Overview of Superabsorbent Polymer Development & Major SAP Producers

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Ian Davenport

Founder and President of Davenport International Associates LLC

25 Years experience of global SAP industry

Exclusive Danson representative for US & Canada
1) History & Development of Superabsorbent Diapers

2) Global Supply / Demand of SAP

3) SWOT (strengths, weakness, opportunities, threat) Analysis Major SAP Producers
Development of SAP Diapers

Early 1980’s – 1st SAP diaper launched in Japan by Unicharm, others follow quickly

1985/86 – P&G Pampers US includes SAP
Development of SAP Diapers

Diaper thickness dramatically reduced as 1g SAP replaces 4+ g. of fluff pulp. Early SAP diapers contain around 5g. of SAP and 40g. of fluff pulp.

1st generation SAP has good absorbency BUT there was trade off between Capacity (CRC) and Absorbency under Load (AUL).

Improved CRC meant reduced AUL
Improved AUL meant reduced CRC
Development of SAP Diapers

1st generation SAP has a uniform cross link density
Development of SAP Diapers

1988-1990, second generation SAP increased cross linking at the surface – usually by Surface Crosslinking (SXL)

This allows much higher AUL while retaining capacity.

Think of this as like a tomato – the surface is flexible but the tomato is held inside
Core/Shell Structured SAP Particles

Non Core/Shell

“Core/Shell with gradually increasing CD”

Crosslink Density (CD)

Post Treatment

“Core/Shell with Surface Shell” (“Surface Skin” or “Tomato-like structure”)

CD = Cross Link Density
Development of SAP Diapers

SAP per diaper has gradually increased to >50% of core weight, with ultra thin diapers moving to a core of 25-30g. total weight, containing 10-14g. SAP

The diaper machine puts the SAP under huge pressure; sometimes the ‘shell’ breaks so that the SAP in the diaper performs badly – we call this ‘ATTRITION’
Development of SAP Diapers

New properties and tests have been developed over time:
Permeability
Gel Conductivity
Special particle size distribution (PSD)

Labels such as 3\textsuperscript{rd}, 4\textsuperscript{th}, 5\textsuperscript{th} generation have been given but all are improvements on 2\textsuperscript{nd} gen. process
SAP now has to do more than absorb and retain fluid, it must also transport fluid after swelling
Development of SAP Diapers

Permeability/ Conductivity

- The transport of liquid through a layer of swollen Superabsorbent. This is a combination of porosity, particle size and the packing of the particles

Different companies have proprietary test methods
Development of SAP Diapers

Latest diapers have ZERO fluff

P&G China first followed rapidly by high tier P&G diapers in US and Europe

SAP now 12-14 g per diaper in high tier diapers with hot melt adhesive and curly fiber; SAP has slightly higher CRC to compensate for loss of fluff pulp & in some cases SAP has a more specific particle size distribution
Development of SAP Diapers

Competitors of P&G will find ways to follow BUT patent landscape is designed to make it hard to follow

Patents tend to cover diaper design and specific raw material combinations
Development of SAP Diapers

Major diaper producers try to patent SAP properties as used in a diaper to block competition:

1) Stop other SAP producers making & selling their SAP type

2) Stop competitors using such a type of SAP in an article such as a baby diaper
SAP Supply Demand

Historical SAP over capacity and falling prices – producers building ahead of demand & lower costs due to economies of scale as production plants became bigger (< 10; 20; 30; 60 kT trend)

Global shortage of Acrylic Acid 2005 and again in 2010 plus high Propylene costs stopped the trend to lower prices. SAP demand exceeded capacity in 2010.
SAP – US Pricing

SAP Supply Demand

Global 2011 demand is about 1.7 million MT

End of year 2011 capacity is 2.1 million, effective 90%

Chart assumes 100% of 2010 capacity available in 2011

90% = ‘sold out’ to allow for downtime, maintenance
SAP Supply Demand

Assumes 100 kT Yixing Danson capacity by end 2011; does not include future Danson expansions

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SAP Producer SWOT Analysis

S  = Strength
W = Weakness
O  = Opportunity
T  = Threat

Compare ‘Big 3’ with Yixing Danson
BASF
Evonik
Nippon Shokubai
Yixing Danson
# SWOT (1) BASF

## Strength
- VERBUND Integration($C_3$, AA, Ester, SAP) = LOW COST (no transport raw material)
- Global (EU, US, Thailand)
- Customer relations PG, KC, SCA, FQ etc.
- Financially strong
- Consistent strategy

## Weakness
- Hard to find!

## Opportunity
- Grow with customers globally
- Study Malaysia, Brazil, China production

## Threat
- Overconfidence
- Slow to add capacity in China
# SWOT (2) Evonik

## STRENGTH
Large capacity in US, EU  
Low cost to operate process  
Customer relations PG, KC, etc.  
Capable and experienced people

## WEAKNESS
No production in Asia  
Own CAA but not GAA production  
GAA transport cost to SAP plant  
2 SAP plants in each of US & EU = extra fixed costs

## OPPORTUNITY
Grow with customers globally  
Saudi Arabia production can be low cost base for sales in ME and Asia

## THREAT
Slow to add capacity in Asia/ China
## SWOT (3) Nippon Shokubai

### STRENGTH
- Strong Acrylic Acid integration
- Global production Japan, China, US, EU
- P&G relationship almost 30 years
- Experienced people

### WEAKNESS
- Purchase Propylene
  - > 50% sales (estimate) to P&G
- Other customers low priority
  - > 60% of capacity in Japan (single plant is vulnerable)
- Rely on 3rd parties for non P&G sales

### OPPORTUNITY
- New factory Indonesia - SE Asia growth
- Develop new customers

### THREAT
- Loss of share at P&G
# SWOT (4) Yixing Danson

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<tr>
<th><strong>STRENGTH</strong></th>
<th><strong>WEAKNESS</strong></th>
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<tbody>
<tr>
<td>Acrylic Acid Supply (Taixing Jurong)</td>
<td>Freight &amp; Duty cost to US &amp; EU</td>
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<tr>
<td>Lowest capital per kT of capacity</td>
<td>Late entry to SAP production</td>
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<tr>
<td>Willing to invest fast in growth capacity</td>
<td>Uncertain product consistency</td>
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<tr>
<td>Fast decision making</td>
<td>Missing relationships with major buyers</td>
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<tr>
<td>Well respected in China</td>
<td>Lack of understanding of buyer behavior</td>
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<td>Fast to learn and adapt</td>
<td>All new staff – a lot to learn</td>
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<tr>
<th><strong>OPPORTUNITY</strong></th>
<th><strong>THREAT</strong></th>
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<td>New player for major customers to leverage</td>
<td>Over confidence (“we build and customers will buy!”)</td>
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<td>Can avoid mistakes of competitors</td>
<td>May underestimate R&amp;D effort &amp; time needed to create latest generation SAP</td>
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<td>No history – no preconception – ‘blank slate’</td>
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Why Danson?

Customers need
• partner for GROWTH
• supplier willing to INVEST
DANSON must:

• Be humble & patient to learn
• Build deep relationships with major customers
• Invest in training of all staff
• Respect patents and invest to patent new Danson developments
• Be consistent and *patient*
Conclusions

Diapers and SAP will continue to evolve

SAP global market will continue to grow minimum 5% with China, SE Asia at much higher rates

SAP Supply/ Demand is Balanced to tight (but changing!!)

There is a real opportunity for Yixing Danson to succeed globally
Danson intend to add capacity to grow sales both domestic and export

2012  80kT  
2013  80kT  
2014  80kT
THANK YOU

To Danson and to Mr. Sun Liping for inviting me to make this presentation in the city of Xiamen

To all of you in the audience for listening

QUESTIONS?

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