Title: **Nomacorc Plantcorc™ wine closures: better biobased performance than cork?**

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**Curriculum:**
Olav Aagaard has been working for over 25 years in the field of polymers in R&D and business development functions. He has a MSc degree in chemical engineering and a PhD in organic chemistry from the Technical University of Eindhoven in the Netherlands. Olav joined Nomacorc (the leader in alternative wine closures) in 2005. He has been instrumental and responsible for several process and product innovations, which includes the transition to a biobased raw materials feedstock leading to the Nomacorc Plantcorc™ closure portfolio. Prior to joining Nomacorc, his career included a 12-year period with DSM. After leaving DSM in 2003 and before joining Nomacorc, Olav spent two years at a financial start-up company, Cardano Risk Management, with responsibilities for marketing and sales. Nowadays, with the acquisition of Nomacorc by the Vinventions group in 2015, he is now responsible for all of Vinvention’s Exploratory R&D.

**Abstract:**
The wine closure business has been dominated for decades by cork. However, due to quality problems like cork taint, alternative wine closures have rapidly taken market share since the beginning of this century. One of these alternatives is a specialty polymer foam product which is sold under the Nomacorc brand name and sells worldwide over 2 billion units per year. Quality, tunable barrier properties and consistency were the main drivers for growth of this coextruded, polyethylene-based product. These technical performance characteristics were clearly differentiating from cork, and are highly appreciated by enologists and winery production managers. However, in order to sustain growth, Nomacorc had to also improve perception and sustainability characteristics of the closure. A major stride was made in 2013, by the introduction of biobased raw materials in our product which lead to the creation of the Nomacorc Plantcorc™ closure portfolio in 2016. This paper will discuss the results and learning points of transitioning towards such a biobased raw material and will provide an insight in how we can make wine closures with better biobased performance than cork.
Nomacorc Plantcorc™ wine closures: better biobased performance than cork?

Olav Aagaard, June 15, 2017
Let’s talk Vinventions & wine closures…..

So what does this has to do with biobased performance materials?
Vinventions: who are we?

VINVENTIONS SNAPSHOT

- 7 global production facilities in the United States, Belgium, China, Argentina, Germany, France, and South Africa.
- Producing over 2.5 billion closures each year, closing every eighth bottle worldwide.
- Serving over 5,000 wineries in 40+ countries on 6 continents—North America, Europe, Latin America, Australia, Asia, and Africa.

We sell complete closure solutions for bottled still and sparkling wine.
Vinventions = House of 7 Brands

**Vision**
Be the most **innovative** and most **trusted global** supplier of **complete wine closure solutions** to the still and sparkling **wine** industry.

**Mission**
We help **wineries and retailers** ensure their wines **present** as intended, **delight** the consumer and **succeed** in the marketplace.

<table>
<thead>
<tr>
<th>Solution categories</th>
<th>PlantCorc</th>
<th>Synthetics</th>
<th>Natural Cork</th>
<th>Screwcaps</th>
<th>Glass Closures</th>
<th>Oenological Services</th>
<th>Marketing Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brands</td>
<td><img src="image" alt="Nomacorc" /></td>
<td><img src="image" alt="Syntek" /></td>
<td><img src="image" alt="Ohlinger" /></td>
<td><img src="image" alt="Vintop" /></td>
<td><img src="image" alt="Vimbor" /></td>
<td><img src="image" alt="Wine Quality Solutions" /></td>
<td><img src="image" alt="Wine Marketing Solutions" /></td>
</tr>
</tbody>
</table>

**Innovative Products and Services for All Our Customers Closure Needs**

We consume roughly 13 kton of polymers per year.
Wine = Luxury food

And what to drink? Too many choices
Wine industry has a very fragmented supply side

ABC Analysis 2016 of the world’s wineries

Too many brands so how to differentiate?

Source: Vinventions
## Premiumization: Driven by high growth in high-value segments

USA Wine Sales, 52 weeks 2016

### Going premium: what does this mean for wine packaging?

<table>
<thead>
<tr>
<th>Price Segment</th>
<th>Sales Value (gross) USA in USD bn</th>
<th>Value Change vs. YA in %</th>
<th>Volume Change vs. YA in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 - 2.99</td>
<td>0.79</td>
<td>-2.5</td>
<td>-3.4</td>
</tr>
<tr>
<td>3.00 - 5.99</td>
<td>4.14</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>6.00 - 8.99</td>
<td>1.62</td>
<td>-2.3</td>
<td>-2.1</td>
</tr>
<tr>
<td>9.00 - 11.99</td>
<td>3.23</td>
<td>6.7</td>
<td>6.3</td>
</tr>
<tr>
<td>12.00 - 14.99</td>
<td>1.90</td>
<td>9.5</td>
<td>9.3</td>
</tr>
<tr>
<td>15.00 - 19.99</td>
<td>1.17</td>
<td>12.1</td>
<td>12.1</td>
</tr>
<tr>
<td>&gt; 20.00</td>
<td>0.97</td>
<td>10.3</td>
<td>10.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13.83</strong></td>
<td><strong>Ø 4.3</strong></td>
<td><strong>Ø 1.8</strong></td>
</tr>
</tbody>
</table>

Source: Nielsen Total U.S. All Outlets (xAOC + Liquor Plus + Conv + Military); 52 w/e 1-2-2016
What is important to the wine consumer?

Motivations for Wine Purchasing – Frequent premium drinkers (Total USA: 37 million)

How important for US wine drinkers are the following factors when purchasing wine?

<table>
<thead>
<tr>
<th>Factor</th>
<th>Importance Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodynamic wine</td>
<td>2.35</td>
</tr>
<tr>
<td>Fairtrade wines</td>
<td>3.78</td>
</tr>
<tr>
<td>Artisan wines</td>
<td>3.80</td>
</tr>
<tr>
<td>Wines with a story</td>
<td>3.89</td>
</tr>
<tr>
<td>Organic wines</td>
<td>3.88</td>
</tr>
<tr>
<td>Farm-to-table wines</td>
<td>3.94</td>
</tr>
<tr>
<td>Locally sourced wines</td>
<td>4.02</td>
</tr>
<tr>
<td>Certified sustainable wines</td>
<td>4.09</td>
</tr>
</tbody>
</table>

Sustainability is an important value

How to become part of the wine story?

Source: Silicon Valley Bank, Sonoma County wine growers
Global warming will influence wine production location

Challenge: Bordeaux

Solution: Wageningen

Sustainability is an important value

What is important to the winery?

Climate change, wine, and conservation

Lee Hannah\textsuperscript{a,b,1}, Patrick R. Roehrdanz\textsuperscript{b}, Makihiko Ikeyami\textsuperscript{b}, Anderson V. Shepard\textsuperscript{b,2}, M. Rebecca Shaw\textsuperscript{c}, Gary Tabor\textsuperscript{d}, Lu Zhi\textsuperscript{e}, Pablo A. Marquet\textsuperscript{f,g,h,i}, and Robert J. Hijmans\textsuperscript{j}

PNAS 2013, 110(17) 6907-6912
Wine = luxury product so glass bottle is the preferred packaging

Majority of wine is packaged in half, normal & magnum bottles
Roughly 21 bln bottles per year = 21 bln closures per year
Roughly 100 kton closures per year
Closure market overview

Overall bottled wine market grew modestly at 1-2%

1997: “Cork” 98% market share
2017: “Cork” 57% market share

Closure costs 1% wine sales value

Replacement market so “Closure Wars”

Closure choice driven by:
- Wine Quality
- Ease of Opening
- Wine “Experience”
- Cost

Growth alternative closures driven by Wine Quality and Ease of Opening

Cork market share driven by the Wine “Experience”
Closure wars: cork taint opened the door for alternatives

Cork taint driver of alternative closure growth

Cork taint risk reduced but not eliminated

Current estimate 1-2% cork taint

But also other quality problems like inconsistency of wine aging

Alternatives better, more consistent and cheaper

Took the cork industry 10 years to find “a solution”
Closure wars: environmental footprint

2008

Sponsored 3rd party study

Framing the alternatives as polluting and non sustainable

Spending 40 mln euro in marketing to promote the natural cork benefits
Environmental message relevant?

Closure 1% of total carbon footprint

Nomacorc outperforming cork! But not in the perception of people’s minds
Plastic Fantastic?

How to deal with plastic perception?

It will take time, money and innovation
Solution: Become the most sustainable closure

Braskem bio-sourced polyethylene

Our research started in 2011

Commercially launched in 2013

Called Nomacorc Select Bio made with Plantcorc™ technology

Zero-carbon footprint

Zero wine faults

100% recyclable = Zero waste
Plantcorc™ Technology

Sugarcane in Brazil → Sugar Fermentation → Bioethanol Dehydration → Green Ethylene → Polymerization → Green Polyethylene

Sequestration → Release upon incineration → Landfill (Recycling)

-1 gr CO2eq (EU) → -4 gr CO2eq (EU)

Plantcorc™ technology leads to a zero carbon footprint closure

Carbon Capture -2 kg CO2/kg PE

Select Green → Coextrusion
Become the most sustainable wine closure

Have 3rd party certified proof

<table>
<thead>
<tr>
<th>Closure</th>
<th>CO2eq per closure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select Green</td>
<td>-1*</td>
</tr>
<tr>
<td>Smart+</td>
<td>7*</td>
</tr>
<tr>
<td>Natural cork</td>
<td>8**</td>
</tr>
<tr>
<td>Microagglo DIAM</td>
<td>21***</td>
</tr>
<tr>
<td>Screwcap</td>
<td>52***</td>
</tr>
</tbody>
</table>

*Carbon footprint data Nomacorc, note Vinolok CF estimate 20-50 gr CO2eq
***http://www.institutduliege.com/colloque2008/Caroline%20Forgues.pdf
Have 3rd party talk about your innovation

2013, Italy

2014, Spain

2014, UK

2014, US

More than 350 press articles
Upgrade to allow for premiumization

& be careful how you call yourself

- Changed the look & feel to resemble high-end natural cork
- No more (perception) issue for premium wines
- Changed the name from Bio to Green
- Bio was confusing for (French) consumers which associate this with organically grown
- 2016: Extended the product line to Nomacorc Green Line

& be careful how you call yourself
Offer sustainability at all price points: Nomacorc Green Line

Superior Performance
- Wine preservation up to 25 years
- TCA and migration free
- Consistent & controlled O₂ ingress
- Reliable bottling performance
- Easy opening and reinsertion
- Optimum wine preservation

Enhanced Design
- Natural woodgrain markings
- Soft-feel skin
- Premium end treatments

Higher Sustainability
- Renewable plant-based materials
- Lowest carbon footprint
- 100 % Recyclable
- Using renewable energy

Introducing Zest
The World’s First Zero Carbon Footprint Premium Sparkling Wine Closure
- Single piece construction
- Glue and TCA Free
- Consistent O₂ ingress
- High CO₂ retention
- Zero carbon footprint
- Fully recyclable
Offer all closures with exciting innovation

**Superior Performance**

- Long term wine preservation
- Bottle-to-bottle consistency
- Guaranteed TCA taint free
- Clean & migration free

**Enhanced Design**

- High performance microagglomerated closure look
- Printing optioning including fire-branding and offset printing
- Custom side & end printing

**Higher Sustainability**

- Glue free composition
- Long term biodegradable
- Fully recyclable
- Fully compliance of regulations governing direct wine contact

**Ohlinger Selektion = The Pinnacle in Natural Cork Performance!**

- Optimum top quality natural cork appearance
- Each cork individual tested by expert sensory professionals
- Guaranteed free from TCA taint and off aromas and flavors

**Ohlinger SELEKTION**
Become part of their story

Grapes

Sequestration

Grape Fermentation Distillation & Shipment

Bioethanol Dehydration

Polymerization

Release upon incineration

Going wine circular

“Grape” line made from wine to protect wine

Green Ethylene

“Grape” line
Keep on innovating

Nomacorc Green line

BPM project Foamex

Non biodegradable and biobased
e.g. Biobased PE, PET, PA, PTT

Biodegradable and biobased
e.g. PLA, PHA, PBS, Starch blends

Conventional plastics
e.g. PE, PP, PET

Biodegradable and fossil-based
e.g. PBAT, PCL

Fossil-based
Thank You!

and now time for a glass of wine