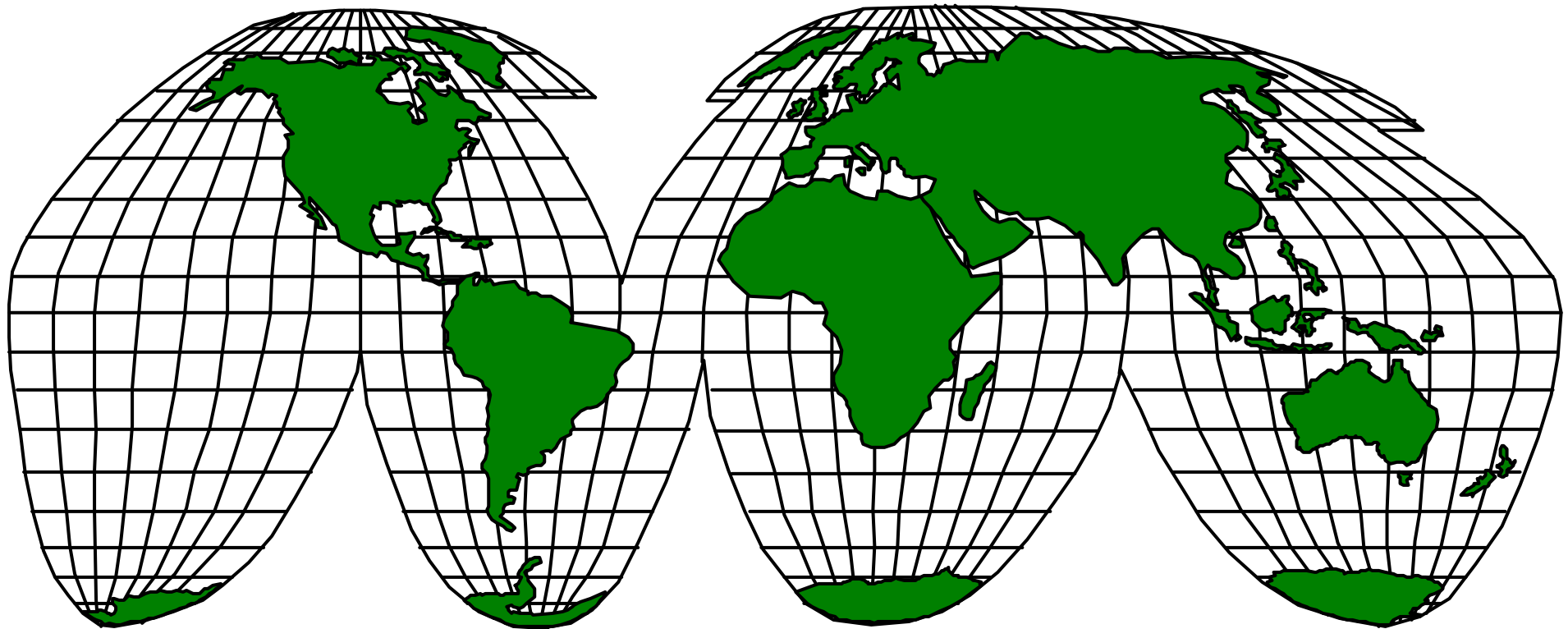


# Ethyl Benzene Styrene Monomer



# What is it?

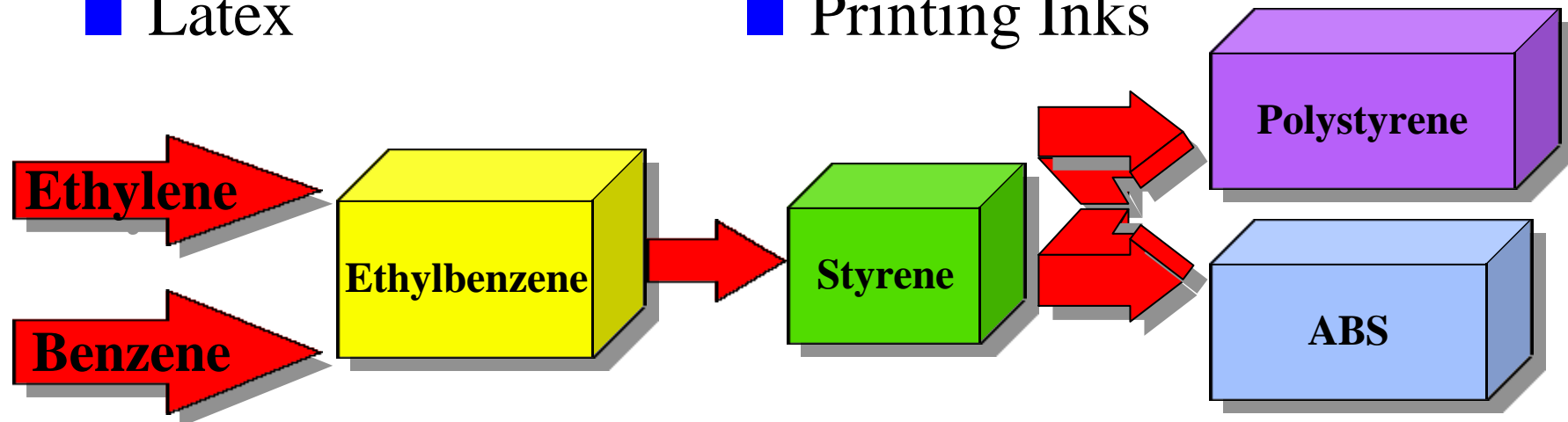


- EB = Ethyl Benzene
- SM = Styrene Monomer
- Both are Intermediate Petrochemical Products

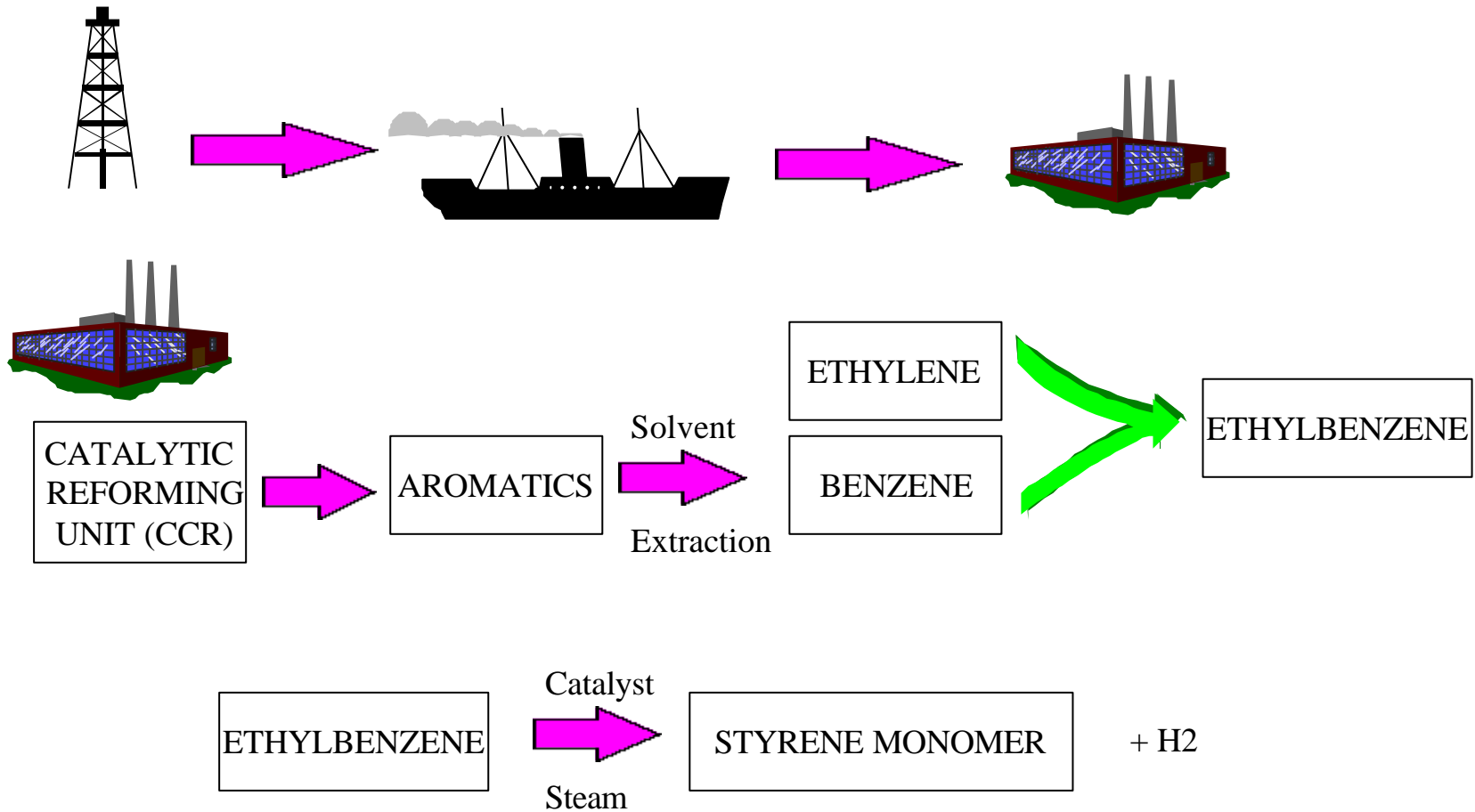
# Where is it used?



- Polystyrene (PS)
- ABS Plastics
- SB Rubber
- Polyester Resins
- Latex
- Paints
- Coatings
- Adhesives
- Resins
- Printing Inks

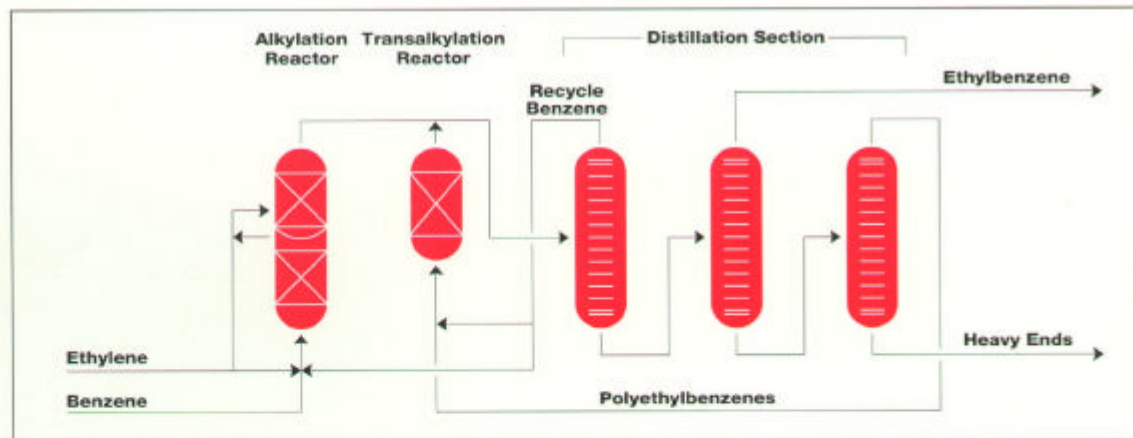


# How is EB/SM Made?

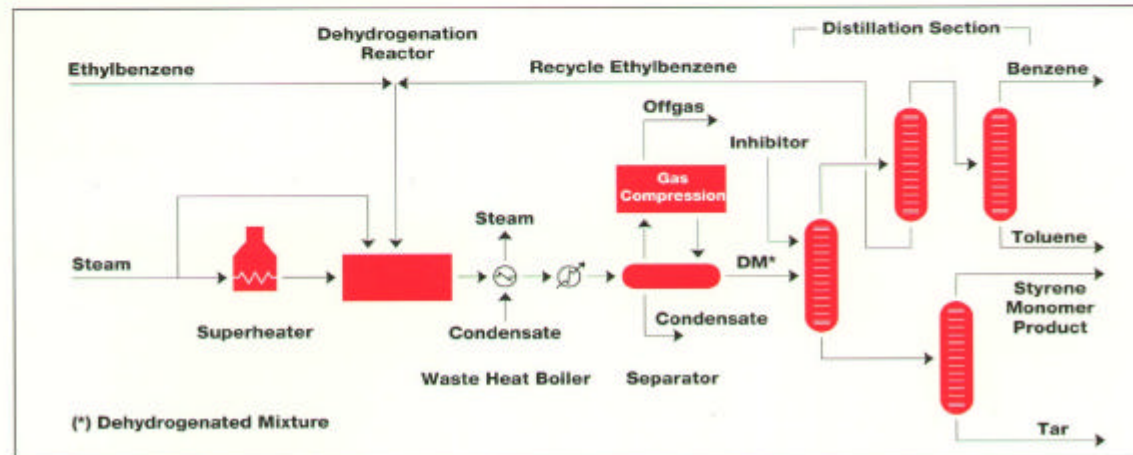


# ABB Lummus Process

**Process Flow Diagram  
Ethylbenzene**



**Process Flow Diagram  
"Classic"  
Styrene Monomer**



# What Analysis is Required?

(ABB Lummas/Monsanto/UOP EB/SM Process)



PLANT SECTION	SERVICE	PARAMETER	RANGE	METHOD	TAG #	Process	Safety	Efficiency	TAI MODEL /SERIES
						Control (Quality)	(Prevent Explosion)	Monitor (Combust)	
EB	DC-152 Alkylator No.2 Outlet	O2	0-5%	Paramag	AT-1101	X			SERIES 3000
EB	EB 1 Distillation Area/ Benzene Feed to Rx MR-105	H2O (L)	0-100ppm	NIR	AT-101	X			MODEL 510
EB	EB Reaction Area / DC- 151 Alkylator Outlet	H2O (L)	0-2000ppm	NIR	AT-1001	X			MODEL 510
SM	Off-Gas / Compressor Discharge (FA-1309) to Gas Cooler(EA-1312)	%O2	0-2%	Paramag	AT-3005 AT-3006 AT-3007	X X X			SERIES 3000 SERIES 3000 SERIES 3000
SM	BA-1301 (Steam Super- Heater)	%O2	0-10%	Paramag	AT-3001 AT-3002	X X			SERIES 3000 SERIES 3000
SM	DA-1301 Process Condensate Stripper	Hydrocarbons	0-10ppm	UV	AT-3004	X			SERIES 6000

# What Analysis is Required?

(Raytheon / Badger EB/SM Process Applications)



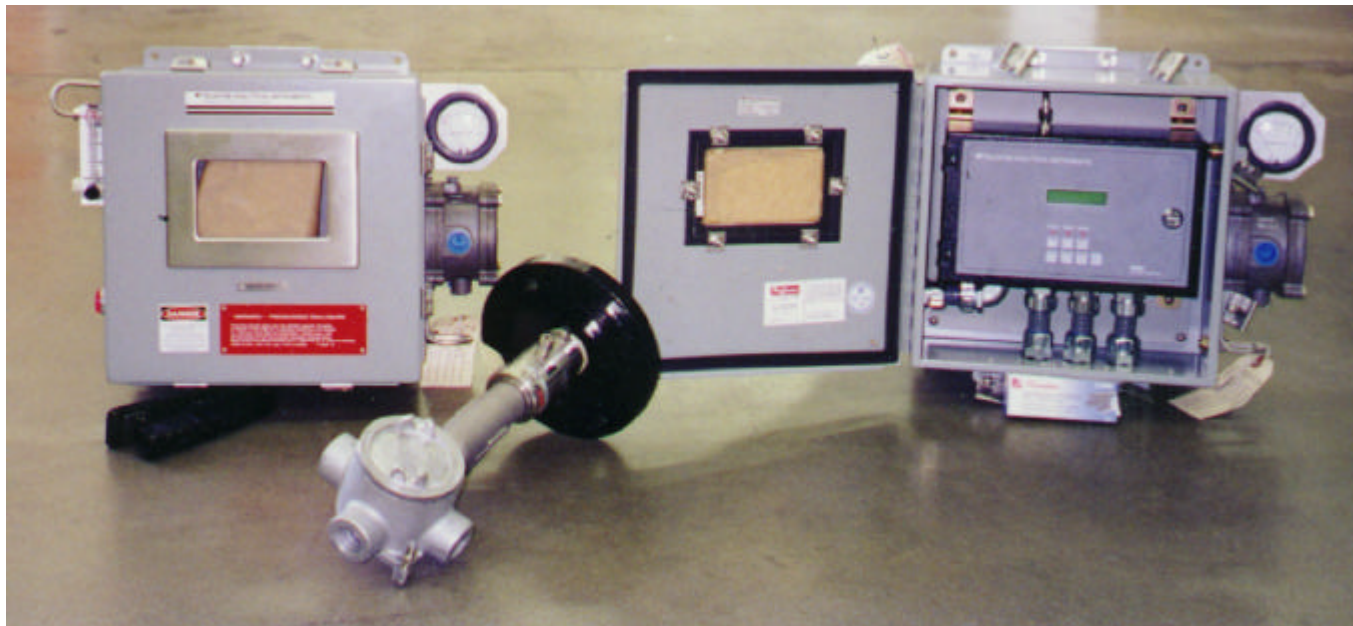
PLANT	SERVICE	PARAMETER	RANGE	METHOD	TAG #	Process Control (Quality)	Safety (Prevent Explosion)	Efficiency Monitor (Combust)	COMMENTS
EB	EB Reactor Regen Gas	Hydrocarbons (as C6H6 eqv)	0-10%	NDIR	AT-1010	X			Reactor Go/No-Go, Purge, Catalyst Revmp
EB	EB Rycle from 37-212-C	H2O	0-250ppm	NIR	AT-2007	X			Product Purity
EB	Recycle Benzene	H2O	0-250ppm	NIR	AT-1002	X			Product Purity
EB	Compressor Discharge/ Reactor Discharge	% O2 (2 pt sqd unit)	0-10%	Electrchm or Paramag	AT-1007	X			
EB	Reactor Discharge	% CO	0-20%	NDIR	AT-1008	X			
		% CO2	0-20%	NDIR	AT-1009	X			
EB	HS-102 Flue Gas Unit	%O2	0-5%	ZrO2	AT-1631			X	
EB	HS-103 Flue Gas Unit	%O2	0-5%	ZrO2	AT-1654			X	
SM	Styrene Vent Gas	ppm O2	0-2,000	Electrchm or Paramag	AT-2005	X			
SM	Stripped Condensate	Hydrocarbons	0-100ppm	UV/VIS	AT-2003	X			
SM	Cooled Condensate	Hydrocarbons	0-10ppm	UV/VIS	AT-3001	X			
SM	HS-201/219 Flue Gas	%O2	0-5%	ZrO2	AT-2029			X	
PSA Unit	PSA Inlet Gas Stream	ppm O2	0-2,000	Electrchm	AT-9701	X			AT-9701 & 9702 used
PSA Unit	H2 Product from PSA	ppm O2	0-10	Electrchm	AT-9702	X			to monitor effcy of PSA Unit

# TAI's Proven Track Record



END USER	LOCATION	PROCESS	YEAR
Honam Ethylene	Korea	Badger/Raytheon	1985
Yukong/Arco	Korea	Badger/Raytheon	1988
Taiwan Styrene Monomer Corp.	Taiwan	Badger/Raytheon	1989
Hyundai Petrochemical (Phase I)	Korea	Badger/Raytheon	1990
Samsung General Chemical	Korea	Badger/Raytheon	1990
Mitsui Toatsu "U" Project	Japan	ABB/Lummus	1993
Hyundai Petrochemical (Phase II)	Korea	Badger/Raytheon	1996
Grand Pacific Petrochemical	Taiwan	Badger/Raytheon	1998

# CTCI EB/SM Project (9060 Analyzer)



# CTCI EB/SM Project (IR7000/3000TB Analysis System)



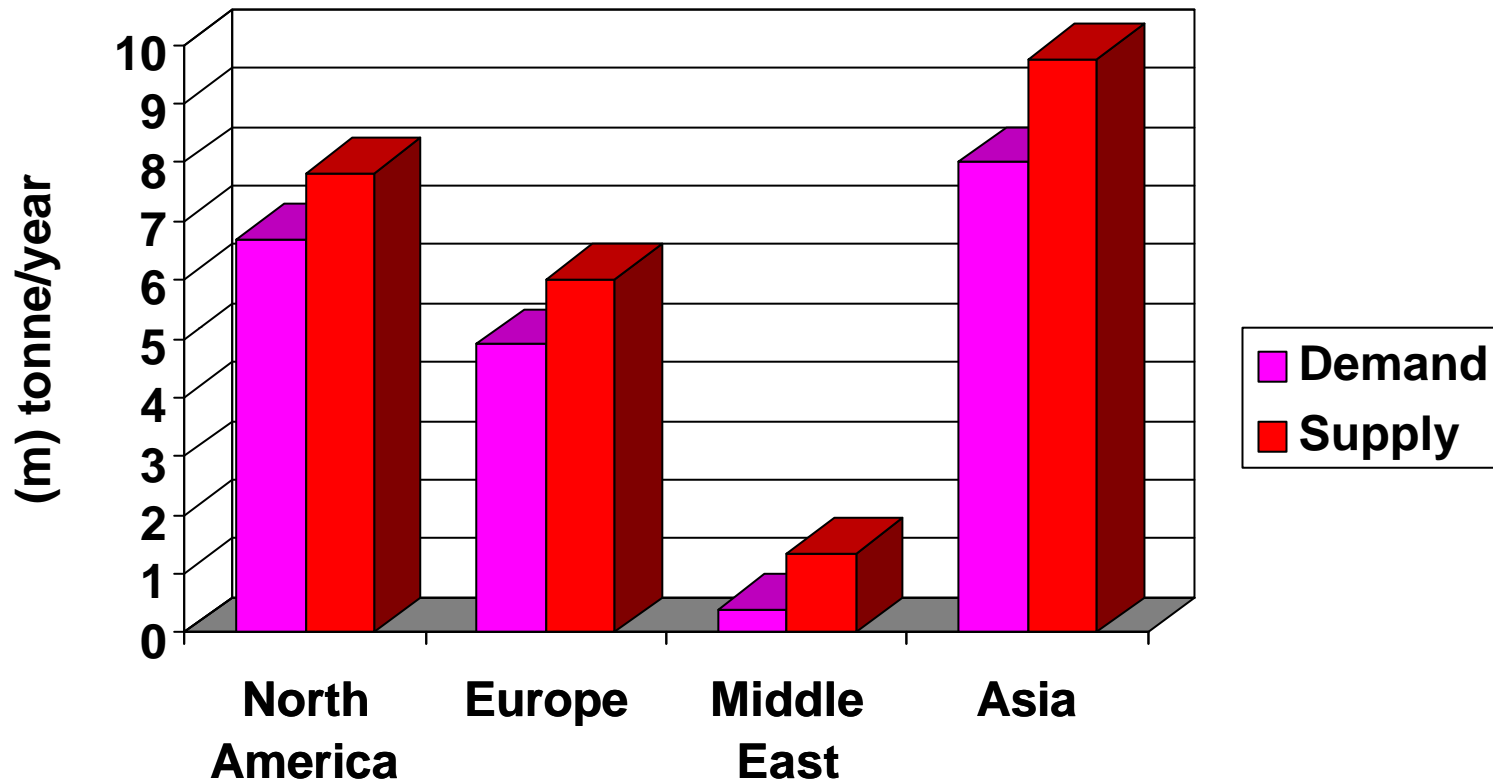
# Condition of the EB/SM Market



- Asian economic crisis could force delay of 2.6m tonne/year of new styrene capacity due onstream by 2000.
- Asian crisis resulted in est. 800,000 tonne/year loss in demand.
- Global markets will be seriously oversupplied at the turn of the century.

(Data Supplied by Asian Chemical News - 20 April 1998 Issue)

# EB/SM MARKET CONDITION (OVERSUPPLY BY YEAR 2000)



(Data Supplied by Asian Chemical News - 20 April 1998 Issue)

# New Projects Being Planned



END USER	LOCATION	CAPACITY (TONS/YR)	ENGINEERING FIRM	PROCESS	START-UP
SK OXICHEMICAL CO., LTD.	ULSAN, KOREA	300,000	BADGER	BADGER RAYTHEON	1998
FORMOSA CHEMICAL & FIBER CORP (FCFC)	TAIWAN	200,000	CTCI	BADGER	1999
SADAF	SAUDI ARABIA	567,000	BADGER	BADGER RAYTHEON	1999
ARCO	ROTTERDAM	285,000	JGC/LUMMAS	ABB LUMMAS	2000
STYRINDO MONO	INDONESIA	200,000	?	?	?
BASF	NANJING, CHINA	300,000	?	?	?
SHELL PO/STYRENE	NANHAI, CHINA	600,000	?	?	2002
BASF	CHINA	300,000	?	?	2002

# Why Buy T.A.I.



1. Single Source Supplier
  - ⇒ Electrochemical, Paramagnetic, ZrO<sub>2</sub> Capabilities for O<sub>2</sub> Analysis
  - ⇒ NDIR for CO/CO<sub>2</sub> & Hydrocarbons
  - ⇒ NIR for PPM H<sub>2</sub>O Analysis in Benzene/EB
  - ⇒ UV for PPM HC Analysis in Condensate
2. Value Added Systems Integration Capabilities
3. Proven Track Record
4. Multiple Configuration Capabilities
5. Competitively Priced, Feature Oriented Products
6. Commissioning Assistance/ Service Support
7. 40 Years Experience

# TAI's Action Plans

(To Improve Hit Rate)



- ✓ A. Understand Process & Needs
- B. Conduct Presentations for Licensors
  - ⇒ ABB Lummus Global
  - ⇒ Raytheon Badger
  - ⇒ Dow Chemical (C4 Conversion)
  - ⇒ Huntsman Chemical
  - ⇒ Dutch State Mines (C4 Conversion)
- C. Having TAI's Name Applied to Approved Vendor's List

# Action Assignment for Reps.



- Identify Location of all EB/SM Plants in the World.
  - Identify Replacement Analyzer Opportunities thru Local Rep. Distribution Network