ParamaX
A Single Source Solution for BTX Complexes

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Presentation Overview

- Market and trends
- Axens' ParamaX portfolio
- Typical plant configuration
- Individual technology outlook

Aromatics Intermediates Market Trends

- **PX - entering a new cycle**
- **New projects for the 2005+ timeframe**
- **Improved economics:**
  - economy of scale
  - maximize overall selectivity
  - lower operating costs

Axens' single source service offer

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

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

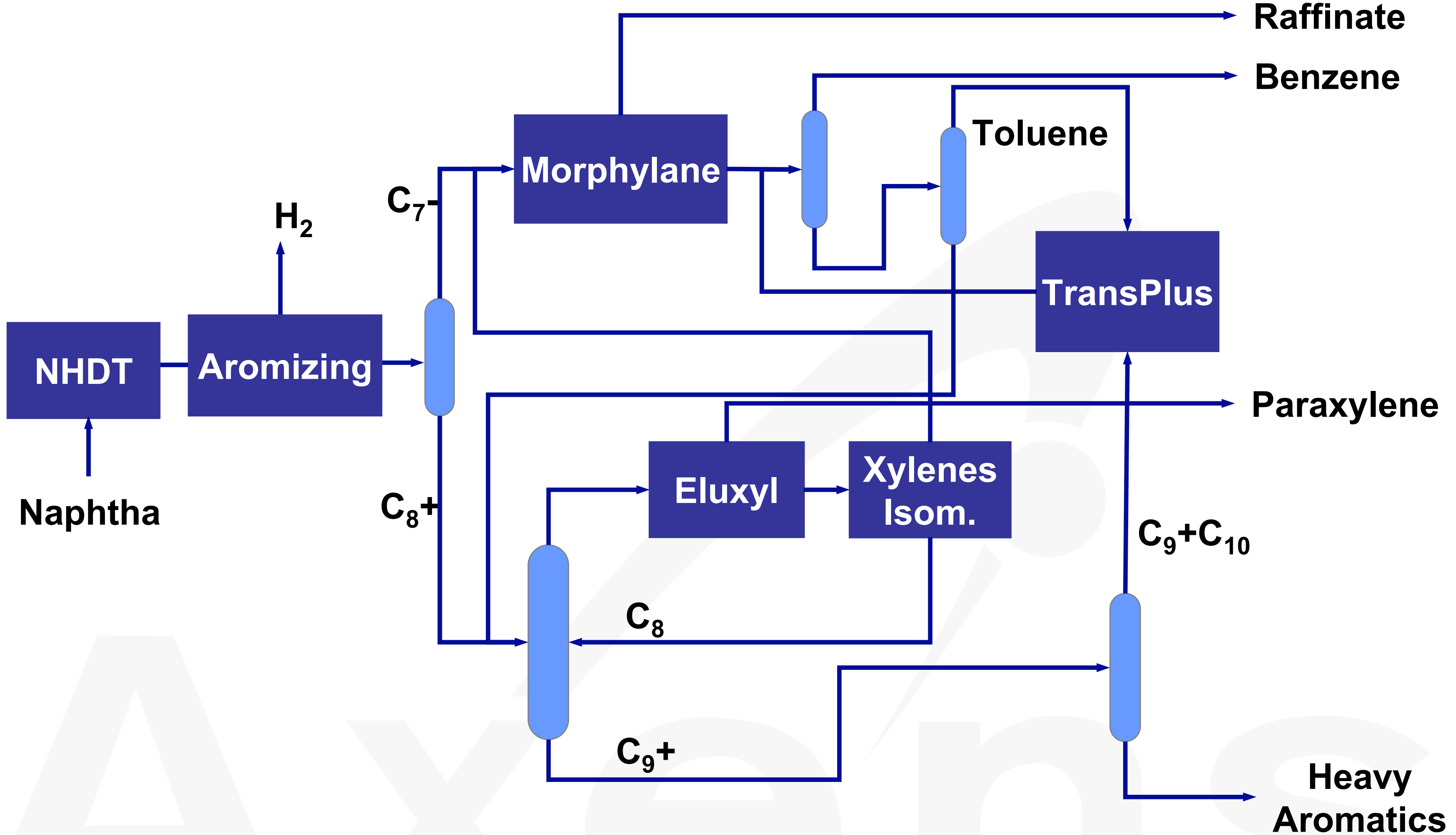
Oparis™ - C_8 aromatics isomerization

Sulfolane - aromatics extraction

TransPlus℠ - Toluene/heavy aromatics transalkylation

PXMax - Toluene selective disproportionation

Typical ParamaX Configuration



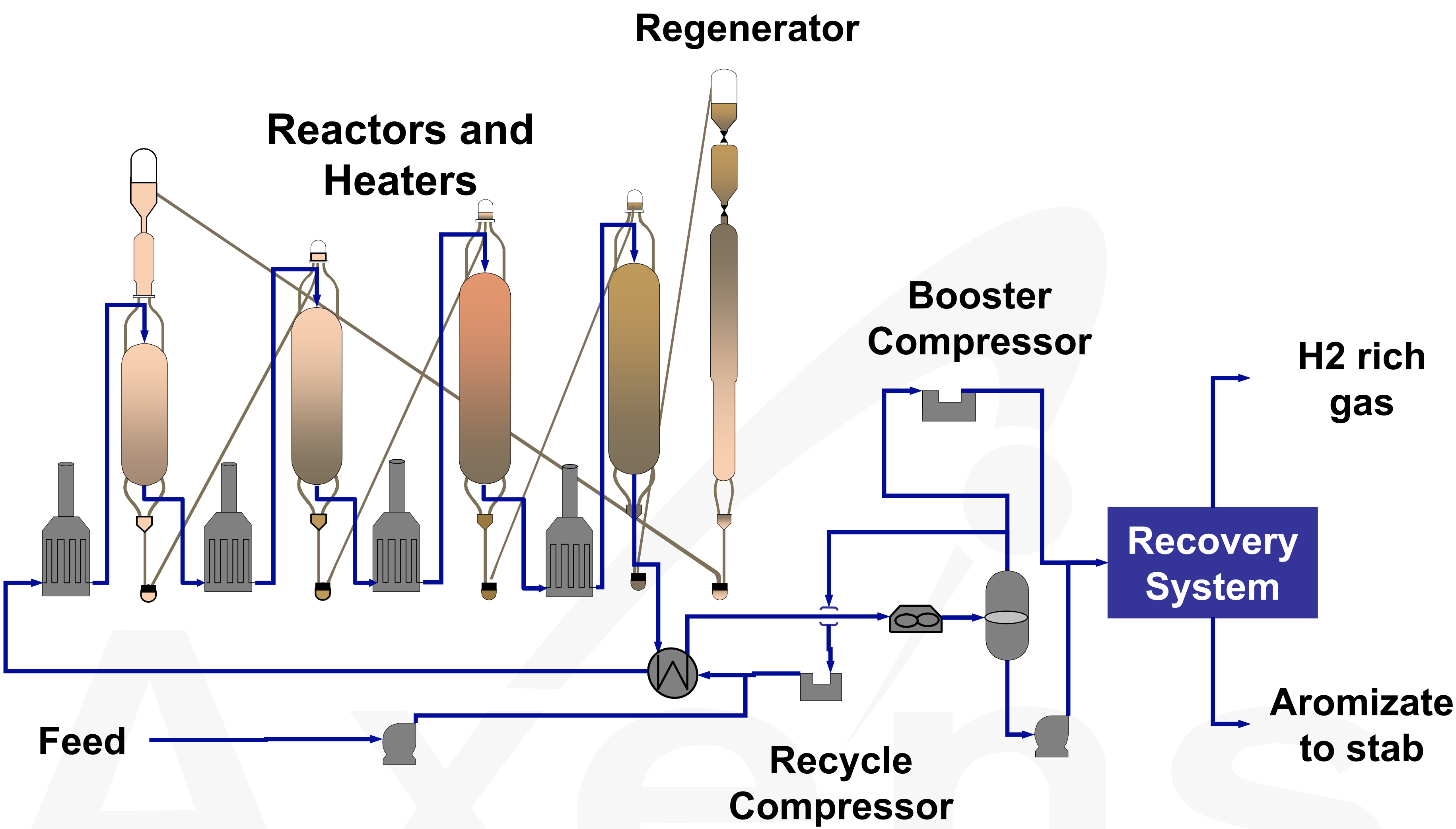
Individual Technologies Overview

- **Ring generation** — ***Aromizing***
- **Aromatics purification** — ***Morphylane***
- **Ring rearrangement** — ***TransPlus***
- **PX separation** — ***Eluxyl***
- **Ring rearrangement** — ***Oparis /XyMax***

Intrinsically lower investment

- **Aromizing: sound side-by-side arrangement**
- **Morphylane: cost effective concept**
- **Eluxyl: commercially-proven large single train capacities**

Aromizing Process



Side-by-Side reactor arrangement

- Simple reactor design
- Reduced mechanical constraints
- Straightforward layout

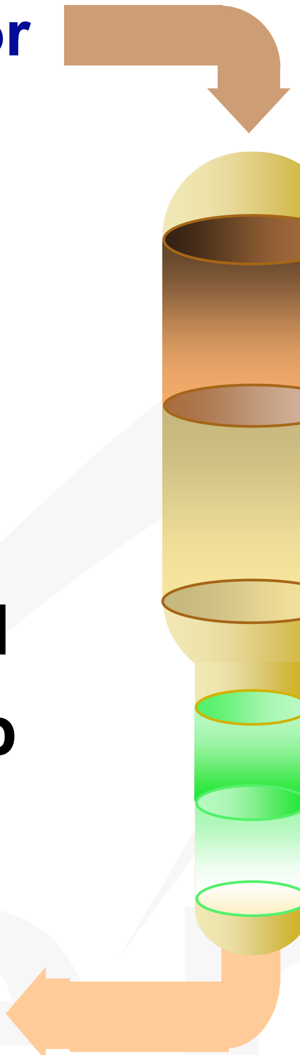
Aromizing: low investment whatever the capacity

- AR-501: new generation catalyst for aromatics production
- Smooth catalyst regeneration system

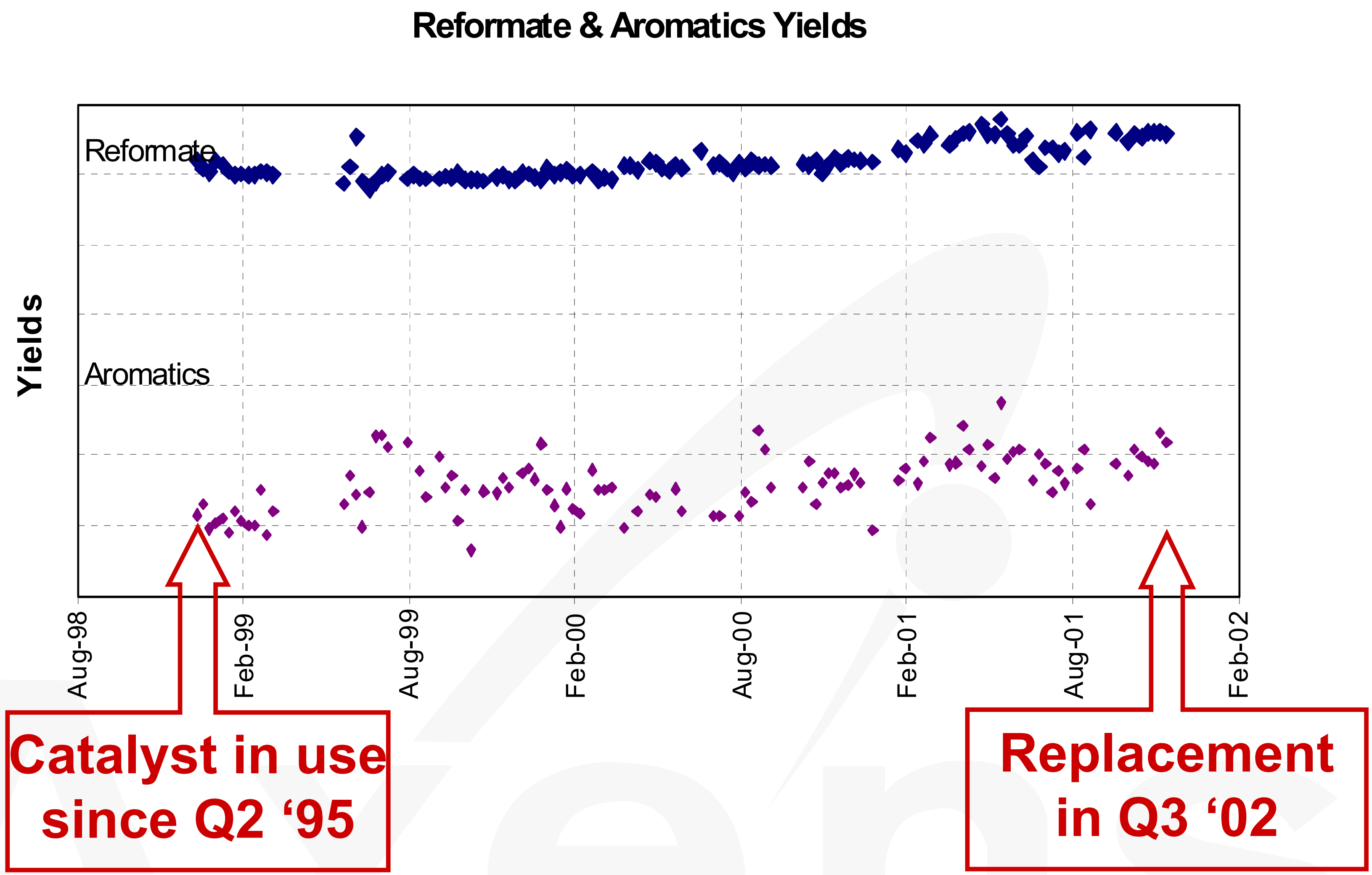
  - Stable performance
  - Long life
  - Low catalyst attrition

Catalyst Regeneration RegenC

- DCS controlled operation
- Independent control of each parameter
- Two combustion stages for complete coke removal
- Regeneration gas clean-up and drying



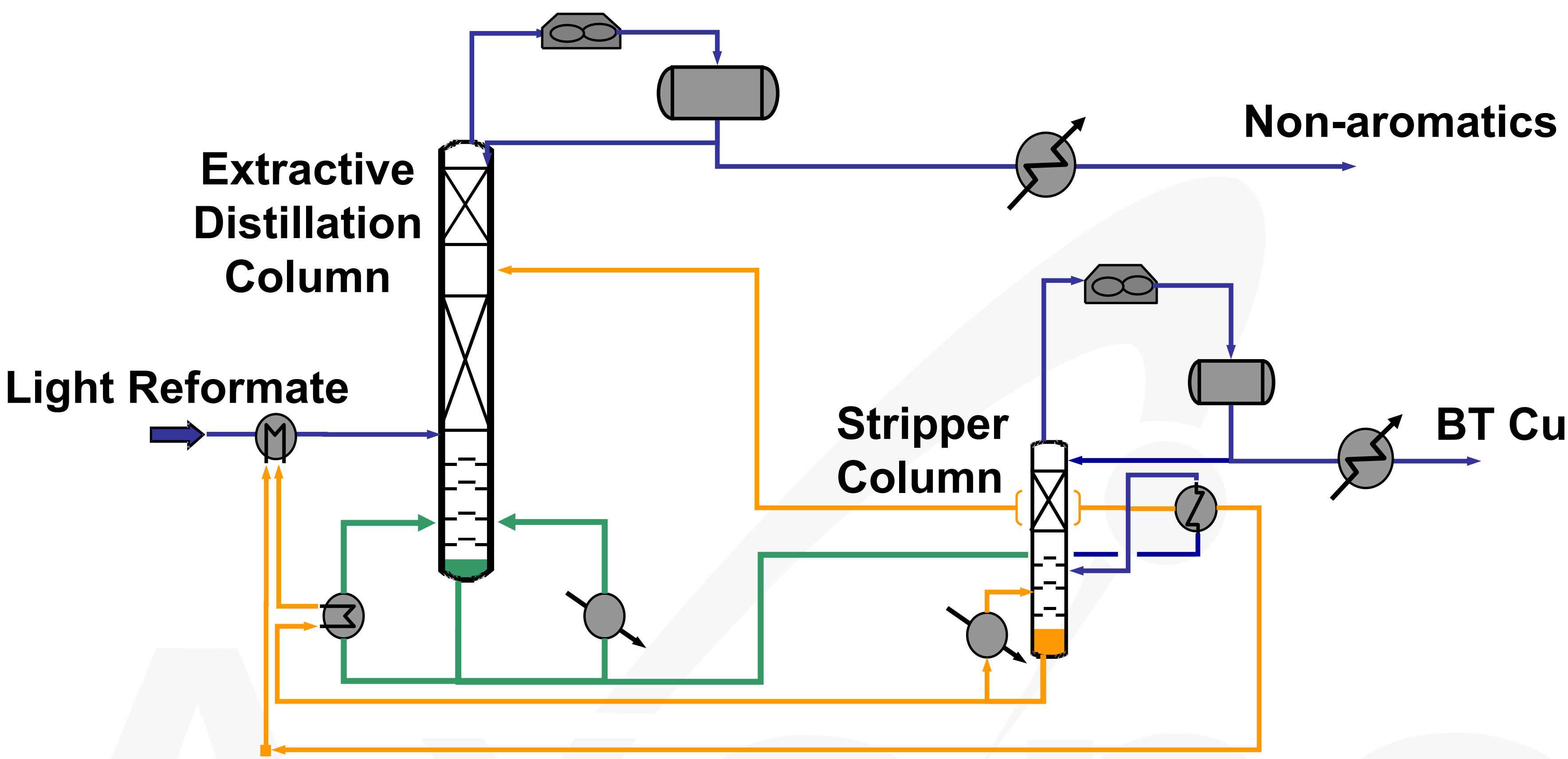
Catalyst Performance



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

- **Cost-effective technology implementation**
- **Unique combination of catalyst activity and regeneration quality:**
  - catalyst life from 6 to 9 years
  - stable performance
  - low attrition

Morphylane Flowscheme

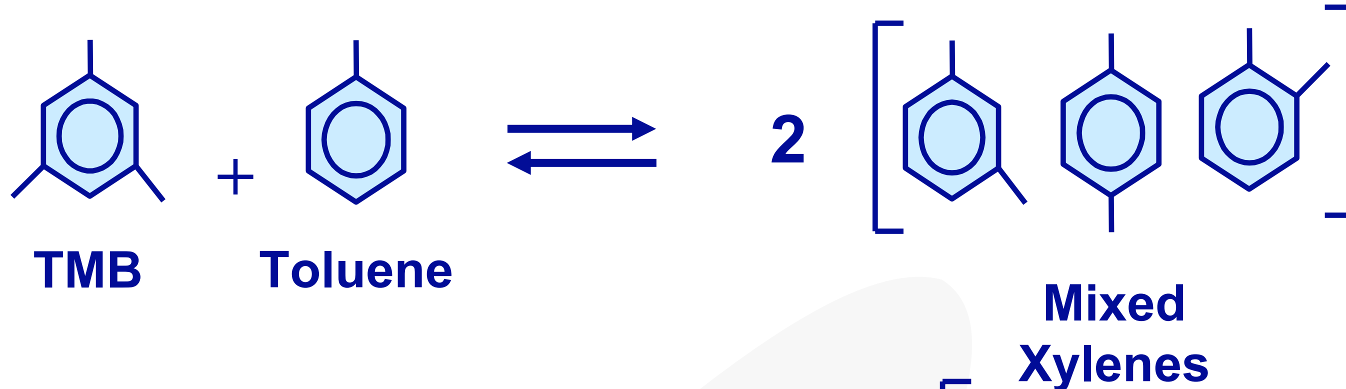


- Reduced number of equipment items
- Easy to operate concept
- Optimized solvent selection
- Low solvent inventory
- Low solvent consumption

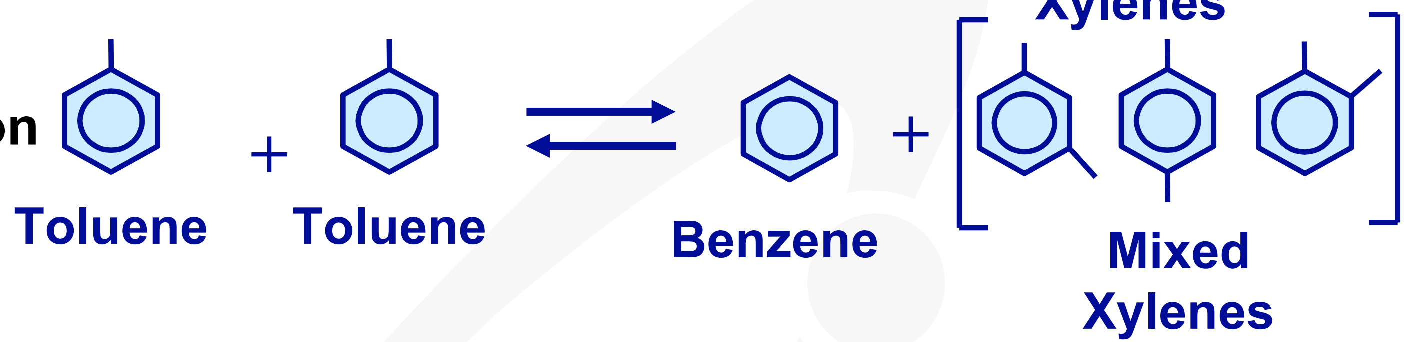
Morphylane: a cost effective technology

TransPlus Reactions

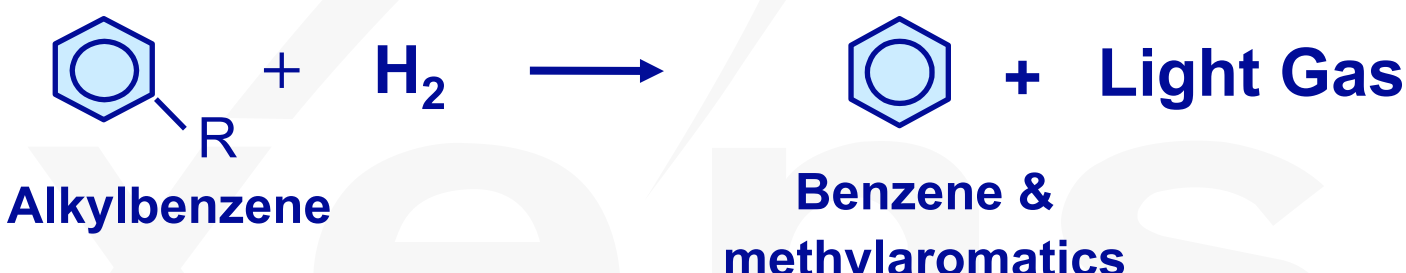
Transalkylation



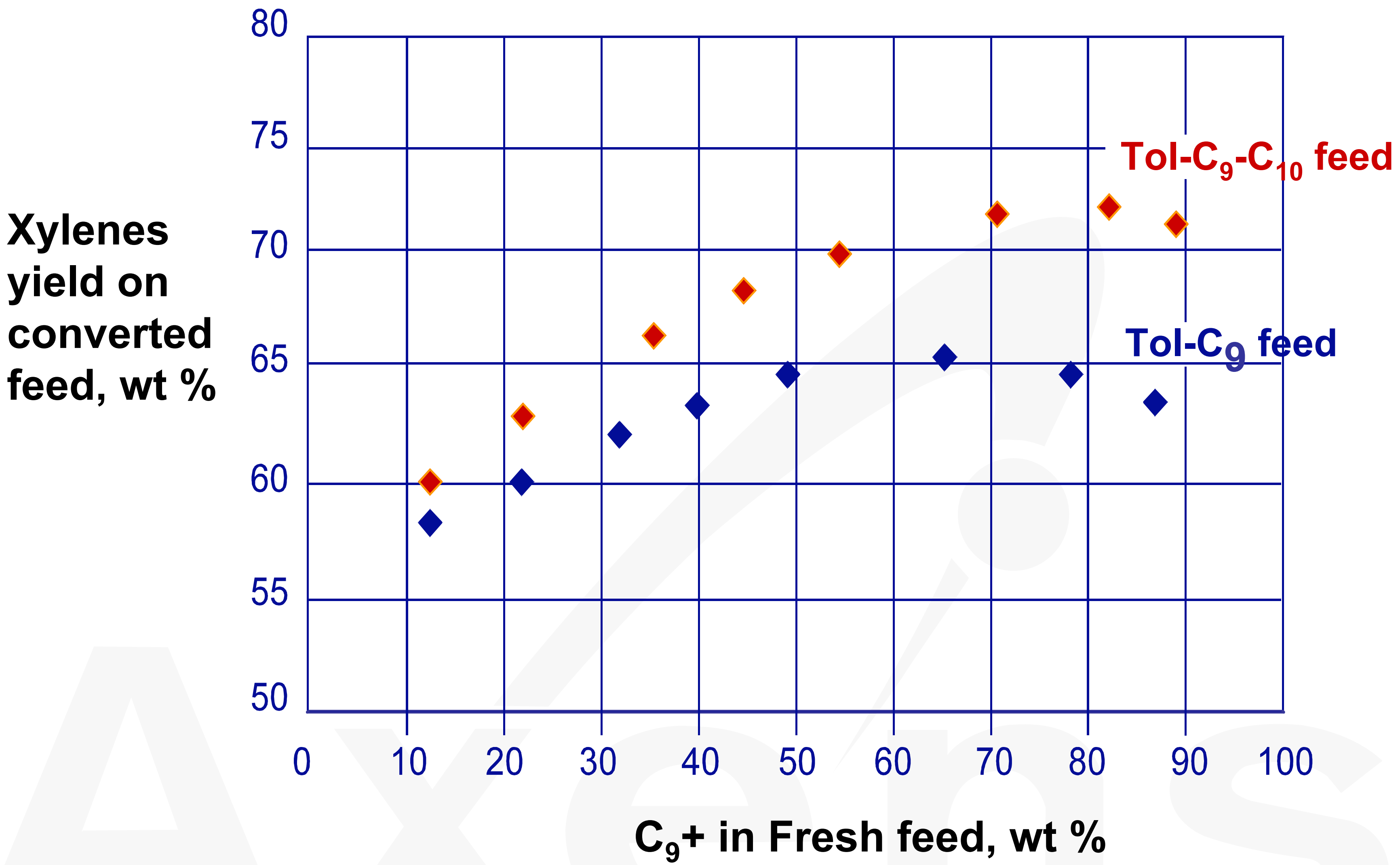
Disproportionation



Dealkylation



Xylenes Yield vs. C_9-C_{10} Aromatics in Fresh Feed



TransPlus Feedstock

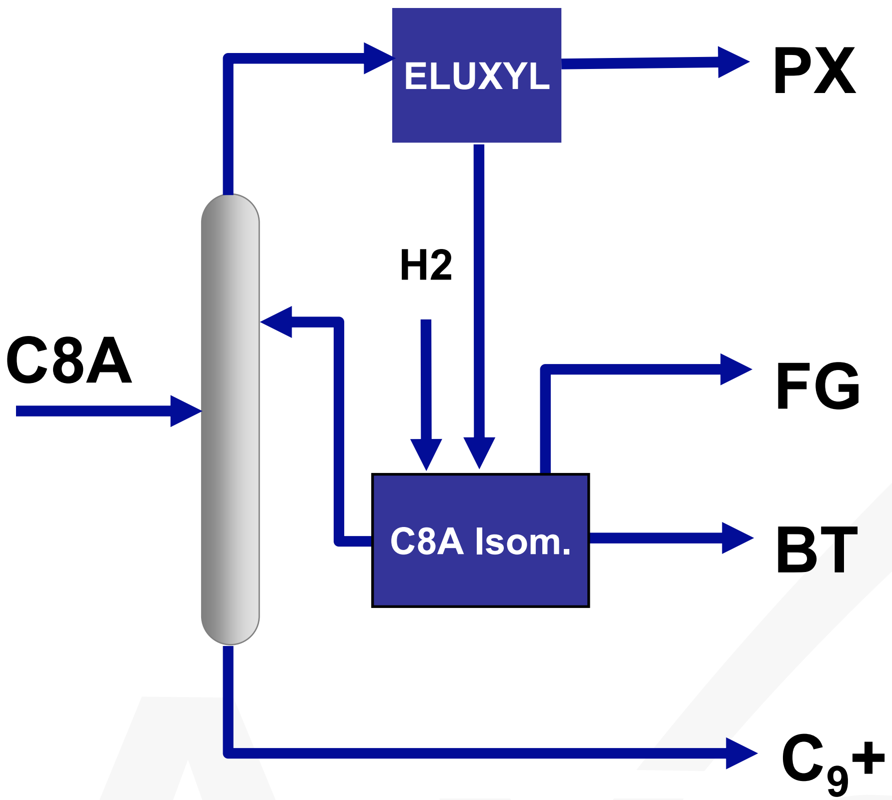
Component	C No.	nBPT ºC	Component	C No.	nBPT ºC	Component	C No.	nBPT ºC	Component	C No.	nBPT ºC
Benzene	6	80	1 methyl 2 npropylbenzene	10	185	1,2,3,5 Tetramethylbenzene	10	198	Tetrahydronaphthalene (tetralin)	10	208
Toluene	7	111	1 phenyl 2,2 dimethylpropane	11	186	1 phenyl 3 methylbutane	11	199	1 methyl 2 n butylbenzene	11	208
Ethylbenzene	8	136	1,4 Dimethyl 2 ethylbenzene	10	187	1,3 dimethyl 2 isopropylbenzene	11	199	1 methyl 2,6 diethylbenzene	11	209
P-Xylene	8	138	2 phenyl 3 methylbutane	11	188	1,3 dimethyl 4 isopropylbenzene	11	199	1,2 dimethyl 4 n propylbenzene	11	209
M-Xylene	8	139	1,3 Dimethyl 4 ethylbenzene	10	188	1 methyl 2 tert butylbenzene	11	200	1,1,3,3 tetramethylindane	13	209
O-Xylene	8	144	1 methyl 3 tert butylbenzene	11	189	1 methyl 3,5 diethylbenzene	11	201	1,2 dimethyl 3 n propylbenzene	11	211
I-Propylbenzene	9	152	1,2 Dimethyl 4 ethylbenzene	10	190	1 ethyl 3 n propylbenzene	11	201	1,1,2 trimethylindane	12	211
N-Propylbenzene	9	159	1,3 Dimethyl 2 ethylbenzene	10	190	1,2 dimethyl 4 isopropylbenzene	11	202	1,1,3,5 tetramethylindane	13	211
1-methyl 3-ethylbenzene	9	161	1 methylindane	10	191	5 methylindane	10	202	1,6 dimethylindane	11	212
1-methyl 4-ethylbenzene	9	162	3 phenylpentane	11	191	1,3 dimethyl 5 n propylbenzene	11	202	1,3,5 trimethyl 2 ethylbenzene	11	212
1,3,5 Trimethylbenzene	9	165	1,1 dimethylindane	11	191	1,2 dimethyl 3 isopropylbenzene	11	203	1,2,4 trimethyl 5 ethylbenzene	11	213
1-methyl 2-ethylbenzene	9	165	2 methylindane	10	191	1 ethyl 2 n propylbenzene	11	203	1,2,4 trimethyl 6 ethylbenzene	11	213
tert-butylbenzene	10	169	1 ethyl 3 isopropylbenzene	11	192	1 methyl 3,4 diethylbenzene	11	204	2 ethylindane	11	214
1,2,4 Trimethylbenzene	9	169	2 phenyl 2 methylbutane	11	192	1,3 dimethylindane	11	204	1,2,3 trimethyl 5 ethylbenzene	11	216
I-Butylbenzene	10	173	1 methyl 4 tert butylbenzene	11	193	1,4 dimethyl 2 n propylbenzene	11	204	1,2,4 trimethyl 3 ethylbenzene	11	217
sec-butylbenzene	10	173	2 phenyl pentane	11	193	1,1,3 trimethylindane	12	205	2 methyl tetralin	11	218
1 methyl 3 ipropylbenzene	10	175	1 ethyl 2 isopropylbenzene	11	193	1 methyl 3 n butylbenzene	11	205	**Naphthalene**	10	218
1,2,3 Trimethylbenzene	9	176	1 methyl 3 sec butylbenzene	11	194	1 ethyl 4 n propylbenzene	11	205	1,2,3 trimethyl 4 ethylbenzene	11	220
1 methyl 4 ipropylbenzene	10	177	1 methyl 3 isobutylbenzene	11	194	1 methyl 2,4 diethylbenzene	11	205	1 methyl tetralin	11	221
Indane	9	178	1,2 Dimethyl 3 ethylbenzene	10	194	1,2,3,4 Tetramethylbenzene	10	205	1,1 dimethyl tetralin	12	221
1 methyl 2 ipropylbenzene	10	178	1,3 dimethyl 3 isopropylbenzene	11	195	n pentyl benzene	11	205	1 ethylindane	11	222
Indene	10	181	1 methyl 2 sec butylbenzene	11	196	4 methylindane	10	206	2 MNaphthalene	11	241
1,3 Diethylbenzene	10	181	1 methyl 2 isobutylbenzene	11	196	1,2 dimethylindane	11	206	1 MNaphthalene	11	244
1 methyl 3 npropylbenzene	10	182	1 methyl 4 isobutylbenzene	11	196	1,3 dimethyl 4 n propylbenzene	11	207			
N-Butylbenzene	10	183	1,4 dimethyl 2 isopropylbenzene	11	196	1 methyl 2,3 diethylbenzene	11	207			
1 methyl 4 npropylbenzene	10	183	1 ethyl 4 isopropylbenzene	11	197	1 methyl 2,5 diethylbenzene	11	207			
1,2 Diethylbenzene	10	183	1,2,4,5 Tetramethylbenzene	10	197	1 methyl 4 n butylbenzene	11	207			
1,3 Dimethyl 5 ethylbenzene	10	184	1 phenyl 2 methylbutane	11	197	2,5 dimethylindane	11	207			
1,4 Diethylbenzene	10	184	1 methyl 4 sec butylbenzene	11	197	1,3 dimethyl 2 n propylbenzene	11	208			

<0.4 wt%

- Processes most of the aromatics from Aromizing unit
- Superior selectivity and yields: CPC Lin Yuan
  - + 20% Fresh Feed
  - + 30% Xylenes yield
  - - 25% Utilities
- High WHSV, low H2/HC

TransPlus offers superior yields and processes an extended range of aromatics

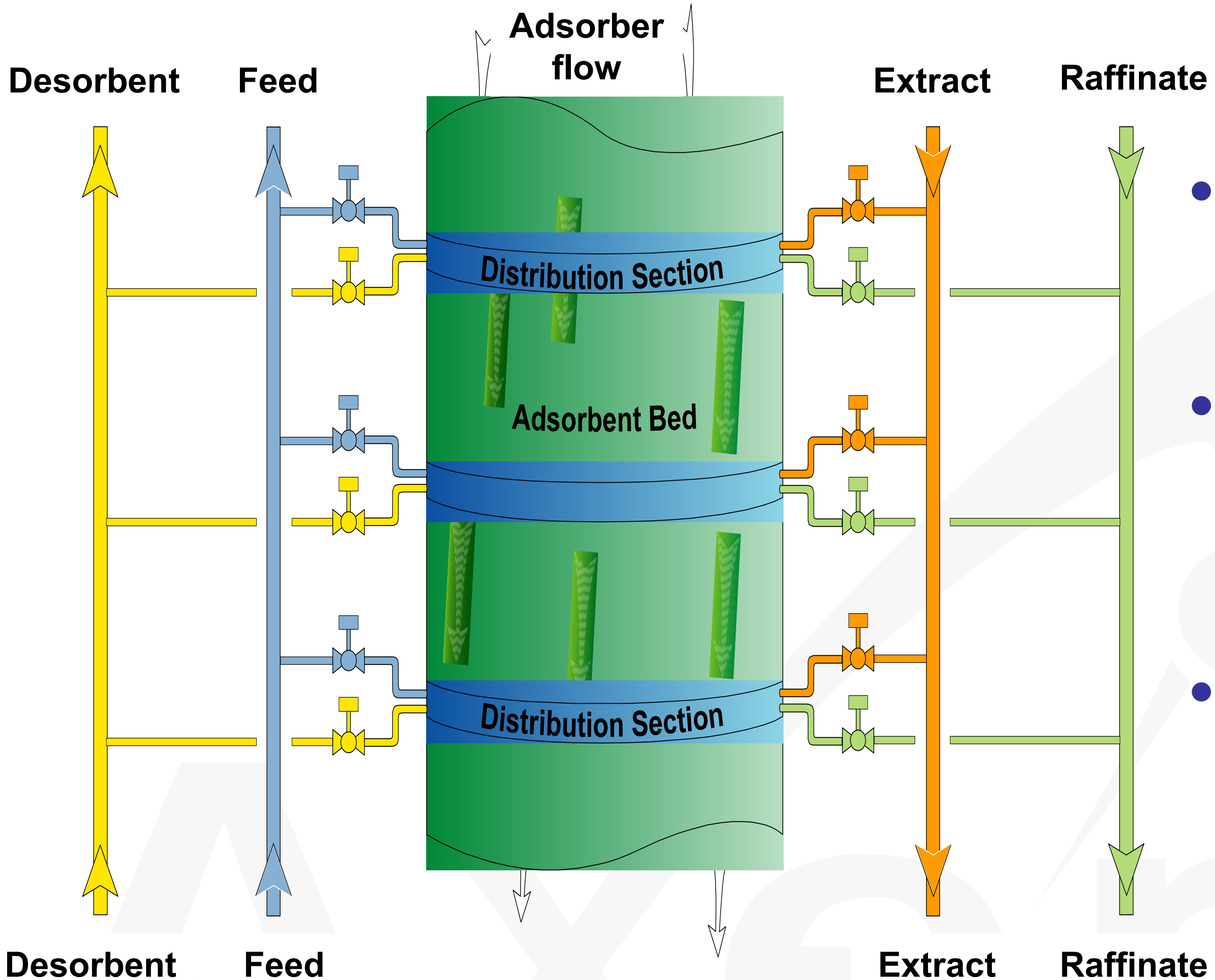
Xylenes Loop Performance



Maximize PX/C8A
Minimize Hydraulics

- Minimize C8A losses
- Maximize PX/C8A in isom
  - PX ATE
  - EB conversion / ATE

Eluxyl: 99.9% PX, 97% Recovery



- High performance adsorbent
- Microprocessor-controlled on/off valves system
- High distribution efficiency

Eluxyl: PX Separation with SMB Concept

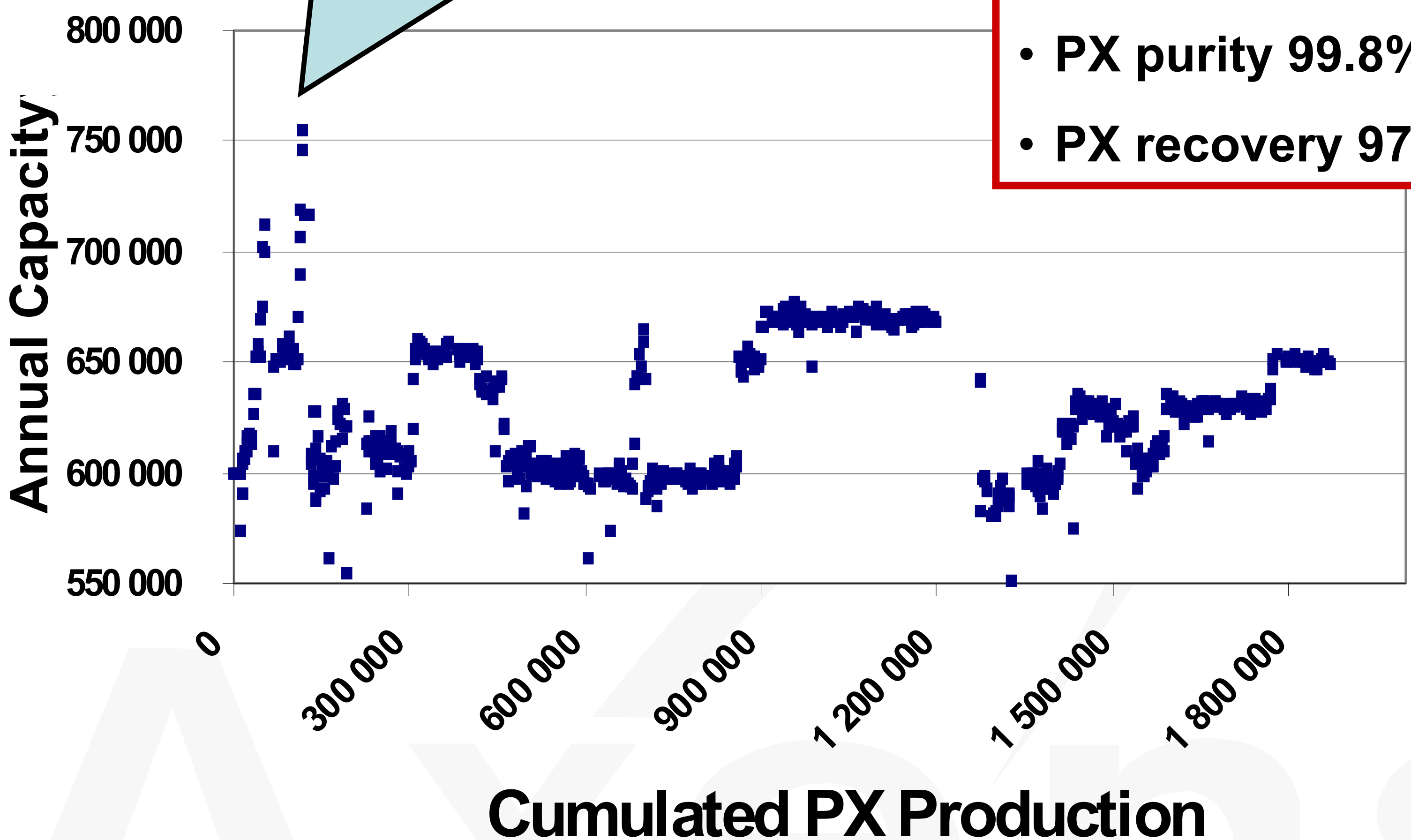
- **4 units in operation, 3 under construction**
- **Limited implementation requirements**
- **Minimum single source equipment**

Eluxyl sets new limits for economy of scale

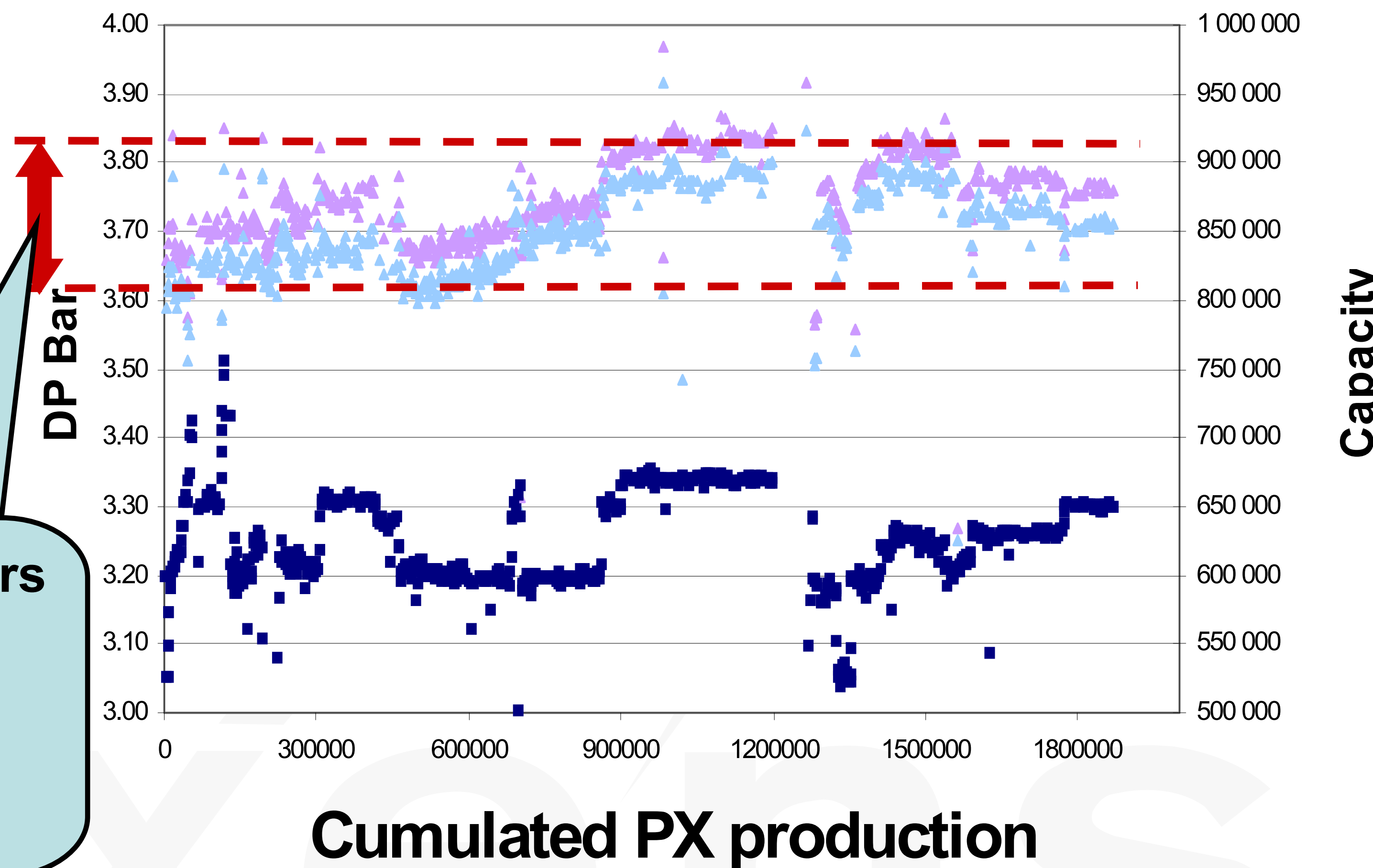
Industrial Feedback

Peak PX production over 750,000 MTA

- **600,000 MTA Nameplate PX capacity**
- **PX purity 99.8%**
- **PX recovery 97%**



Adsorbers Pressure Drop vs PX Production



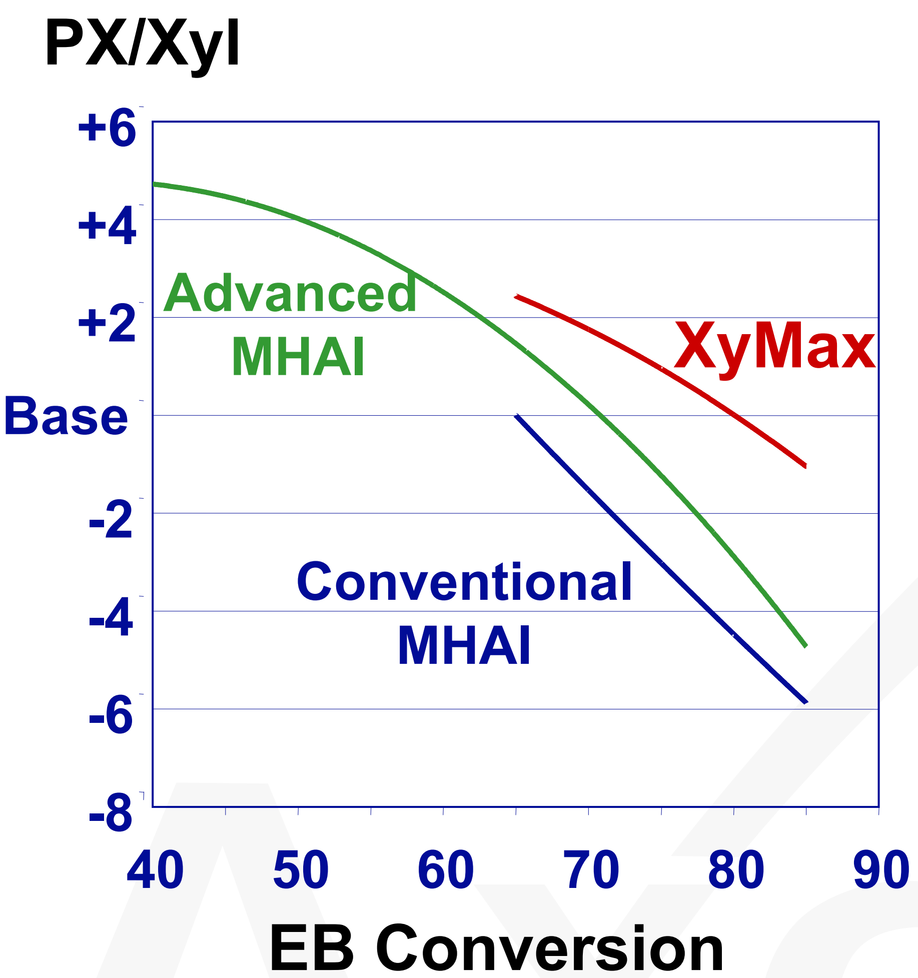
- Over three years operation
- DP increase < 200 grams
- Flat trend

Eluxyl Technology

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

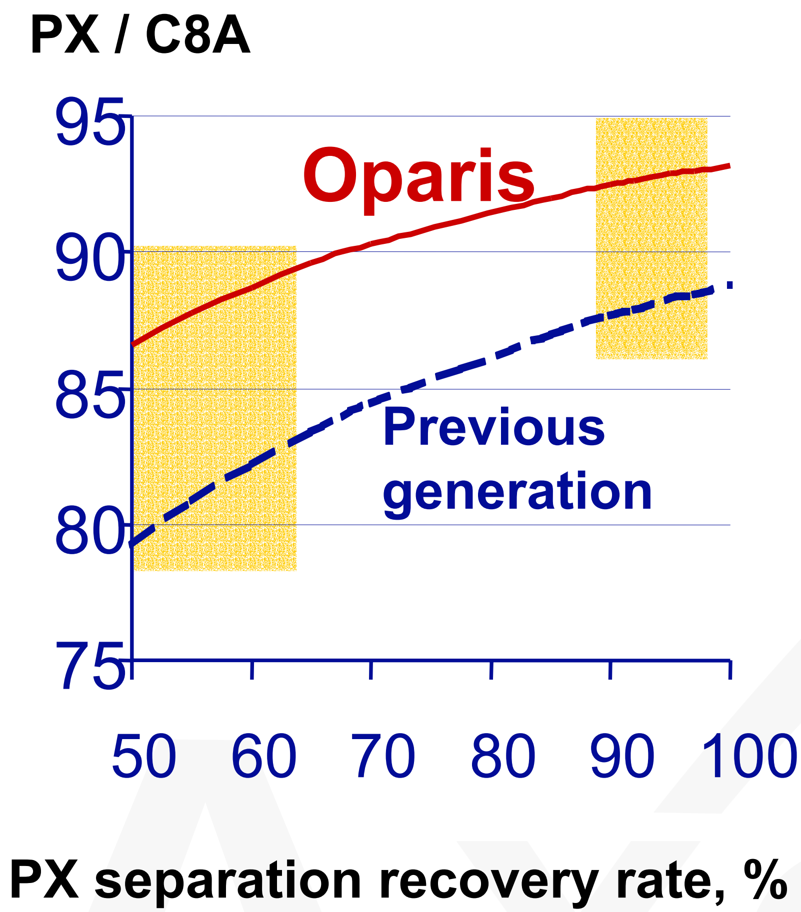
Eluxyl development challenges are met

XyMax Performance



- ➔ Xylenes isomerization
- ➔ EB dealkylation to benzene
- ➔ In use in 3 plants (17 applications overall)
  - EB conversion from 60% to 85%
  - PX / X ~ Thermodynamic equilibrium at reactor outlet
  - Xylenes loop PX/X # 97%
  - High WHSV low H2/HC

Oparis: Higher Selectivity



- ➔ **Xylenes isomerization**
- ➔ **EB isomerization to xylenes**
- ➔ **Three units in operation**
  - **- 25% more active**
  - **- PX "ATE" ~ 97%**
  - **- EB ATE from 40% to 60%**
  - **- PX / (EB + Xyl) ~ 92%**
  - **- in-situ regeneration proven**

Axens ParamaX Portfolio

- **Single source licensing offer**
- **Meets tomorrow's performance expectations to**
  - **reduce investment**
  - **increase yields**
  - **minimize operating costs**

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