C₈A Isom. Promoted Reactions

Xylenes Isomerization



EB isomerization to Xylenes



Oparis



Optimal Aromatics Isomerization

- **Unique combination of high activity and improved selectivity:
PX/C8A > 92% industrially achieved**
- **Robust and stable catalyst**
- **In-situ regeneration fully proven**
- **Industry benchmark: 14 industrial reference in drop-in replacement, one grassroots**

Oparis Industrial Experience



Area	Country	Year	Type
Asia	Taiwan	2001	Drop-in replacement
Asia	Taiwan	2002	Drop-in replacement
Asia	India	2003	Drop-in replacement
Asia	Japan	2004	Drop-in replacement
Asia	Thailand	2004	Drop-in replacement
Europe	Portugal	2004	Drop-in replacement
Asia	Indonesia	Q1 2006	Drop-in replacement
Asia	China	2008	Grassroot
Americas	Mexico	Q2 2006	Drop-in replacement
Asia	China	Q2 2006	Drop-in replacement
Europe	Poland	Q3 06	Drop-in replacement
Asia	Taiwan	Q3 06	Drop-in replacement
Asia	Taiwan	Q2 2007	Drop-in replacement
Asia	India	Q2 2007	Drop-in replacement

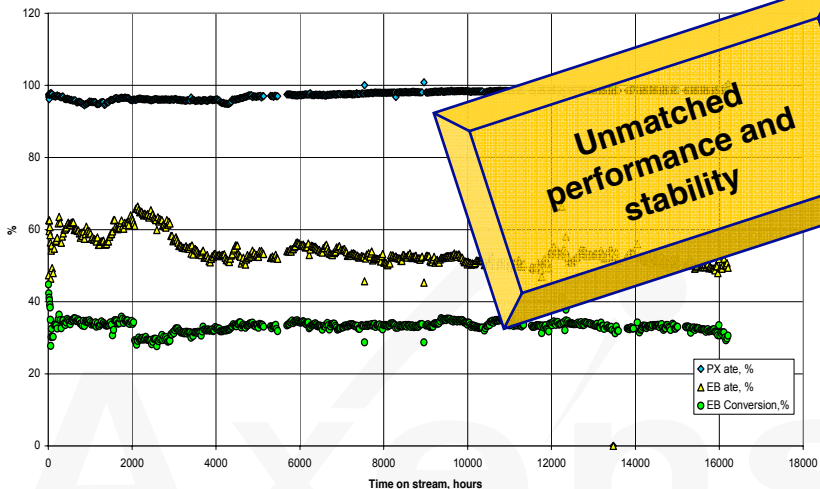
Oparis performance judged striking enough to replace incumbent catalyst

Americas Brazil Q3 05 Drop-in replacement

Oparis 16th reference to be coupled with Eluxyl (Dec 2008)

Oparis Unit 2

Figure 9. Performance of Oparis catalyst at FCFC Aroma-2
Approach to equilibrium, and EB conversion



Oparis at TPX

Figure 4. Performance of Oparis catalyst at Thai Paraxylene Company Ltd.

EB / PX approach to eqm and EB conversion

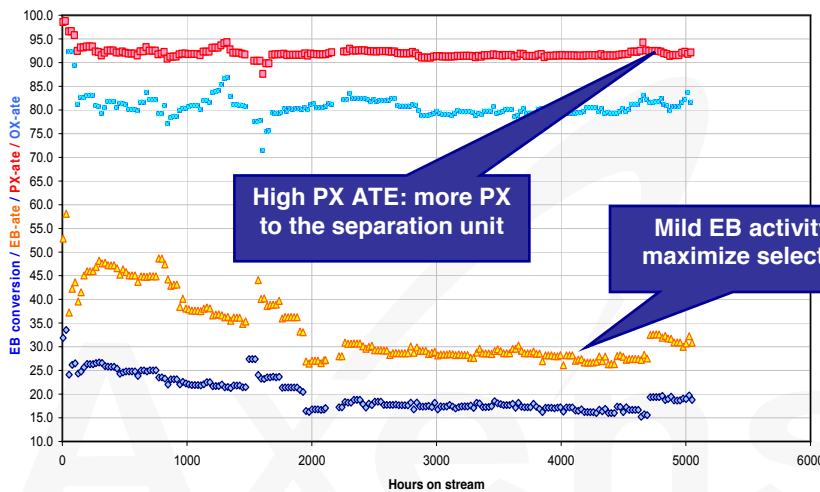
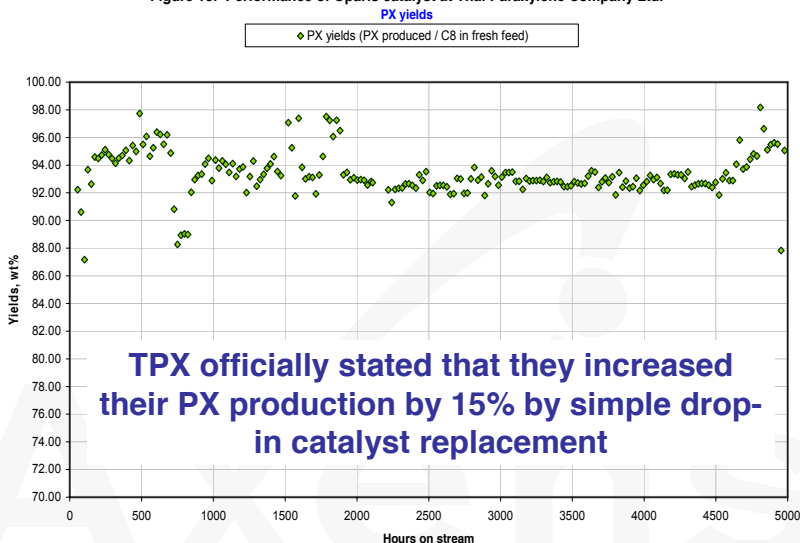




Figure 13. Performance of Oparis catalyst at Thai Paraxylene Company Ltd.



Isomerization Technology Option

Whatever the option, ParamaX offers

- **High selectivity / activity**
- **Cost effective operating conditions**
- **Robust and stable**
- **Fully industrially proven**

Processing Option determined on economics only



Maximize selectivity to PX...

- CCR catalyst efficient on wide boiling range feeds
- Transalkylation designed to process heavy feedstocks (C9-C10 Aros)
- Highly selective Xylenes Isomerization technologies



Minimize investment cost...

- CCR technology lay-out
- Simple concept Morphylane
- Eluxyl technology economy of scale
- High space velocity & low H₂/HC Transalkylation and Isomerization technologies



Minimize operating cost...

- CCR technology / catalyst: low attrition
- Optimized Morphylane solvent
- Eluxyl SPX-3003 reduces desorbent requirement
- Low H₂/HC Transalkylation and Xylenes Isomerization technologies



Maximize time on-stream cost...

- Optimized Morphylane solvent
- On-the-fly Eluxyl maintenance
- Transalkylation catalyst stability
- Xylenes Isomerization catalysts stability

**Backed-up by extensive
commercial experience**

Industrial experience



Middle East, 740 kMTA PX



Far East, 520 kMTA PX



Far East, 700 kMTA PX

Axens Profile in Aromatics, January 2009

67

Conclusions

- **Axens' ParamaX offer has retained petrochemical industry's attention**
- **ParamaX technology performance and reliability offer low investment and operating costs**
- **Ideally suited for today's worldscale projects**
- **ParamaX concept features a unique combination of business practices: Licensor, Operating company, Engineering company**

Thank You for your attention

Axens Profile in Aromatics, January 2009

68