Vegetable Oil-Based Waterborne Polyurethane Dispersions

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Why vegetable oils
- Fossil fuels used in the manufacturing of plastics account for approximately 7% of the worldwide use of non-renewable oil and gas.
- Vegetable oils are one of the most widely used renewable resources for the chemical and polymer industries owing to their readily availability and low prices.

Importance of polyurethanes
- Polyurethanes (PUs) are incredibly versatile polymers, which find various applications in industrial coatings, foams, insulation, and fibers.
- The conventional polyurethane products usually contain a significant amount of organic solvents and sometimes even free isocyanate monomers.
- Waterborne Polyurethane Dispersions (PUDs) are coatings and adhesives that use water as the primary solvent.
- PUDs are increasingly being used in many industrial and commercial applications as an improved and more environmentally-friendly solution.
- PUDs present many advantages relative to conventional PUs, including low viscosity at high molecular weight and good applicability.

Objectives
- Our goal here is to use vegetable oil-based polyols to produce waterborne coatings with high performance, which release no volatile organic compounds (VOCs).
- Study different vegetable oil-based polyols and their effect on properties and structure.

Experimental
- Epoxidize the unsaturated sites of vegetable oils (soybean and linseed oils) to create epoxidized vegetable oils (EVOs) with approximately 2.7 OH groups.
- The EVO was then converted into methoxylated or chlorinated polyols by opening the epoxy rings with methanol or hydrochloric acid.

Properties of the vegetable oil-based polyols

<table>
<thead>
<tr>
<th>Polyols</th>
<th>OH number (mg KOH/g)</th>
<th>OH functionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castor oil</td>
<td>163</td>
<td>2.70</td>
</tr>
<tr>
<td>Soy-methanol</td>
<td>149</td>
<td>2.65</td>
</tr>
<tr>
<td>Soy-HCl</td>
<td>155</td>
<td>2.76</td>
</tr>
<tr>
<td>Linseed-HCl</td>
<td>156</td>
<td>2.78</td>
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Advantages
- Current alkyd products will be replaced by less expensive, water-based, VOC free, environmentally friendly, high performance coatings.
- Present petroleum starting materials will be replaced by biorenewable, natural oils.

Potential applications
- Furniture coatings
- Automobile coatings
- Paper coatings
- Electronic and fiber optic coatings
- Pressure – sensitive adhesives

Conclusions
- Practical waterborne agricultural oil-based coatings have great potential in today’s market.
- Initial results have provided promising new coatings.
- There are numerous large markets and a wide variety of applications for these bio-coatings.

References
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Acknowledgements
Thomas Garrison Dr. Yongshang Lu
Dr. Richard C. Larock Larock Research Group
National Science Foundation Grant No. EEC-0813570