Chlor-Alkali & Derivatives Markets

PVC Committee Meeting at APIC 2013
Taipei, 10 May 2013

Charles Fryer
APIC 2013
US GULF CAUSTIC SODA & CHLORINE PRICES

$/Metric Ton

Source: Tecnon OrbiChem
APIC 2013
COST of ECU on the US GULF

$/Metric Ton

Source: Tecnon OrbiChem
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**NATURAL GAS, CRUDE OIL & COAL PRICES**

![Graph showing the price trends of US Nat Gas, Oil, and Coal from 1999 to 2013.](source: Tecnon OrbiChem)
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EFFECT OF ENERGY COST ON CASH COST OF PRODUCTION OF THE ECU (Metric)

$/ECU

Energy Cost $/mmBtu

Source: Tecnon OrbiChem
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US PVC EXPORTS

1,000 Metric Tons

Source: Tecnon OrbiChem
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US GULF EXPORT CAUSTIC SODA & CHLORINE PRICES

$/Metric Ton

-400
-300
-200
-100
0
100
200
300
400
500
600
700
800
900
1,000
1,100
1,200


Caustic Soda
Chlorine value into Exported EDC
1.38 \times [EDC - (0.285 \times Ethylene) - 20]

Source: Tecnon OrbiChem
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CYCLES IN CHLOR-ALKALI BUSINESS

Chlorine Price

Caustic Soda Price

Price Trend

1. Chlorine up, Caustic down
2. Chlorine peak, Caustic up
3. Chlorine down, Caustic up
4. Chlorine down, Caustic peak
5. Chlorine trough, Caustic down

Source: Tecnon OrbiChem
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ASIAN CAUSTIC SODA & CHLORINE PRICES

$/Metric Ton

Chlorine up, Caustic down
Chlorine peak, Caustic up
Chlorine down, Caustic up
Chlorine down, Caustic peak
Chlorine trough, Caustic down

Source: Tecnon OrbiChem
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CHINESE CAUSTIC SODA & CHLORINE PRICES

Rmb/Metric Ton (inc. VAT)

2006 2007 2008 2009 2010 2011 2012 2013

Source: Tecnon OrbiChem
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CHINESE VALUE OF ECU

$/Metric Ton/ECU

Source: Tecnon OrbiChem

ECU Value Cl + 1.10 NaOH
Caustic Soda
Liquid Market membrane
Chlorine Liquid
All inc VAT
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PRODUCTION ROUTES TO PVC

Chlorine → EDC Direct → VCM Furnace → VCM
Ethylene → EDC Oxy → HCl → Chlorine Burner → VCM Reactor → VCM
Chlorine → Hydrogen → Chlorine Burner → Acetylene → VCM Reactor → VCM
Calcium Carbide → Water → Reactor → PVC

Source: Tecnon OrbiChem
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**EAST CHINA RAW MATERIAL PRICES**

Rmb/Ton (inc VAT)

Source: Tecnon OrbiChem
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EAST CHINA COAL vs CALCIUM CARBIDE PRICES

Rmb (inc VAT)

Source: Tecnon OrbiChem
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PVC CASH COST COMPARISON IN CHINA

$/Metric Ton

Source: Tecnon OrbiChem
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EAST CHINA PVC PRODUCTION COSTS (March 2013)

$/Ton (excl VAT) Source: Tecnon OrbiChem

- Ethylene + Chlorine
- Calcium Carbide + HCl

- Other costs
- Chlorine (0.59)
- Ethylene (0.47)
- Export Sales
- Price in E China ex works
- Other costs
- Chlorine (0.62) + Hydrogen
- CaC₂ cost (1.45)

Source: Tecnon OrbiChem
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USA & CHINA CASH PVC PRODUCTION COSTS (March 2013)

$/Ton (for China excl VAT)

- **Ethylene at cash cost ex Ethane; Chlorine at spot price** (USA)
- **Ethylene contract price + Chlorine spot price** (USA)
- **Ethylene + Chlorine** (CHINA)
- **Calcium Carbide + HCl** (CHINA)

**Other costs**:
- Chlorine (0.62) + Hydrogen
- CaC₂ cost (1.45)

Source: Tecnon OrbiChem
Source: Tecnon OrbiChem

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**PVC PRODUCTION COSTS vs CRUDE OIL PRICE**

- Production cost of PVC-A (from calcium carbide) in E China (excl VAT), Mar 2013
- China can export PVC-A
- International PVC cash cost from ethylene ex naphtha cracker plus chlorine at ECU cost ÷ 2.1
- International Price NE Asia - March 2013

Source: Tecnon OrbiChem
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CHINA PVC-A PRODUCTION GROSS MARGIN

$/Ton

Source: Tecnon OrbiChem
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CHINA PVC-E PRODUCTION GROSS MARGIN

$/Ton Source: Tecnon OrbiChem

Ethylene Based PVC Cash Cost
Ethylene Based PVC Price (excl. VAT)
Difference between Ethylene Based Price (ex VAT) and Ethylene Based Cash Cost

Source: Tecnon OrbiChem
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CHINA PVC EXPORTS vs CRUDE OIL PRICE

Source: Tecnon OrbiChem
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CRUDE OIL PRICE, ECU COST, CFBT, CHLORINE PRICE & CAUSTIC SODA PRICE RELATIONSHIP

Source: Tecnon OrbiChem

US Domestic Mar 2013
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‘SHOULD WE SELL LOW-PRICED EDC TO MAKE ADDITIONAL CAUSTIC SODA AVAILABLE FOR SALE?’

Source: Tecnon OrbiChem
The slump in building construction in the USA and Europe and the 2012 slowdown in the Chinese economy led to weakened prices for vinyl chain products, worldwide, weak chlorine values and therefore high caustic soda prices BUT …
  - Building construction is recovering in the USA
  - Asian caustic prices are now in decline, so …
  - Chlorine values are likely to recover, then strengthening PVC prices

Low-cost gas from shale has greatly strengthened the US competitive position for chemicals, particularly for vinyl products
  - US ethylene production costs from ethane are far lower than from naphtha-based crackers widely used in Asia and Europe
  - US electrical power costs and hence the cost of the ECU are lower than for most other chlor-alkali producers
  - Hence US producers of EDC, VCM and PVC have a huge competitive advantage
  - US advantages will last for many years

Source: Tecnon OrbiChem
The traditional chlor-alkali cycle seems to have entered a caustic-weakening and chlorine-strengthening phase, at least in Asia. If there is economic improvement in 2013 we can expect that worldwide:

- Operating rates and chlorine values will rise
- Caustic soda prices will decline

Chinese PVC, largely acetylene-based, had lost competitiveness in 2011-2012 based on high coal costs, but a decline in coal prices over the past 12 months is leading to better margins and rising export flows.

Source: Tecnon OrbiChem
Tecnon OrbiChem

...your source of expert chemical industry knowledge