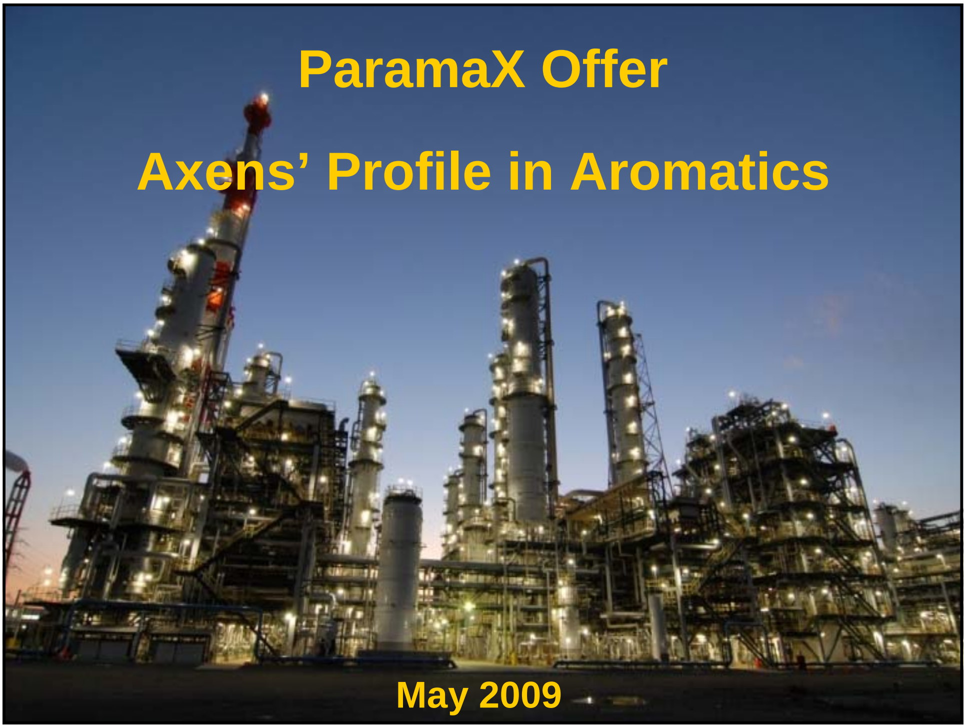
ParamaX Offer

Axens' Profile in Aromatics



May 2009

Agenda

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

Paraxylene Market Trends

- 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?

BTX Market Overview

- 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

BTX Licensing Challenges

- **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

Agenda

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

ParamaX - The Axens Offer

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

ParamaX Technologies

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 - C_7+ aromatics hydrodealkylation for benzene production
XyMax - xylenes isomerization with EB dealkylation
Morphylane - aromatics extractive distillation
MTDP-3 - toluene disproportionation
Oparis™ - C_8 aromatics isomerization
Sulfolane - aromatics extraction
TransPlus℠ - toluene/heavy aromatics transalkylation
PXMax - toluene selective disproportionation

ParamaX References

Country				/X/C9+	BZ
					300
			50		200
		180			
	04)	450			150
	running (Q1' 07)	750	100		300
	Start-up Q2 09	820			200
Japan	running (Q4' 07)	420			200
China	Start-up Q4 08	840			300
China	Start-up Q2 09	1600	240		400
China	Start-up Q4 08	700	100		390
Kingdom of Saudi Arabia	Start-up Q1 11	700		690	140
Brazil	Start-up Q1 12	780			690
Korea	Start-up Q1 11	900			280
Kazakhstan	Start-up Q1 11	500			130

- 7.2 MMTA PX capacity awarded
- 40% of projects / 45% capacity
- All projects proceeding

Single source ParamaX Licenses

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**

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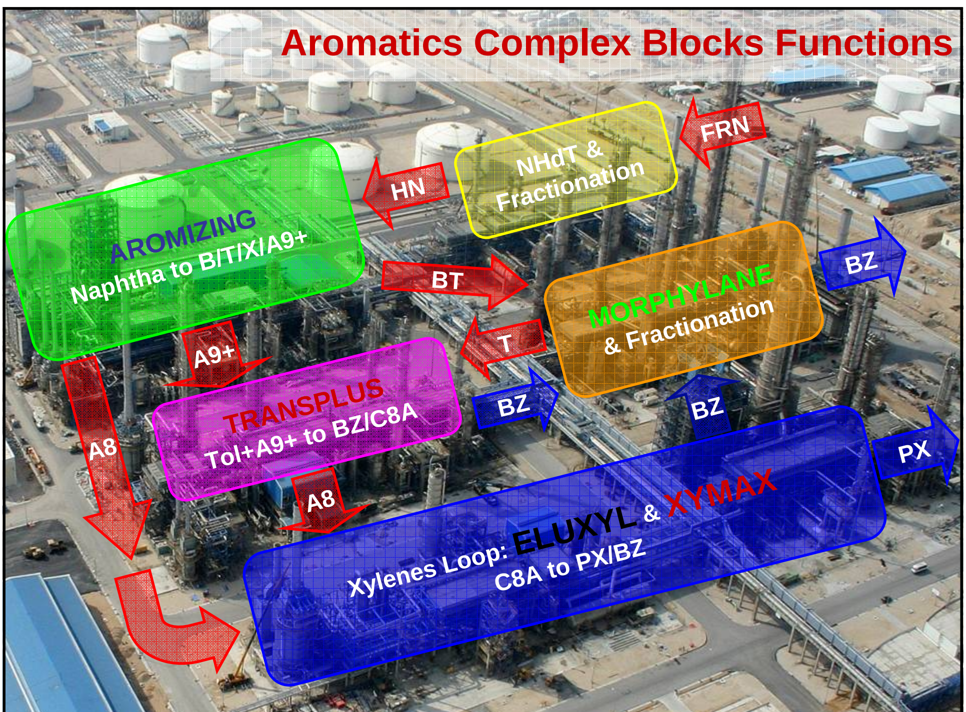
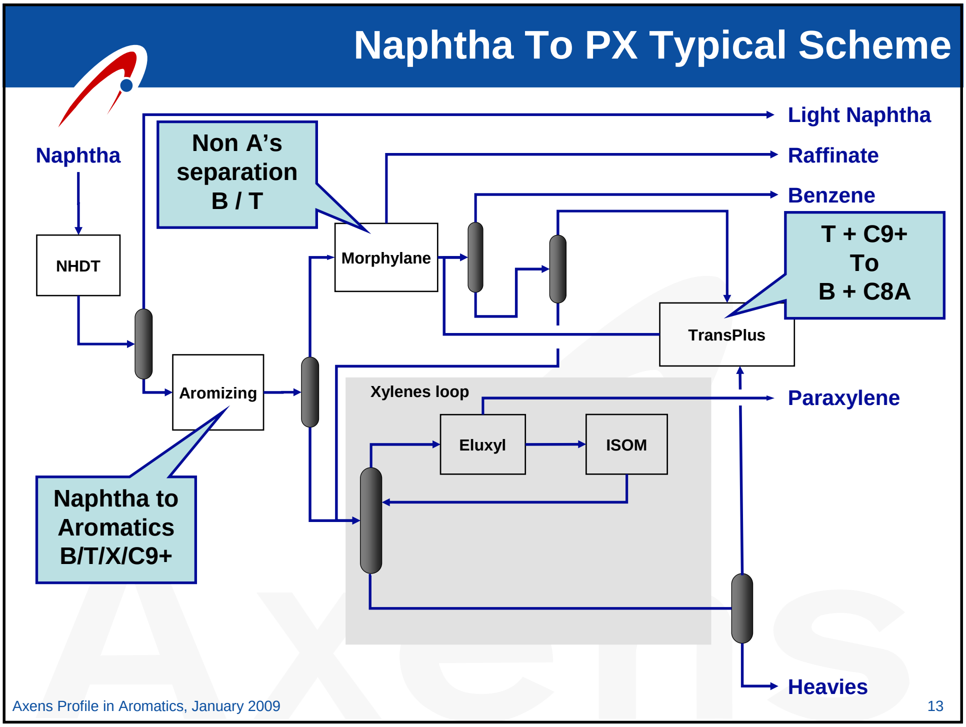
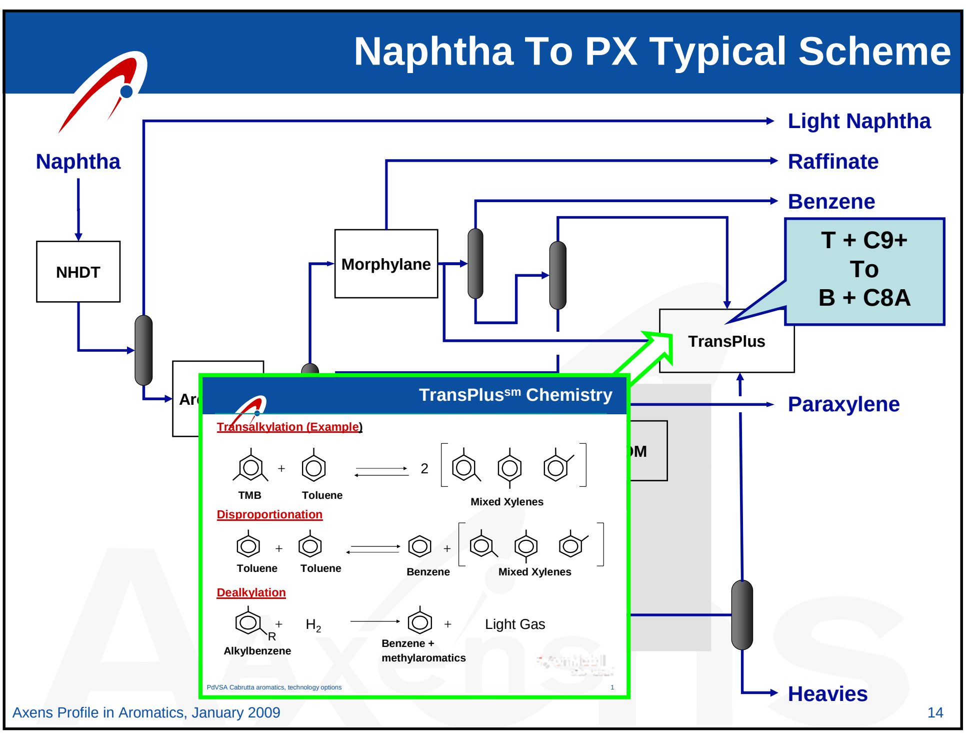
- ParamaX offer
- **Key technologies outline**
- ParamaX experience

Aromatics Complex Blocks Functions




Naphtha To PX Typical Scheme
Naphtha
NHDT
Non A's separation B / T
Morphylane
Aromizing
Naphtha to Aromatics B/T/X/C9+
Xylenes loop
Eluxyl
ISOM
TransPlus
T + C9+ To B + C8A
Light Naphtha
Raffinate
Benzene
Paraxylene
Heavies
Axens Profile in Aromatics, January 2009
13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Naphtha
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T + C9+ To B + C8A
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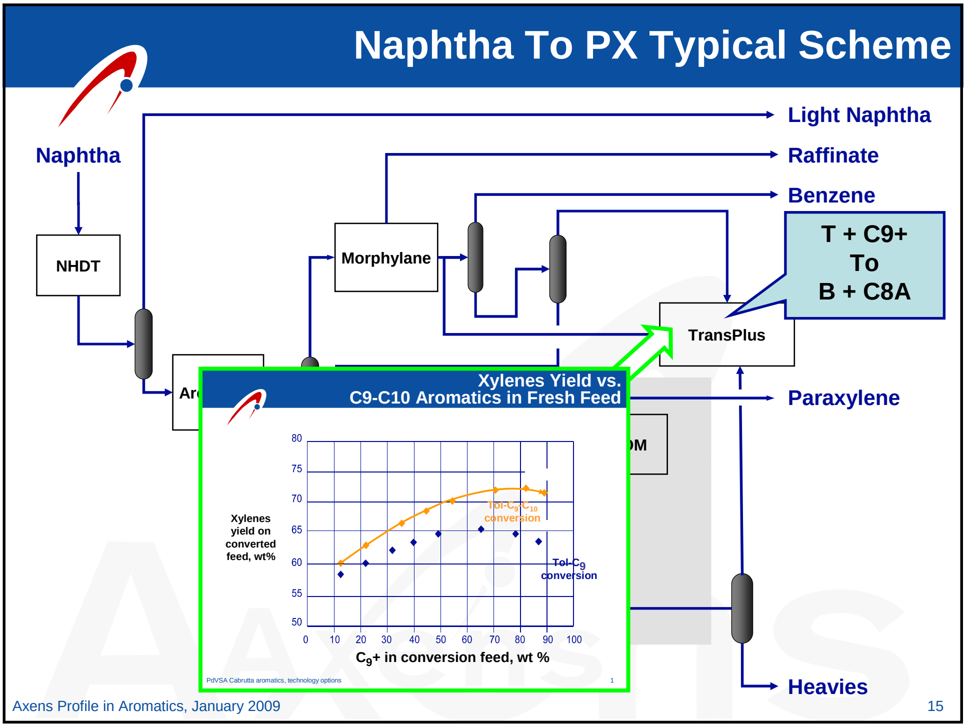
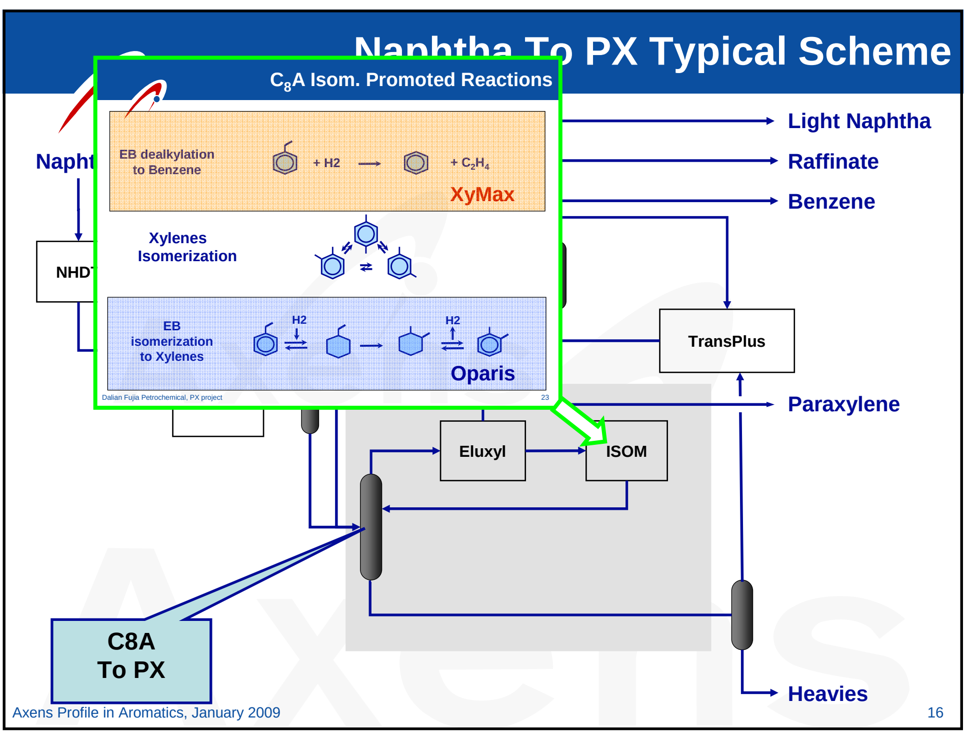
Raffinate
Benzene
Paraxylene
Heavies
TransPlus^{sm} Chemistry
Transalkylation (Example)
TMB
Toluene
2
Mixed Xylenes
Disproportionation
Toluene
Toluene
Benzene
Mixed Xylenes
Dealkylation
Alkylbenzene
H_2
Benzene + methylaromatics
Light Gas
Axens Profile in Aromatics, January 2009
14


Naphtha To PX Typical Scheme
Naphtha
NHDT
Morphylane
Light Naphtha
Raffinate
Benzene
T + C9+
To
B + C8A
TransPlus
Paraxylene
Heavies
Xylenes Yield vs.
C9-C10 Aromatics in Fresh Feed
Xylenes yield on converted feed, wt%
Tol-C9-C10 conversion
Tol-C9 conversion
C9+ in conversion feed, wt %
80
75
70
65
60
55
50
0
10
20
30
40
50
60
70
80
90
100
Axens Profile in Aromatics, January 2009
15


Naphtha To PX Typical Scheme
C8A Isom. Promoted Reactions
EB dealkylation to Benzene
+ H2
+ C2H4
XyMax
Xylenes Isomerization
EB isomerization to Xylenes
H2
H2
Oparis
Dalian Fujia Petrochemical, PX project
Light Naphtha
Raffinate
Benzene
TransPlus
Paraxylene
Eluxyl
ISOM
Heavies
C8A
To PX
Axens Profile in Aromatics, January 2009
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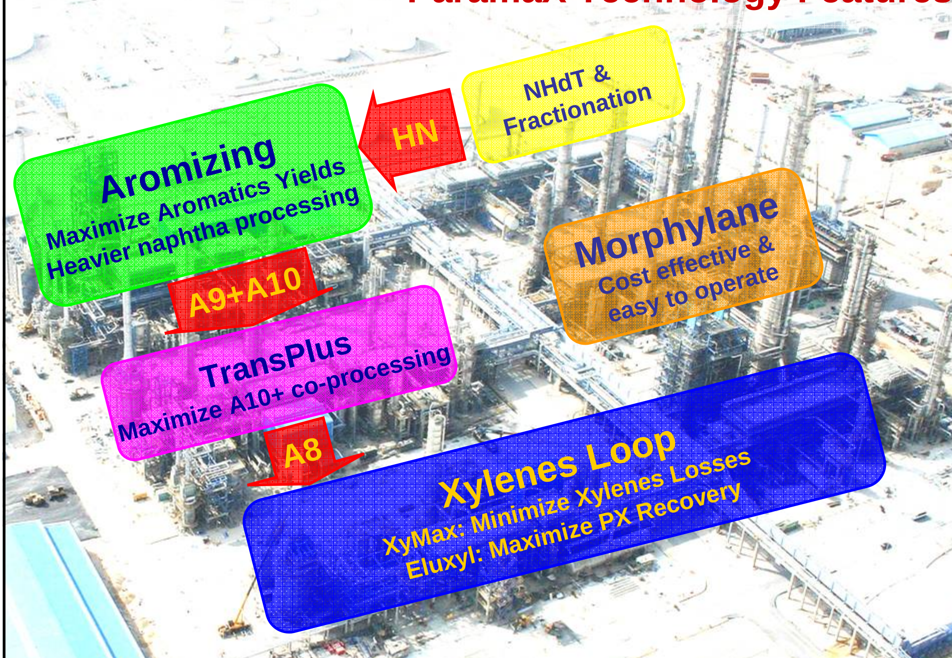
ParamaX Technology Features



ParamaX : CCR Technology

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

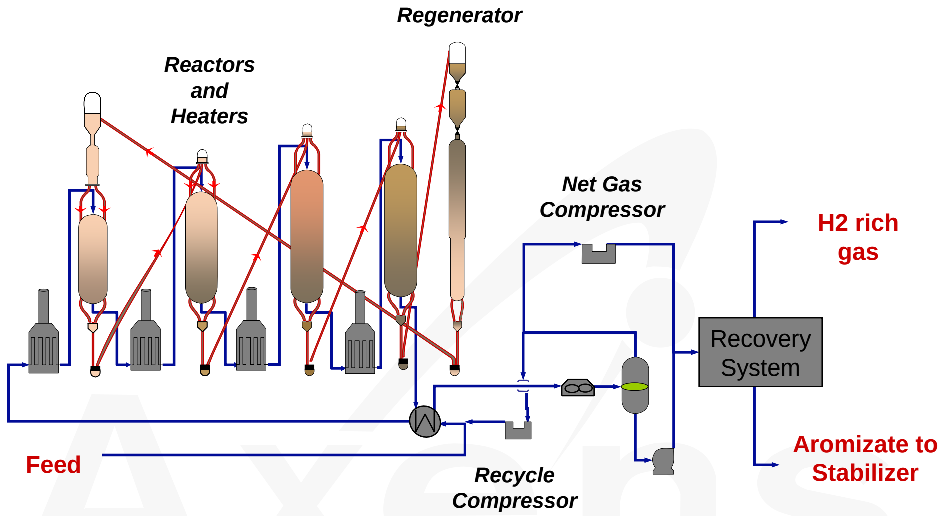
>50% market share over last 3 years

Axens' CCR recent references

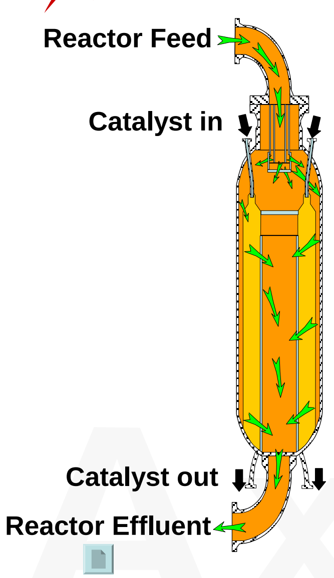
CUSTOMER	LOCATION	CAPACITY (BPSD)	START-UP DATE	SEVERITY RON clear
FCFC	Mailiao (Taiwan)	40 000	2007	104 (Aromizing)
SK Energy	Ulsan (S. Korea)	30 000	2006	105 (Aromizing)
NIOEC	Arak (Iran)	20 000	2009	100
ENOC - EPCL	Dubai (UAE)	36 000	2008	102
SAFRA	Yanbu (Saudi-Arabia)	10 000	2008	104
OMAN OIL COMPANY	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	45 000	2009	100
NIOEC	Bandar Abbas (Iran) N°2	45 000	2009	100
NIOEC	Bandar Abbas (Iran) N°3	45 000	2009	100
HoodOil	Ras Issa (Yemen)	15 000	[illegible]	102
DRAGON AROMATICS	Xiamen (China)	[illegible]	[illegible]	106 (Aromizing)
PETRONAS & Republic Of Sudan	Port Sudan (Sudan)	13 500	[illegible]	102
KNPC	Mina Abdulla (Kuwait)	18 000	[illegible]	102 - 104
HELPE	Thessaloniki (Greece)	15 000	[illegible]	100
DFPC	Dalian (China)	[illegible]	2008	105 (Aromizing)
NIORDC	[illegible]	20 000	[illegible]	100
TOTAL / Saudi-Aramco	Jubail (Saudi Arabia)	67 000	2011	104 (Aromizing)
NIOEC	Bandar Abbas (Iran)	25 000	2010	100
WEPEC	Dalian (China)	[illegible]	2010	102
KMG	Atyrau (Kazakhstan)	25 500	2010	104 (Aromizing)
Petrochina	Qingyang (China)	15 000	2010	102
PDVSA	El Palito (Venezuela)	24 500	2010	104
QPCC	Messaieed (Qatar)	40 000	2010	104 (Aromizing)
Egyptian Refining Company	Cairo (Egypt)	14 000	2011	102
GGSRL	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

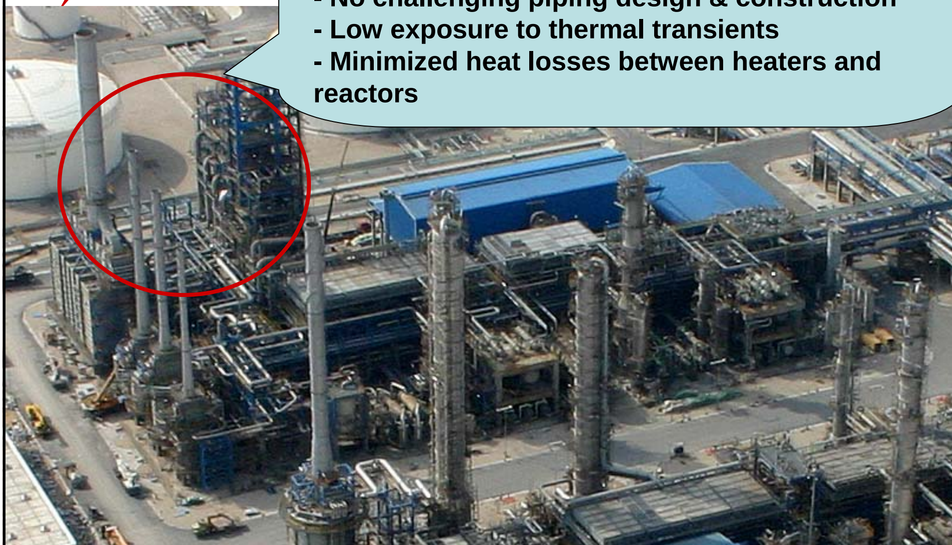


Reactor Design

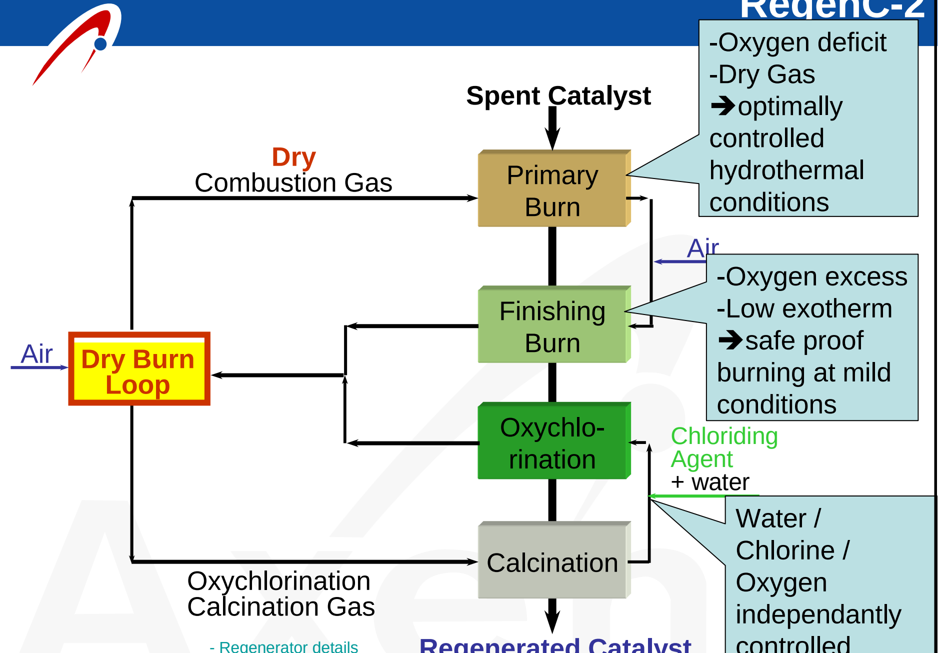


- **Simple reactor concept**
  - Metal thickness based on process conditions
  - Basket type internals
  - Low-scale structure
  - Straightforward layout
  - Easy engineering
  - Easy maintenance
- **Design taylored to the process**
  - All reactor design criteria independantly optimized (away from pinning 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

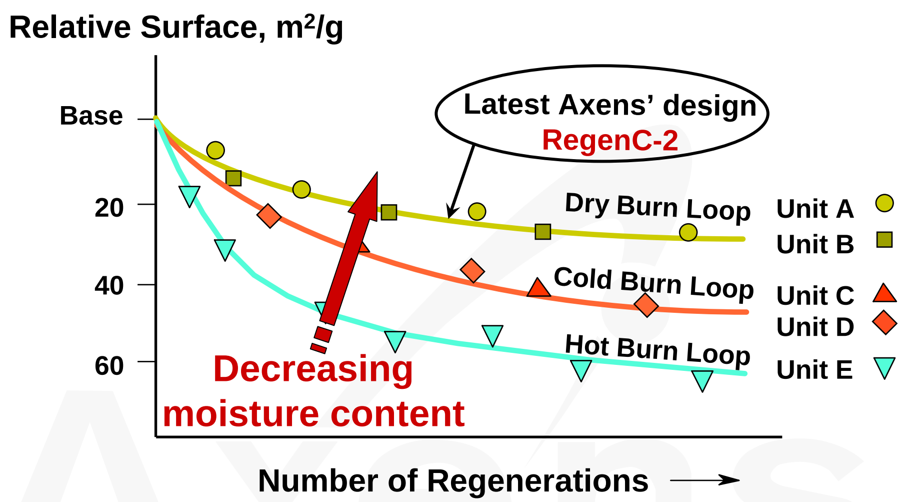


RegenC-2

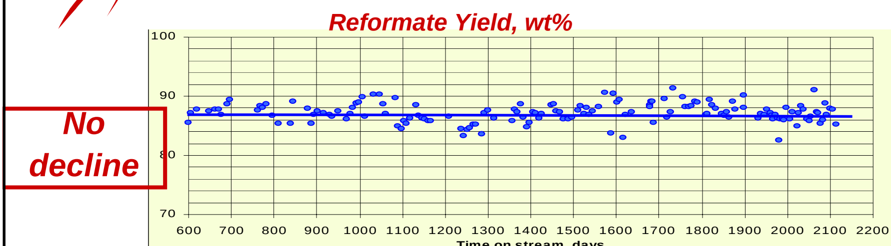


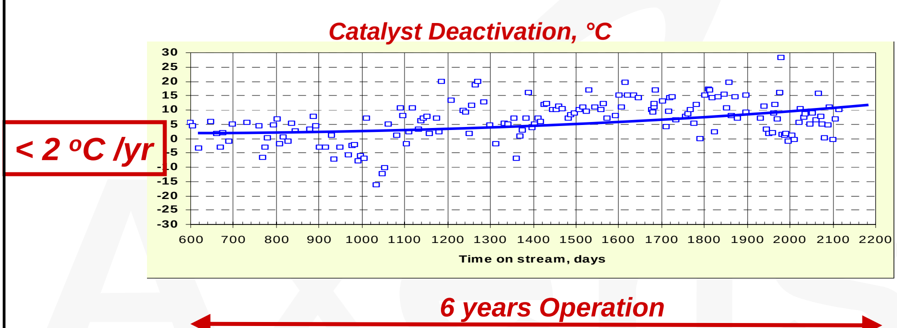
- Regenerator details

CR 201 Surface Area Decline vs. Regenerations in Commercial Units

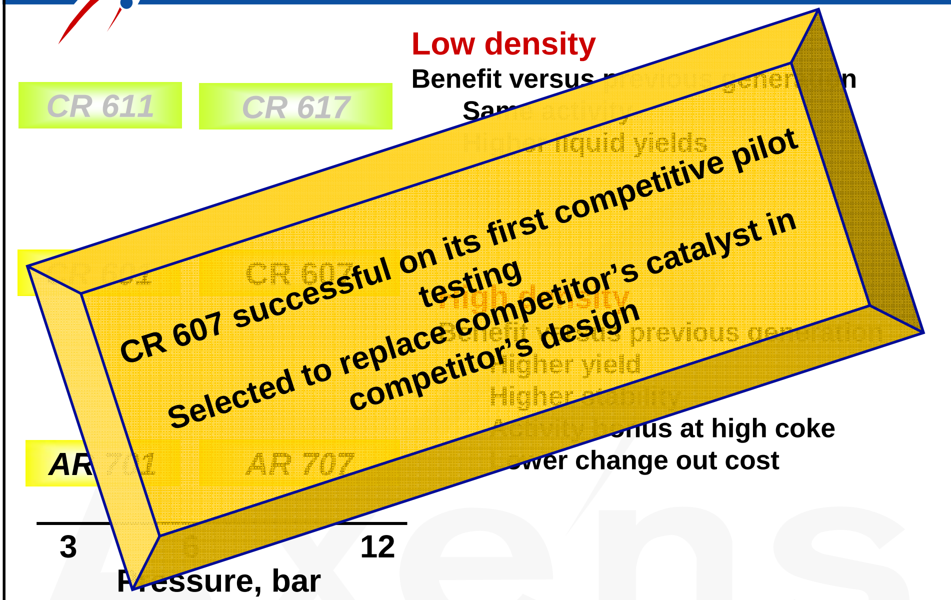


Yield Stability & Catalyst Deactivation





CCR Catalysts Portfolio

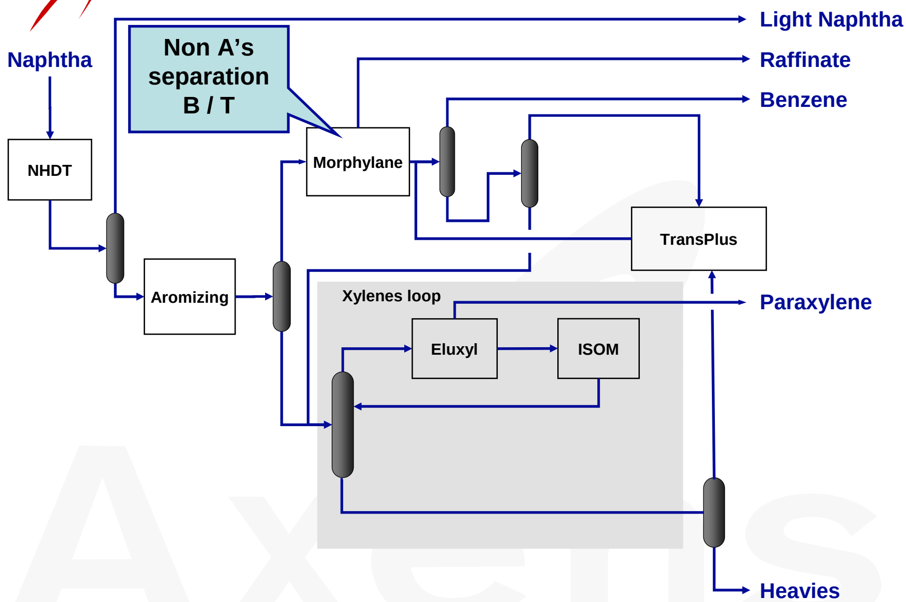


Aromizing

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

Aromatics Process Units Duties



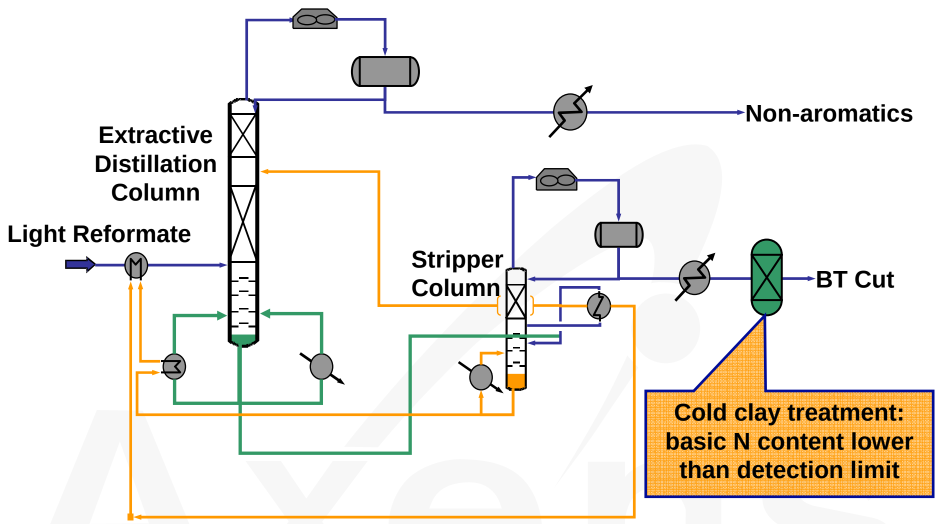
Morphylane

Morphylane: Pure Bz and Tol from Light Reformate

- Reduced number of equipment items: low CAPEX and OPEX
- Easy to operate concept
- Optimized solvent selection
- Low solvent inventory and consumption

Over 55 Industrial References

Morphylane Flowscheme

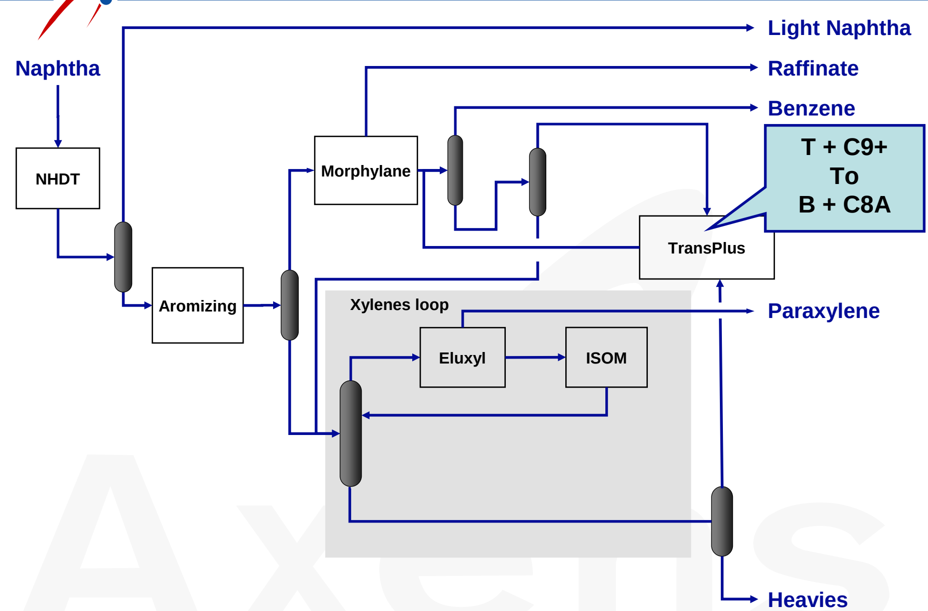


MORPHYLANE References

Start-Up	Company Plant Site	Feed Process	Process Data	Aromatics Capacity		Licensor	Co[illegible] Project[illegible]
2009	**Xingtai Risun** **Coal & Chemical LTD** Yanjiatun (Xingtai), P.R. China	Coke Oven Light Oil **MORPHYLANE**	Benzene Toluene Xylenes	74,400 [illegible] [illegible]	t/y t/y t/y	Uhde	[illegible]
2009	**JERP -** **Jubail Export Refinery Project** Jubail (Saudi Arabia)	Reformate **MORPHYLANE**	Benzene	140,300	t/y	Uhde	**E** (in cooperation with Axens)
2009	**Tabriz Oil Refining Company** Iran	Reformate **MORPHYLANE**	Benzene	[illegible]	t/y	Uhde	**E** (in cooperation with Axens)
2009	**Jiant[illegible] Chemical Co., Ltd.** [illegible], P.R. China	Coke Oven Light Oil **MORPHYLANE**	Benzene Toluene	[illegible] [illegible]	t/y t/y	Uhde	**E,P**
2008	**[illegible] Kun[illegible] Co. Ltd.** Kun[illegible], P.R. China	Coke Oven Light Oil **MORPHYLANE**	Benzene Toluene [illegible]	[illegible] [illegible] [illegible]	t/y t/y t/y	Uhde	**E,P**
2008	**GCW [illegible] Gas Group Co.** Anshan, P.R. China	Coke Oven Light Oil **MORPHYLANE**	Benzene [illegible] Xylenes	[illegible] [illegible] [illegible]	t/y	Uhde	**E,P**
[illegible]	**Sasol** South Africa	Pyrolysis Gasoline **MORPHYLANE**	Benzene	[illegible]	[illegible]	Uhde	**E**
[illegible]	**HoodOil** Yemen	Reformate **MORPHYLANE**	[illegible]	210,000	t/y	Uhde	**E** (in cooperation with Axens)
20[illegible]	**Shell Eastern** Singapore	[illegible] **MORPHYLANE**	Benzene	210,000	t/y	Uhde	**E** (in cooperation with Axens)
2007	[illegible]	Reformate **MORPHYLANE**	Benzene/ Toluene	310,000	t/y	Uhde	**E** (in cooperation with Axens)
2007	[illegible]	Reformate **MORPHYLANE**	Benzene/ Toluene	350,000	t/y	Uhde	**E** (in cooperation with Axens)
2006	**Baosteel International** Taiyuan, P.R. China	Coke Oven Light Oil **MORPHYLANE**	Benzene Toluene	56,000 12,000	t/y t/y	Uhde	**E**
2006	**Repsol S.A.** Tarragona, Spain	Reformate and Pyrolysis Gasoline **MORPHYLANE**	Benzene	221,000	t/y	Uhde	**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



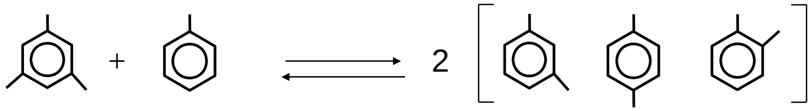
TransPlus

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**

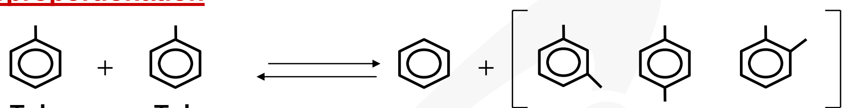
TransPlus[sm] Chemistry - Desireable

Transalkylation (Example)



TMB **Toluene** **Mixed Xylenes**

Disproportionation

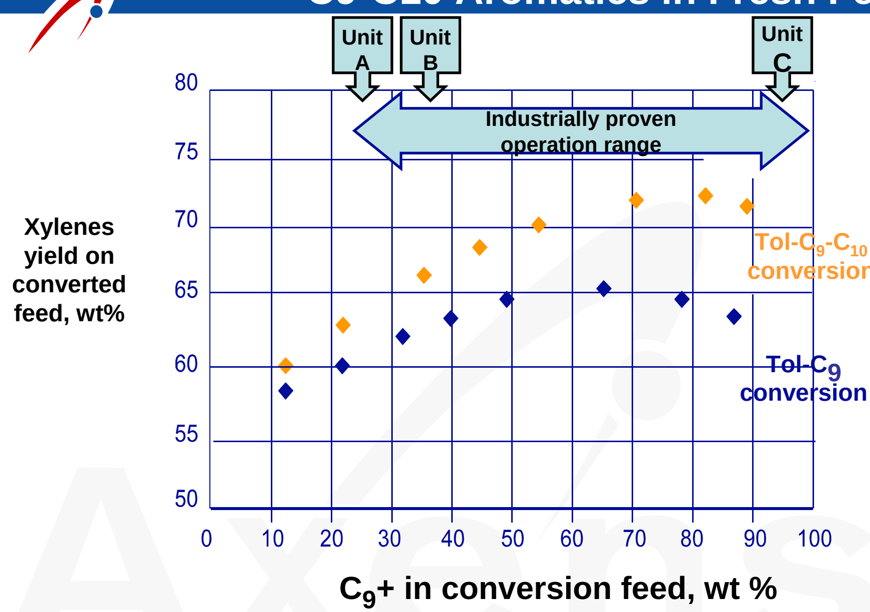


Toluene **Toluene** **Benzene** **Mixed Xylenes**

Dealkylation

Alkylbenzene **Benzene + methylaromatics**

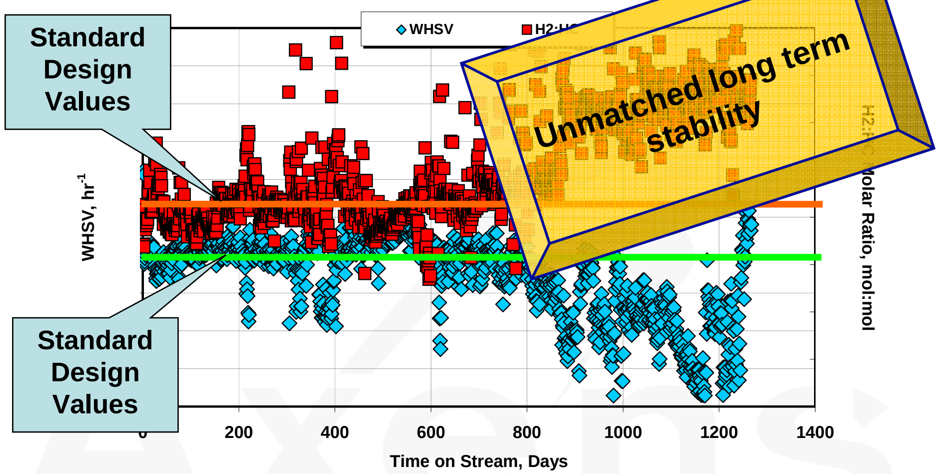
TransPlus Xylenes Yield vs. C9-C10 Aromatics in Fresh Feed



TransPlus™ Catalyst Performance Unit B

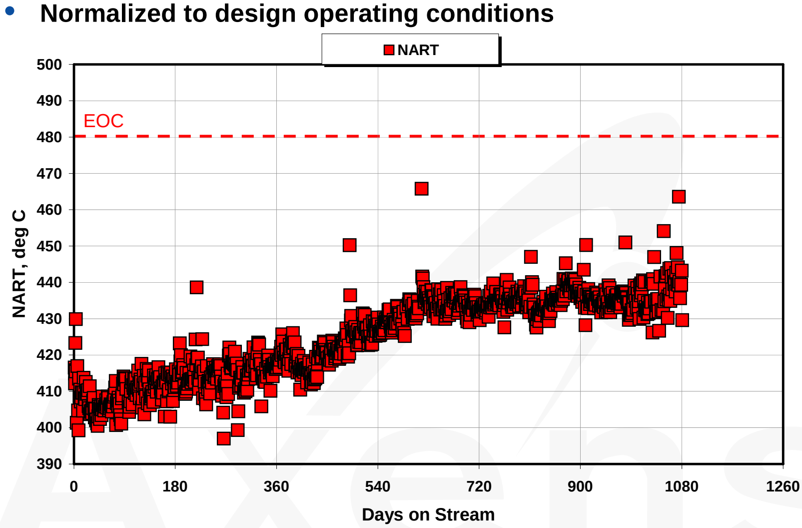
TransPlus^{sm} Catalyst Performance - Unit B

- Operating Conditions similar to ones proposed



TransPlus^{sm} Catalyst Performance - Unit B

- Normalized to design operating conditions



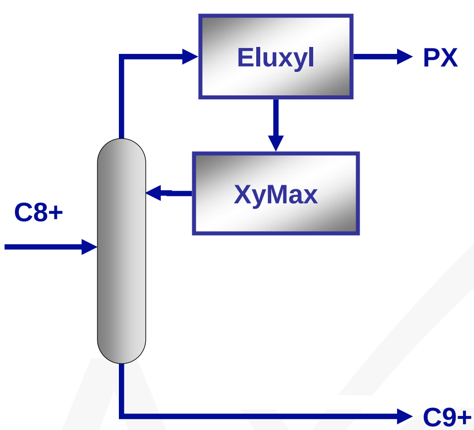
TransPlus™ References

Location	Unit Type	Start-up
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

Xylenes Loop Efficiency



Maximize PX/X

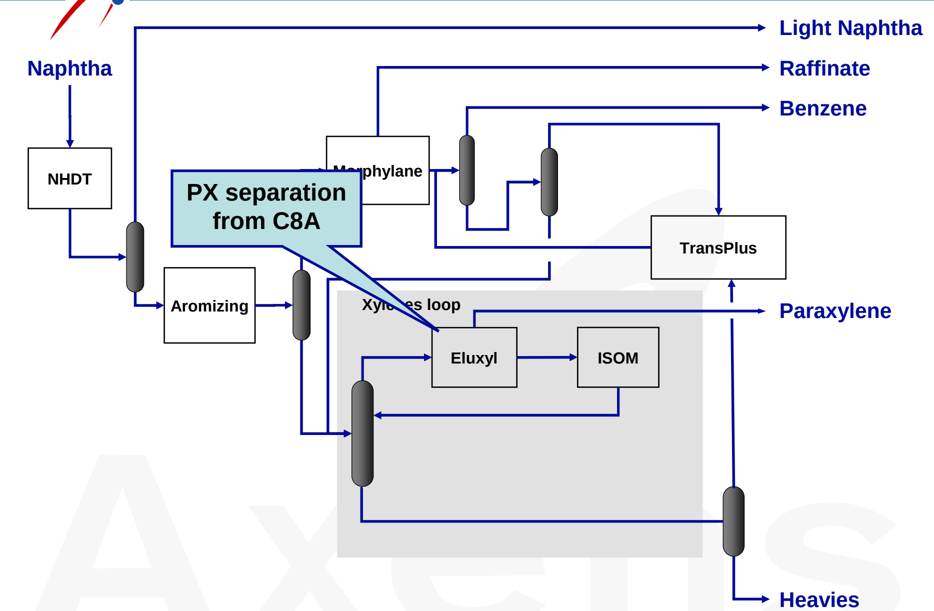
Minimize Xylenes losses

Minimize hydraulics

Maximize EB conversion

Maximize PX/X (PX $_{ATE}$)

Aromatics Process Units Duties



Eluxyl
PX Separation with SMB Concept

- 7 units in operation, 8 under design / engineering
- PX capacity from 180 to 900 kMTA
- Demonstrated industrial reliability and flexibility

Eluxyl sets new limits for economy of scale

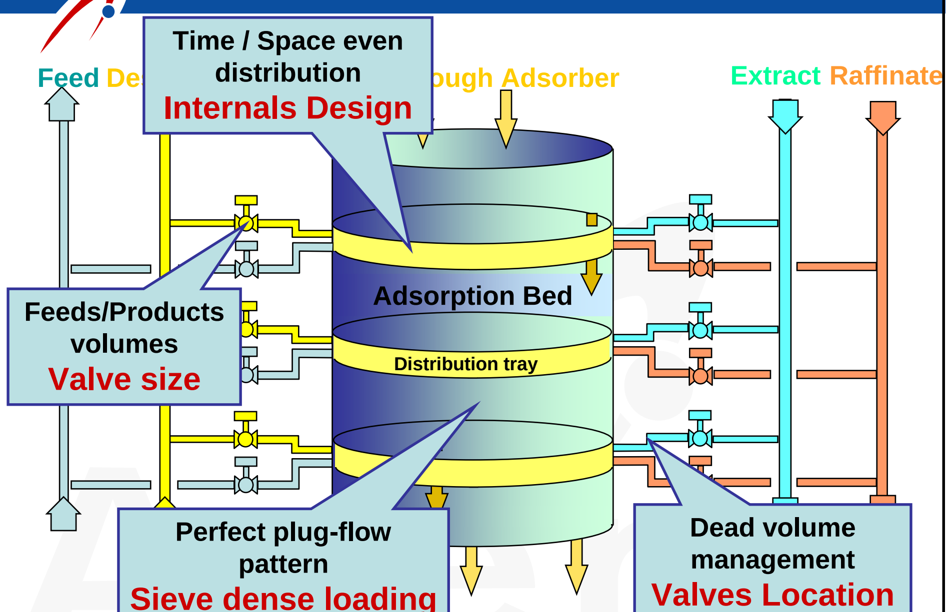
Eluxyl Licenses

Location	Capacity / line kMTA	Start-Up
Asia	600 000	
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	
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 references in 'Mix-and-Match' plants

ParamaX Project under commercial operation

Eluxyl Adsorbers Concept



Eluxyl On/Off Valves & SCS

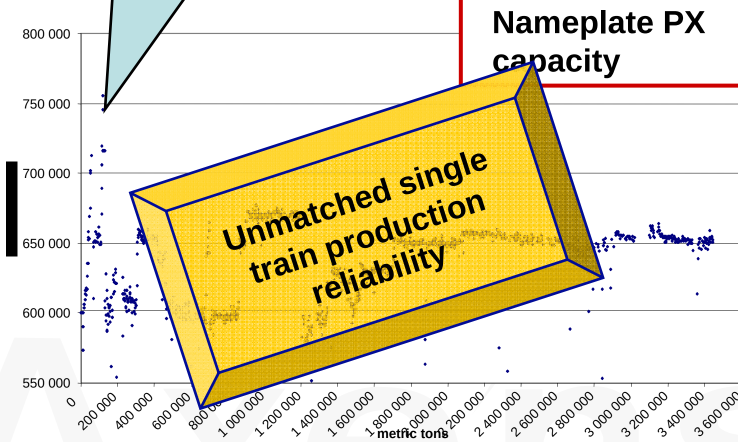
- Ability to handle large streams
- Valve management cancels pressure hunting
- Mechanical ruggedness
- Separation Zones configuration is an operating parameter
- Zones allocation disconnected from actual number of beds

On/Off valves concept open new operational horizons
Only the 'software' changes

Industrial Feedback

Peak PX production over 750,000 MTA

- 600,000 MTA Nameplate PX capacity

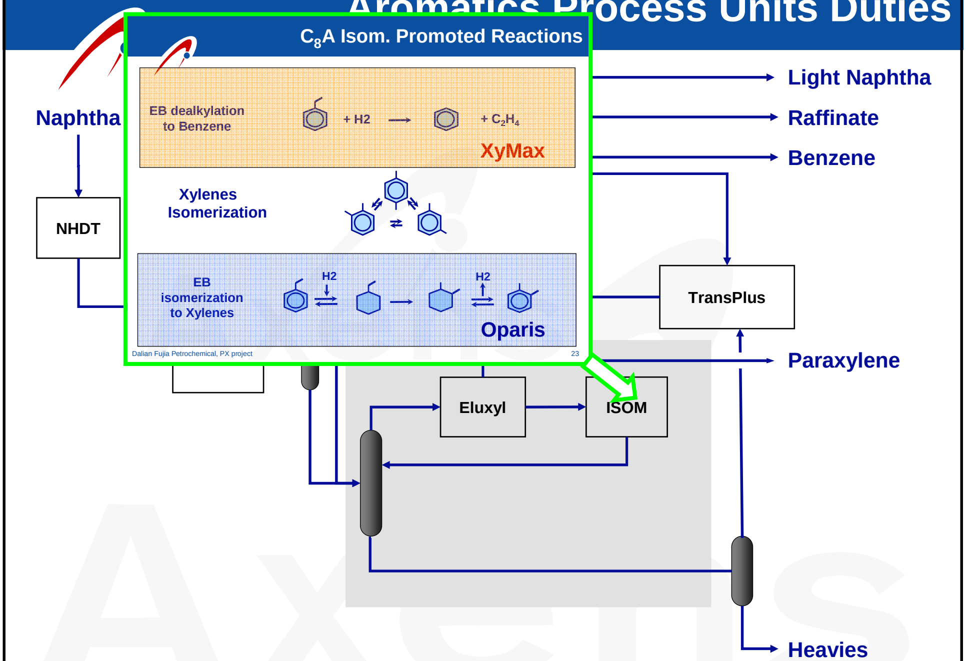


Unmatched single train production reliability

Today exceed 5500,000 MTA PX

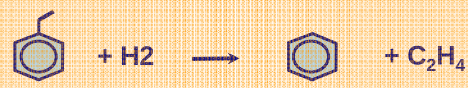
- ☑ Large single train capacity
- ☑ SCS / PLC / Valves reliability and flexibility
- ☑ Overall hydraulic control of adsorption section
- ☑ Mechanical resistance

Eluxyl Development Challenges Are Met



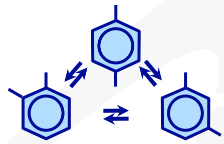
C_8A Isom. Promoted Reactions

EB dealkylation to Benzene

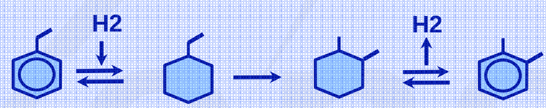


XyMax

Xylenes Isomerization

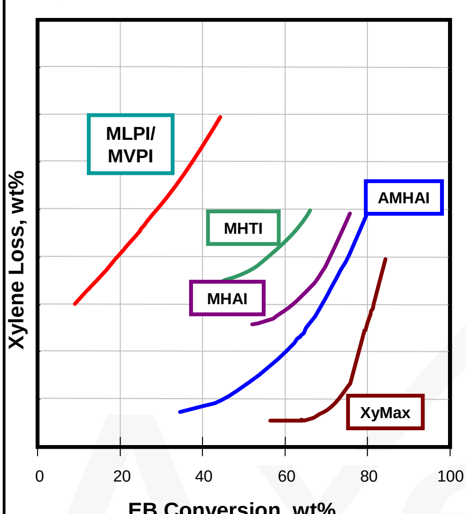


EB isomerization to Xylenes



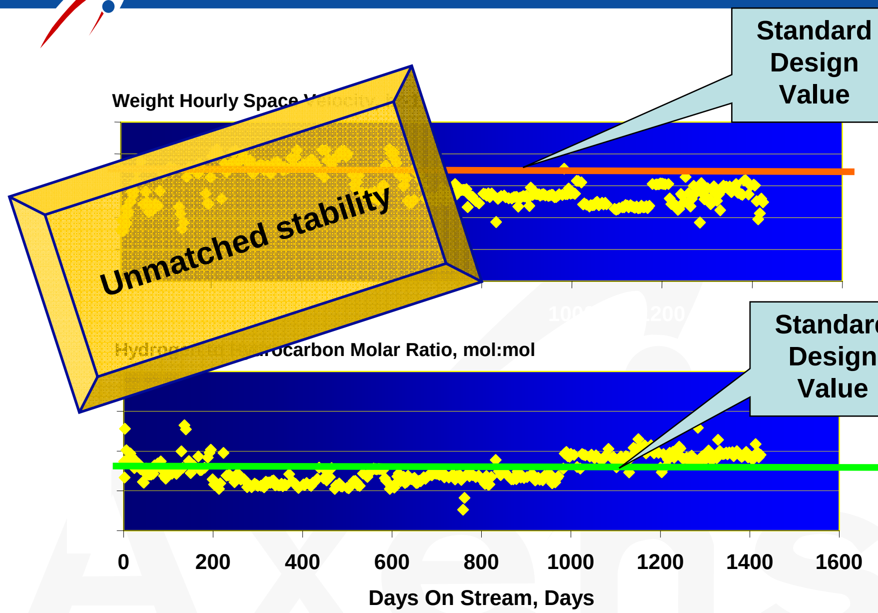
Oparis

XyMax Performance

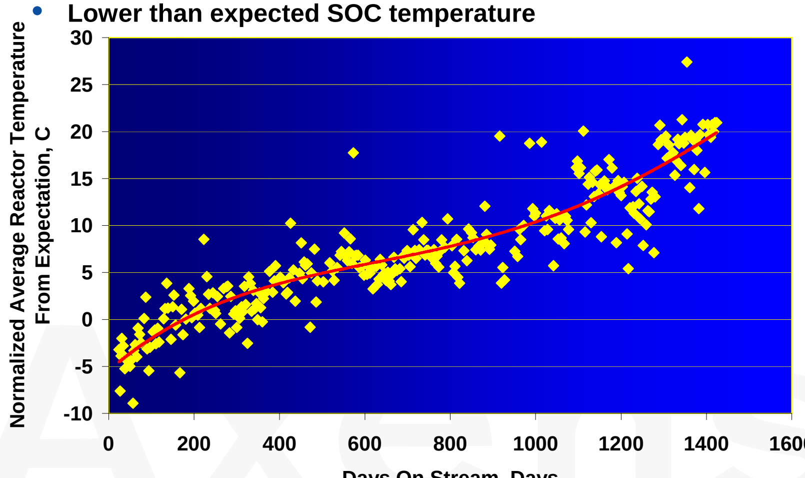


- ➔ Xylenes isomerization
- ➔ EB dealkylation to benzene
- ➔ 15 Industrial references
- EB conversion from 60% to 85%
- PX / X ~ Thermodynamic equilibrium at reactor outlet
- Xylenes loop PX/X > 96%
- High WHSV, low H_2/HC, Highly Stable

XyMax Performance

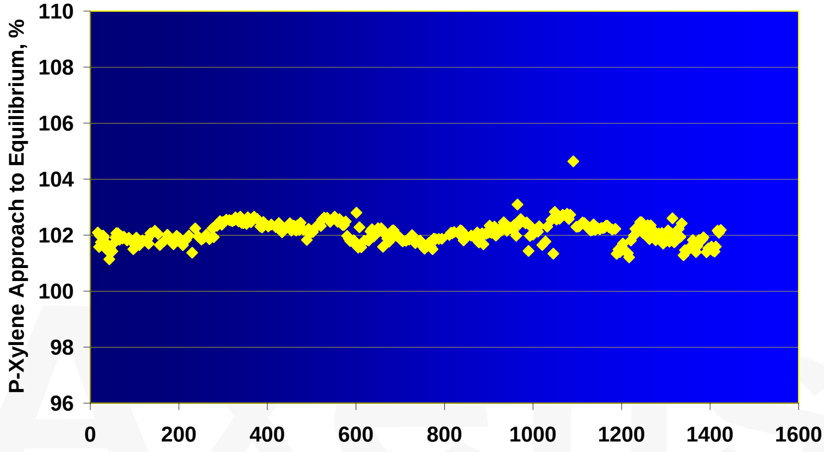


- Currently on stream for over 3.5 years
- Very Low aging rate - less than 5°C/year
- Lower than expected SOC temperature



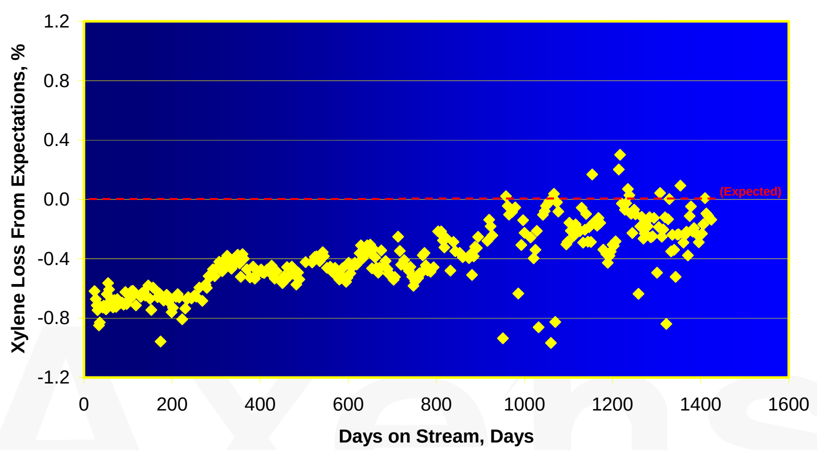
Jurong XyMax

- Higher than expected PXAE
- Stable throughout the cycle



Jurong XyMax

- Lower than expected xylene loss



XyMax™ References

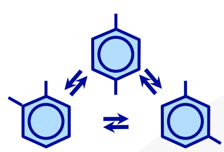
Location	Unit Type	Start-up
Singapore/EM	Retrofit	2000
Netherlands	Retrofit	2002
Licensee	Retrofit	2002
Baytown	Retrofit	2003
Total	Retrofit	2004
Asia	Retrofit	2004
Asia	Retrofit	2005
Asia	Retrofit	2007
Japan/JEC	Grass Roots	2007
Asia/Oman	Grass Roots	2009*
Asia	Grass Roots	2008*
Asia	Grass Roots	2010*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

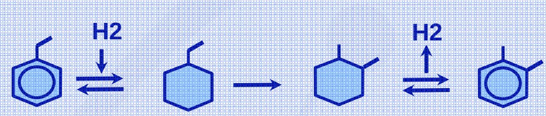
ParamaX Projects under commercial operation

C_8A Isom. Promoted Reactions

Xylenes Isomerization



EB isomerization to Xylenes



Oparis

Oparis

*Op*timal *Ar*omatics *Is*omerization

- **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 grassroot**

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
Americas	Brazil	Q3 05	Drop-in replacement
Asia	China	Q4 08	Drop-in replacement

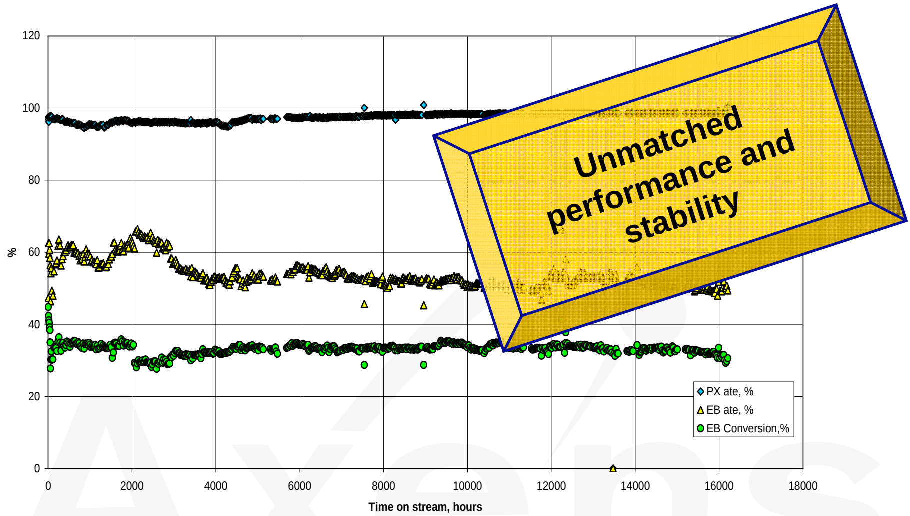
Oparis performance judged striking enough to replace incumbent catalyst

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

Oparis Unit 2

Figure 9. Performance of Oparis catalyst at FCFC Aroma-2

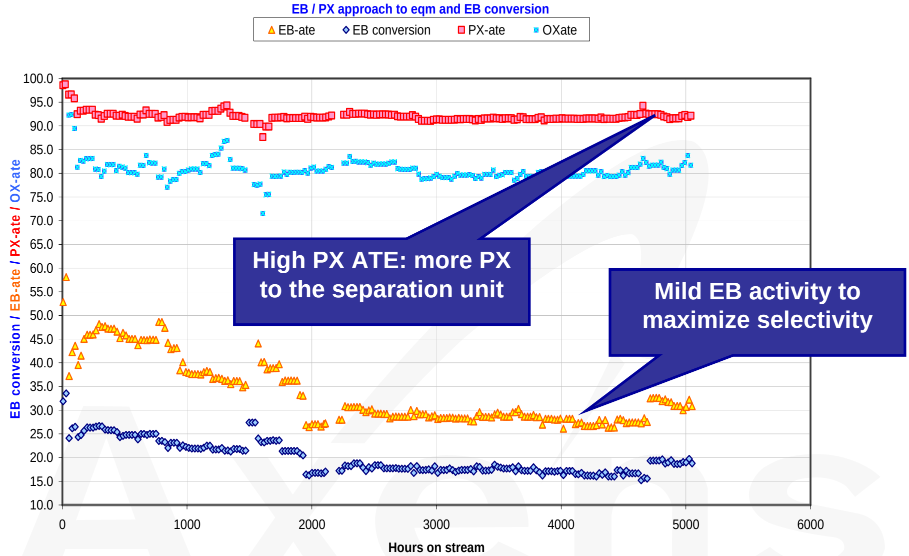
Approach to equilibrium, and EB conversion



Oparis at TPX

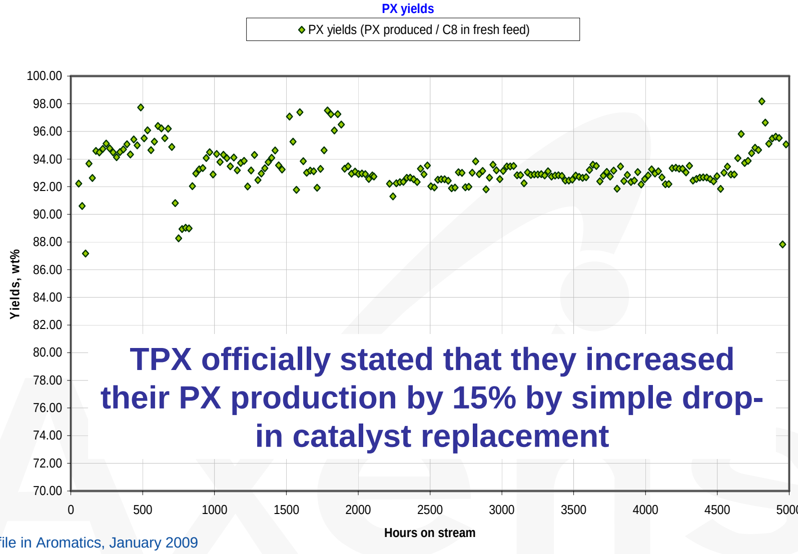
Figure 4. Performance of Oparis catalyst at Thai Paraxylene Company Ltd.

EB / PX approach to eqm and EB conversion



Oparis at TPX

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



TPX officially stated that they increased their PX production by 15% by simple drop-in catalyst replacement

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

ParamaX Portfolio

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

ParamaX Portfolio

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

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