PVC vs. Polyurethane: A Tubing Comparison

by John Stover
Director, Product Management & Product Regulatory Compliance
NewAge® Industries, Inc.
Introduction

PVC and polyurethane are thermoplastic materials that can be formed into a variety of shapes, including tubing and reinforced hose. Both materials are useful in numerous applications. But depending on factors such as temperature, chemicals and outdoor use, one product may perform better than the other in a particular application.

This document will examine each material’s benefits, drawbacks and common uses as they pertain to products available from NewAge Industries, Inc.

PVC

Although no plastic tubing product can universally handle all applications, PVC (polyvinyl chloride) products cover one of the widest ranges of applications serviced by any one type of plastic material.

Flexible PVC tubing offers a broad range of chemical and corrosion resistance, excellent abrasion and wear resistance, rubber-like flexibility, visual contact with the flow (with clear styles), and outstanding flow characteristics. These features, along with various construction options like wire, spiral or braid reinforcement or unreinforced tubing, and the different formulations available (industrial, fuel and oil grade, 3-A, FDA, NSF, USP Class VI), make PVC attractive for a wide variety of uses.

Examples include chemical processing, water transfer, waste product lines, viscous fluid handling, wet or dry food handling, beverage transfer, dairy processing, granular material conveyance, air and gas supply, vacuum lines, pump discharge, spray systems, small engine fuel lines, protective jacketing, potable water and irrigation systems.

Some of PVC’s disadvantages are that it may harden and become less pliable when certain fluids — concentrated acids and alkalis, for example — are transferred through it. Standard PVC tubing does not
react well with fuels and oils; the tubing will harden and crack. Special PVC formulations are available for fuel and oil applications, such as those involving small engines for power landscaping equipment.

Industries that use PVC tubing:

- industrial
- medical
- chemical
- food, beverage and dairy
- cleaning apparatus
- pool and spa
- appliance
- laboratory
- energy

**Polyurethane**

Polyurethane, often abbreviated as PU, PUR or TPU, combines the best properties of plastic and rubber. It offers high elongation values (stretchability) like rubber and abrasion resistance that’s superior to PVC. Polyurethane is naturally flexible and does not use additives to retain its flexural properties.

Combining good chemical resistance with excellent weathering characteristics sets polyurethane apart from other thermoplastics. It has exceptional resistance to most gasolines, oils, kerosene, and other petroleum-based chemicals, making it an ideal choice for fuel lines (although additives in today’s gasoline and petroleum products warrant field testing). Polyurethane is generally more resistant to pressure and vacuum applications than corresponding sizes of PVC or rubber. It is also more cut resistant than most other thermoplastics.
The two basic formulations of urethane, ester and ether, have some important differences. Water attacks ester-based urethane, causing a significant reduction in physical properties. Ether urethanes exhibit far superior hydrolytic stability, especially in humid environments. Ether-based materials also resist fungus growth better than ester-based materials.

Generally, polyurethane is tackier than PVC. It may stick to itself, which — especially in the case of tubing — can result in tangles. Additives can be mixed with the polyurethane resin at manufacture to reduce tackiness. Material combinations such as PVC/polyurethane blends can also change the surface characteristics, but PVC by itself has a naturally slipperier surface than 100% polyurethane.

Typical polyurethane tubing applications include pneumatic control systems, petroleum product transfer, cable jacketing, air lines, powder and granular material transfer, fluid lines, sleeving, low pressure hydraulics and robotics.

Industries that use polyurethane tubing:

- agriculture
- chemical
- appliance
- undersea oil exploration
- nuclear power
- mining
- industrial
- petroleum
- automotive

**Similarities & Differences**

Characteristics that PVC and polyurethane have in common:

- Kink resistance
- The ability to be colored either solidly or with tints so that the tubing or reinforced hose remains transparent
• Flexibility
• Customization such as heat formed shapes, thermal bonding, overbraiding for increased pressure and/or heat resistance, manufacture in harder or softer durometers, non-stock sizes
• Specified cut-to-length pieces

Important ways in which the two materials differ:

• Low temperature use — PVC can be used at temperatures approaching –50°F/ –45°C, while polyurethane can handle those near –95°F/-70°C
• The transfer of odors or taste to products flowing within — PVC is generally regarded as odorless and tasteless; polyurethane is not
• Weather resistant properties — PVC may harden and discolor when exposed to certain conditions; polyurethane handles outdoor applications well
• PVC generally costs less than polyurethane

The following charts compare the physical properties of several styles of PVC and polyurethane tubing. **Note:** This information pertains to properties and characteristics of PVC and polyurethane products available from NewAge Industries, Inc. The values listed are typical for the materials used in manufacture and are meant to be used as a guide. Field testing should be performed to find the actual values for a specific application.
## Comparison Chart 1: Physical Properties

<table>
<thead>
<tr>
<th>Product</th>
<th>Hardness, Shore A (±5)</th>
<th>Tensile Strength, PSI</th>
<th>Elongation @ Break, %</th>
<th>Brittle Temperature, °F</th>
<th>Maximum Operating Temperature, °F</th>
<th>Working PSI @ 70°F</th>
<th>Burst PSI @ 70°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearflo® Tubing</td>
<td>68</td>
<td>1900</td>
<td>400</td>
<td>-41</td>
<td>175</td>
<td>14 - 70</td>
<td>56 - 280</td>
</tr>
<tr>
<td>Clearflo® Fuel &amp; Oil Tubing</td>
<td>62</td>
<td>1980</td>
<td>730</td>
<td>-20</td>
<td>175</td>
<td>40 - 68</td>
<td>120 - 204</td>
</tr>
<tr>
<td>Nylobrade® Hose</td>
<td>80</td>
<td>2500</td>
<td>320</td>
<td>-50</td>
<td>175</td>
<td>50 - 465</td>
<td>150 - 1395</td>
</tr>
<tr>
<td>Newflex® Hose, Standard &amp; Heavy Duty</td>
<td>65</td>
<td>1900</td>
<td>440</td>
<td>-45</td>
<td>150</td>
<td>35 - 105</td>
<td>105 - 315</td>
</tr>
<tr>
<td>Newflex® Hose, Light Duty</td>
<td>70</td>
<td>2000</td>
<td>420</td>
<td>-42</td>
<td>140</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>Vardex® Hose</td>
<td>73</td>
<td>2100</td>
<td>270</td>
<td>23</td>
<td>150</td>
<td>70 - 200</td>
<td>210 - 600</td>
</tr>
<tr>
<td>Superthane® Ester Tubing</td>
<td>85</td>
<td>6000</td>
<td>550</td>
<td>-95</td>
<td>185</td>
<td>27 - 135</td>
<td>81 - 405</td>
</tr>
<tr>
<td>Superthane® Ether Tubing</td>
<td>85</td>
<td>5500</td>
<td>580</td>
<td>-90</td>
<td>175</td>
<td>22 - 135</td>
<td>66 - 405</td>
</tr>
<tr>
<td>Superthane® Pneumatic Tubing</td>
<td>85</td>
<td>5500</td>
<td>580</td>
<td>-90</td>
<td>175</td>
<td>130 - 135</td>
<td>390 - 405</td>
</tr>
<tr>
<td>Urebrade® Hose</td>
<td>85</td>
<td>5500</td>
<td>580</td>
<td>-90</td>
<td>175</td>
<td>40 - 250</td>
<td>160 - 1000</td>
</tr>
</tbody>
</table>

*Dependent on tubing/hose size

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## Comparison Chart 2: Appearance, Standards & Performance

<table>
<thead>
<tr>
<th>Product</th>
<th>Material</th>
<th>Reinforced</th>
<th>Standards Met by Ingredients or Tubing/Hose</th>
<th>Color</th>
<th>Odorless &amp; Tasteless</th>
<th>Weather Resistant</th>
<th>Made in USA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PVC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearflo® Tubing</td>
<td>Clear PVC</td>
<td>No</td>
<td>FDA, NSF 51*, 3-A, Class VI</td>
<td>Clear</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Clearflo® Fuel &amp; Oil Tubing</td>
<td>Transparent Yellow PVC</td>
<td>No</td>
<td>n/a</td>
<td>Transparent Yellow</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Nylobrade® Hose</td>
<td>Clear Braided PVC</td>
<td>Yes</td>
<td>FDA, NSF 51* &amp; 61*, Class VI</td>
<td>Clear</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Newflex® Hose, Standard &amp; Heavy Duty</td>
<td>Clear Spiral PVC</td>
<td>Yes</td>
<td>FDA, 3-A</td>
<td>Clear</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Newflex® Hose, Light Duty</td>
<td>Clear PVC with White Spiral</td>
<td>Yes</td>
<td>FDA, 3-A</td>
<td>Clear with white spirals</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Vardex® Hose</td>
<td>Clear PVC with Steel Wire</td>
<td>Yes</td>
<td>FDA</td>
<td>Clear</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Polyurethane</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Superthane® Ester Tubing</td>
<td>Clear Ester Polyurethane</td>
<td>No</td>
<td>FDA</td>
<td>Transparent Amber</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Superthane® Ether Tubing</td>
<td>Clear Ether Polyurethane</td>
<td>No</td>
<td>FDA, NSF 61</td>
<td>Transparent Amber</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Superthane® Pneumatic Tubing</td>
<td>Colored Polyurethane</td>
<td>No</td>
<td>NSF 61</td>
<td>Transparent Red, Blue, Yellow, Green &amp; Clear; Opaque Gray, Black, White &amp; Orange</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Urebrade® Hose</td>
<td>Clear Ether Braided Polyurethane</td>
<td>Yes</td>
<td>FDA, NSF 61</td>
<td>Transparent Amber</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*The finished product is certified by the National Sanitation Foundation (NSF).*
Conclusions

The deciding factor in whether to choose PVC or polyurethane tubing depends on the specifics of your application — what will flow through the tubing, what temperatures are involved, will it be used indoors or out, what pressure capabilities are needed, are leachables a concern, what hardness is required, will fluids drip onto the tubing, can it be sterilized, can it be reused?

Communication with your tubing supplier is a tool you can use to help determine what tubing material is the right one for your particular needs. Ask questions and request samples for evaluation. Perform field testing, and when the results are in, you’ll be able to make a well-educated decision.

For more information on NewAge Industries’ PVC and polyurethane tubing and hose, contact the company at 215-526-2300 or visit http://www.newageindustries.com.