Grease compatibility with elastomers: What it is, why it is important and a how-to-test primer

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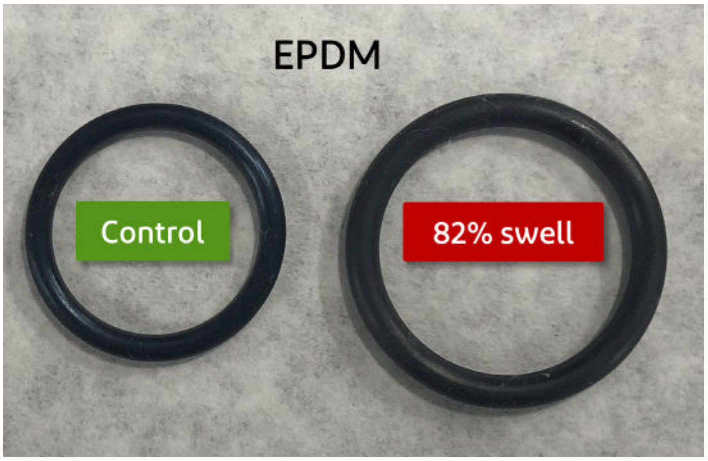
Introduction

Elastomer machinery parts and components can be a cost-effective alternative to metal components, and proper lubrication can extend their operating life and efficiency. However, some traditional lubrication formulations are not elastomer-compatible and can weaken or degrade the part – making testing critical in determining the proper lubricant for an application. Compatibility charts exist, but they are a general starting guideline and are incomplete.

"Compatibility" in this aspect is when a grease or other lubricant has a minimal impact on the physical properties of the polymer or elastomer in terms of size, durometer or brittleness. Acceptability of changes to the polymer and grease is specific to the application in which they are targeted to be used. Using the testing method described in this paper will help ease selection and will help users identify viable and nonviable lubricant options through calculation of swelling and observation of color and/or texture changes.

Figure 1. *Example of EPDM O-ring control vs. test O-ring after treatment*



Compatibility testing

Test methods

A sampling of test methods for evaluating compatibility of elastomers and polymers in various conditions is listed in Table 1.

Table 1. *Standardized methods for polymeric/elastomeric material compatibility tests*

Standardized method	Properties evaluated
ASTM D4289	Elastomer compatibility of lubricating greases and fluids
ASTM D471, ASTM D543, ISO 175	Effect of liquid chemicals on polymeric materials
ASTM E831	Thermal expansion of solid materials
ASTM D7264, ASTM D790, ISO 178	Flexural properties of polymeric materials
ASTM D638, ISO 527	Measurement of tensile properties

ASTM D4289 explains a method for comparing the effects of lubricants on elastomers using sheet materials to evaluate swell and durometer. Here, a simplified example of a test for elastomer compatibility using O-rings and omitting durometer is described. O-rings were selected for consistency in surface finish; durometer was omitted, as previous experiments showed a direct correlation between swell and durometer change (swell/softening vs. shrinkage/hardening).

Note: The method is recommended to be used as a first-pass screening and is not meant to guarantee elastomer/grease compatibility under all exposure conditions.

Procedure

1. Using an analytical balance fitted with a density determination kit and recorded to the nearest 0.0001 g, O-ring masses are measured before submersion in lubricant.
2. A thick layer of the selected lubricant is spread along aluminum foil.
3. The selected O-rings are placed onto the lubricant, with a generous amount of space in between the O-rings and only 1 elastomer type per sheet of foil.
4. To hold the O-rings in position, each elastomer O-ring is pressed gently into the lubricant.
5. A second thick layer is then applied over top of the O-rings, ensuring that they are completely covered and that no air bubbles are present in the lubricant.
6. Each aluminum foil test specimen is placed on a tray and inserted into an oven at 125°C.
7. After 3 days (72 hours) at 125°C, the lubricant packages are removed from the oven.

Figure 2. *. Balance fitted with a density determination kit*

8. After allowing the material to cool for 15 minutes, the elastomers are removed and wiped down with a dry, clean cloth.
9. After a secondary wipe-down with a clean cloth, the O-rings are weighed again.
10. Determination of volume swell (ΔV%) is calculated:

$$\Delta V,\,\% = \frac{(M_3 - M_4) - (M_1 - M_2)}{(M_1 - M_2)} \cdot 100$$

Where:
ΔV = change in volume, %
M_1 = initial mass of specimen in air, g
M_2 = initial mass of specimen in water, g
M_3 = mass of specimen in air after immersion, g
M_4 = mass of specimen in water after immersion, g

11. Perform a visual inspection or measure length changes and make a determination based on the table below:

Rating	% swell		Visual
Excellent	-10 < 10	*and*	No change
Good	-20 < 20	*and*	No obvious change
Fair	-40 < 40	*and/or*	Slight color change
Poor	-40 ≤ or 40 ≥	*and/or*	Obvious color change/texture change

Conclusion

Elastomer machinery parts and components can be a cost-effective alternative to metal components, and proper lubrication can extend the operating life and efficiency of these components. However, some traditional lubrication formulations are not plastic-compatible and can weaken or degrade the part – which is why testing is critical to determine the proper lubricant for the application.

Using the testing method described in this paper may help ease the selection process and may help users identify viable and nonviable lubricant options through calculation of swelling and observation of color and/or texture changes.

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