The Future for Rosin Esters in Hot Melt Adhesives

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Agenda

- Introduction - Adhesive market status and trends
- Trends affecting Rosin Ester usage in Hot Melt Adhesives
- Rosin Ester consumption by Adhesive market segment
- Trends by market segment
- 2028 forecast for Rosin Ester usage in Hot Melt Adhesives
- Global perspective
- Conclusion

Sources - Industry data and JEL Consulting research
Introduction
Hot Melt Adhesives European Market

- European market size estimated at 650kT
- Growing at around 3.5% per year
- Tackifier market is ca. 250kT (38% of total adhesive)
- Rosin Ester market is ca. 90kT
  - 14% of total adhesive
  - 36% of tackifier portion
  - Rosin Ester market has declined by ca. 1% per year over last 5-10 years, despite overall adhesive market growth
- Rosin Ester usage varies by Adhesive market segment and geography

Sources- Industry data and JEL Consulting research
### Hot Melt Adhesives
#### Key Market Trends and Developments

<table>
<thead>
<tr>
<th>Trends &amp; Demands</th>
<th>Developments</th>
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<tbody>
<tr>
<td>Lower application temperatures to save energy and improve handling safety</td>
<td>Lower softening point adhesives with equivalent or better properties</td>
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<td>Reduced downtime due to equipment breakages and cleaning</td>
<td>Clean-running, highly thermally stable products that do not char or break down</td>
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<td>Cost saving- increased recycled content, smaller reserves, less adhesive</td>
<td>Next generation products with excellent specific adhesion to low energy substrates at low usage rates</td>
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<td>Renewable, recyclable</td>
<td>Not yet solved!</td>
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<tr>
<td>Avoid having to think about adhesives!</td>
<td>Turn-key adhesive solutions based on total cost in use- partnerships with equipment manufacturers</td>
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*Sources: Industry data and JEL Consulting research*
Hot Melt Adhesives - ca. 650kT
Estimated Quantity by Market Segment - Europe 2018

- Rigid Packaging: 24%
- Assembly: 24%
- Woodworking: 16%
- PSA: 11%
- Labelling: 7%
- Automotive: 5%
- Flexible Packaging: 5%
- Converting: 3%
- Non-wovens Bookbinding: 2%
- Bookbinding: 2%
- Converting: 3%
- Non-wovens Bookbinding: 2%

Sources: Industry data and JEL Consulting research
Trends Affecting Rosin Ester Usage in Hot Melt Adhesives

**Positives**
- Superior adhesion in many applications
- Good hedge against hydrocarbon price and availability swings
- Seen as “renewable” alternative to hydrocarbon tackifiers (but still need hydrocarbon for the polymer, so not a “green” adhesive)
- Odour of RE is sometimes favoured over hydrocarbons

**Negatives**
- Growth in metallocene catalysed PP and PE polymers which are generally incompatible with rosin ester tackifiers
  - Driven by market leaders, Henkel and HB Fuller, who were given early access to the technology
  - First products had very poor adhesion, but later generations improved on this
  - Metalloence catalysed polymers enable more stable, cleaner running and lower usage adhesives to be formulated
- Rosin esters sometimes associated, unfairly, with “old technology”- dirty, smelly and poor stability
- “Standard” hydrocarbon tackifiers have also improved

*Sources - Industry data and JEL Consulting research*
Rosin Esters in HM Adhesives- ca. 90kT
Estimated Quantity by Market Segment- Europe 2018

Sources- Industry data and JEL Consulting research
Rigid Packaging
Segment growing at 2% per year

*Case & carton sealing (“End of Line”), case and tray erection, aseptic cap and straw attach, many other niches (e.g. roll and ream wrap in paper industry)*

**Positives for Rosin Esters**
- Buyer lack of focus / resistance to change, especially for small users
- Drive towards good housekeeping- cleaning and maintenance of equipment
- Cost focus of buyers/ tendency for RFQs
  - Adhesive cost relatively small as % of total- often part of MRO spend
  - Perceived total cost benefits of metallocene can be overlooked
- Increased recycled content and changing designs creates adhesion challenges

**Negatives for Rosin Esters**
- Metallocene has grown fastest in this segment, taking share from EVA / RE
  - Allows less focus on the adhesive process
  - Enables faster line speeds
- Unlikely to return to EVA / RE after metallocene adoption
  - Standardisation is appealing
- Metallocene can be attractive for turn-key solutions involving application equipment and/or complete packaging lines
  - BUT!...can also be perceived as a threat for those selling equipment spares

*Sources- Industry data and JEL Consulting research*
Assembly
Segment growing at 4% per year overall

Many diverse applications, including: Transportation (Automotive considered separately), Filter, Construction, Spring and Mattress, Appliances, Carpeting and Textiles, Cord-strapping

Positives for Rosin Esters

- Adhesives are specified into parts, often for many years, especially in Transportation, Filters, Construction and Appliances, leading to few changes

- Addresses specific adhesion challenges, e.g. in Spring and Mattress sub-segment

- Focus on adhesive cost
  - Adhesive is high proportion of part cost
  - Drive towards good housekeeping - cleaning and maintenance of equipment

Negatives for Rosin Esters

- Metallocene can be favoured where water-white adhesive colour is important

Sources: Industry data and JEL Consulting research
Woodworking
Segment growing at 2% per year

Edge-bandng, profile-wrapping and top lamination of finishes onto various wood and fibre-based materials (e.g. IKEA furniture products)

Positives for Rosin Esters

- Traditional segment of high RE usage
- Addresses specific adhesion challenges
- Focus on adhesive cost
  - Adhesive is high proportion of part cost
  - Drive towards good housekeeping-cleaning and maintenance of equipment

Negatives for Rosin Esters

- Trend towards polyolefin products that rival environmental resistance of PURs

Sources- Industry data and JEL Consulting research
PSA

Segment growing at 3% per year

Labels, tapes and self-adhesive coatings- this is an application-defined segment (not a market) so there is sometimes confusion and overlap with other segments

Positives for Rosin Esters

- More complex systems- tackifier choice driven by polymers / rubbers used
- Addresses specific adhesion and conversion challenges
- Value of adhesive is inherently part of customer’s “sell-on” value
- Tendency to lower coat weights on labels drives increased tackifier content (not only RE)

Negatives for Rosin Esters

- Doubts about colour and temperature stability for applications that demand them

Sources- Industry data and JEL Consulting research
Labelling
Segment growing at 1% per year

*Bottle, jar and can labelling directly with hot melt- competes with PSA applications and water-based adhesive technology*

**Positives for Rosin Esters**
- Low growth segment with little motivation for change from traditional formulations

**Negatives for Rosin Esters**
- Doubts about colour and temperature stability for applications that demand them

Sources- Industry data and JEL Consulting research
Automotive
Segment growing at 4% per year

Non-structural (secondary) bonding, e.g. for thermal/ sound insulation, headlights, bumpers- many and varied applications

Positives for Rosin Esters
- Addresses specific adhesion challenges
- Adhesives are specified into parts, often for many years, leading to few changes
- Users are focused on good housekeeping- cleaning and maintenance of equipment

Negatives for Rosin Esters
- Doubts about colour and temperature stability for applications that demand them

Sources- Industry data and JEL Consulting research
Rosin Esters in HM Adhesives - ca. 97kT
Projected Quantity by Market Segment - Europe 2028

Sources: Industry data and JEL Consulting research
Rosin Esters in Hot Melt Adhesives
Regional Variations

Europe

- Market uptake of metallocene higher in Western and Northern Europe than Southern and Eastern Europe
  - Focus on technology advancement and “total cost of ownership” of adhesive
  - Partnerships with equipment companies (Nordson, Robatech, etc.) to sell solutions to customers rather than just products
  - Many small to medium hot melt producers in Italy, Spain and Portugal with long-standing customer and supplier relationships and more market inertia

North America

- Evidence that market penetration of metallocene has been slower than in Europe
  - Customers are more adhesive price-driven
  - Users have more “hands on the machine”- focus on equipment maintenance

Sources- Industry data and JEL Consulting research
Rosin Esters in Hot Melt Adhesives
Regional Variations

South America
- Market uptake of metallocene seems low
  - Perhaps due to traditional high usage of gum rosin esters

Asia
- Appreciable adoption of metallocene for new applications and with global users
- Operator education is not always sufficient to benefit from material savings
- Equipment maintenance is low cost, and/or comes included as part of a service package with the equipment
- EVA / Rosin Esters still maintain a healthy share due to local manufacture

Sources: Industry data and JEL Consulting research
Conclusion

- New technologies such as metallocene have taken, and will continue to take share from "traditional" hot melts such as those that use rosin esters.
- This is particularly true in the largest segment for hot melts, Rigid Packaging.
- In other segments, the arguments for metallocene technology are not so compelling.
- However, it is expected that an equilibrium will be reached, and rosin ester will remain a significant tackifier technology, due to its adhesion performance, specific polymer compatibilities and renewable nature.

**ROSIN ESTERS HAVE A FUTURE IN HOT MELT ADHESIVES!**

*Sources - Industry data and JEL Consulting research*
Thank You!

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