LIFE CYCLE ASSESSMENT
MOTOR OIL PACKAGING CASE STUDY

MOTOR OIL PACKAGE COMPARISON

Motor oil has traditionally been packaged in rigid HDPE bottles, but recently, there have been examples of motor oil being packaged in flexible stand-up pouches with fitments. For this Life Cycle Assessment study, flexible stand-up pouches with fitments and rigid HDPE bottle formats were evaluated for their environmental impacts with a cradle-to-grave boundary.

WATER CONSUMPTION

Manufacturing rigid HDPE bottles involves an injection molding process, which requires excess water to cool down the molds. Flexible stand-up pouches are formed by laminating multiple thin layers of film together, which requires much less water by contrast.

In fact, the HDPE bottle consumes 6X more water than the stand-up pouch.

GREENHOUSE GAS EMISSIONS

Both package formats contain plastic, but the flexible stand-up pouch has a reduced carbon impact because it uses much less material than the rigid HDPE bottle.

The rigid HDPE bottle has a greenhouse gas emission about 1.5X that of the flexible stand-up pouch with fitment.

Even though rigid HDPE bottles are recycled at a rate of 34.4%, 2X as much material still ends up as municipal solid waste in landfills compared to the stand-up pouch, leading to a larger end-of-life impact.

FOSSIL FUEL CONSUMPTION

A lighter package with a manufacturing process that is less energy intensive will almost always result in lower fossil fuel consumption, as is the case with the flexible stand-up pouch with fitment. Rigid HDPE bottles are heavier and require more energy/fuel during the injection molding process, which results in higher fossil fuel consumption.

The rigid HDPE bottle weighs about 3X more than the flexible stand-up pouch and uses 173% more fossil fuel resources.
END OF USE SUMMARY

SOURCE REDUCTION BENEFITS

While both the rigid HDPE bottle and flexible stand-up pouch enable packaging efficiency through high product-to-package ratios, the flexible stand-up pouch comes out ahead.

Flexible stand-up pouch:

- **97.4%** Product weight
- **2.6%** Package weight

Rigid HDPE bottle:

- **93.7%** Product weight
- **6.3%** Package weight

RECOVERY BENEFITS

Assuming the flexible stand-up pouch is not recycled, it still results in a **substantially lower** amount of material ending up as municipal solid waste versus a rigid HDPE bottle.

Compared to the flexible stand-up pouch:

- The rigid HDPE bottle results in almost **2X** the amount of material ending up as municipal solid waste.
- The rigid HDPE bottle’s recycling rate would need to increase from **34.4%** to **64%** to equal the amount of discarded material associated with a flexible stand-up pouch.

IMPLICATIONS

When the rigid HDPE bottle and flexible stand-up pouch with fitment are used for motor oil packaging, the flexible structure has an overall favorable outcome in terms of fossil fuel usage, greenhouse gas emissions, water consumption and materials landfilled. This is largely driven by the flexible stand-up pouch using about **1/3** of the material used in the rigid HDPE bottle, which results in less energy used in manufacturing and transporting of the package materials, and a reduction in associated environmental impacts.

<table>
<thead>
<tr>
<th>FORMAT</th>
<th>FOSSIL FUEL CONSUMPTION (MJ-EQUIV)</th>
<th>GHG EMISSIONS (KG-CO₂ EQUIV)</th>
<th>WATER CONSUMPTION (L)</th>
<th>PRODUCT-TO-PACKAGE RATIO (%)</th>
<th>PKG LANDFILLED (G)/1000 KG MOTOR OIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLEXIBLE STAND-UP POUCH W/ FITMENT</td>
<td>14.12</td>
<td>.5998</td>
<td>1.03</td>
<td>38.0 : 1 97.4% : 2.6%</td>
<td>26,301</td>
</tr>
<tr>
<td>RIGID HDPE BOTTLE</td>
<td>38.58 (+173%)</td>
<td>1.52 (+153%)</td>
<td>6.33 (+513%)</td>
<td>14.8 : 1 93.7% : 6.3%</td>
<td>45,501 (+73%)</td>
</tr>
</tbody>
</table>

For more information and methodologies of assessments, please visit [www.flexpack.org](http://www.flexpack.org) to download Flexible Packaging Association’s “A Holistic View of the Role of Flexible Packaging in a Sustainable World” report and refer to pages 129-167.