

Generic Biobased Transformer Oil

Product Selection and Description

Biobased transformer oil is relatively new to the market. Results of independent tests on the performance of biobased transformer oil are comparable to results for other transformer oils, such as the mineral-based and silicone-based fluids in BEES. Biobased transformer oil is produced from vegetable oil feedstock.

Flow Diagram

The flow diagram in the figure below shows the elements of biobased transformer oil production, as it is currently modeled in BEES.

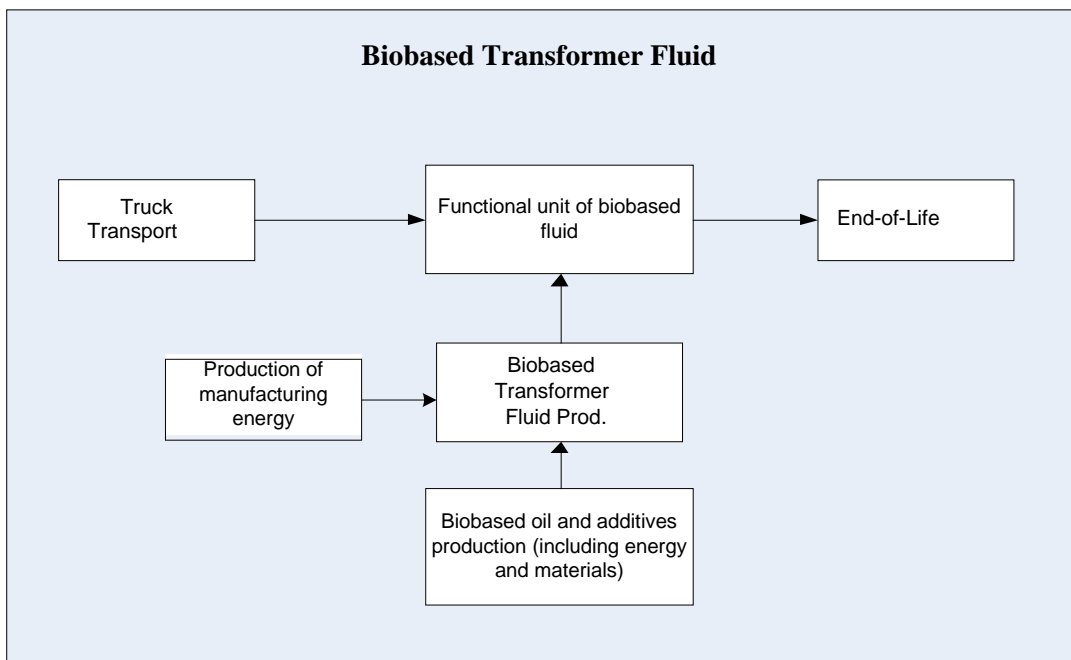


Figure 1: Generic Biobased Transformer Oil System Boundaries

Raw Materials

Generic biobased transformer oil is composed of the materials listed in the Table below.

Table 1: Generic Biobased Transformer Oil Constituents

<i>Constituent</i>	<i>Mass (kg/kg oil)</i>
Biobased oil (soybean and/or other vegetable oils)	96.5 %
Antioxidants and other additives	3.5 %

Production data for converting soybeans to oil¹ is updated with more recent U.S. LCI Database data on soybean growing and harvesting. While fertilizer and agrichemical use, and some energy use for farming equipment, are similar in amount to the older data, electricity use is different (slightly higher), as is natural gas use. There are also additional inputs represented by the new data, including lime.

Manufacturing

¹ Sheehan, J. et al., NREL/SR-580-24089 (Washington, DC: US Department of Agriculture and US Department of Energy, May 1998).

After producing biobased oil, antioxidants and other additives are added as enhancements. These additives are confidential so could not be reported, but their production data come from the SimaPro database. The energy requirement for producing transformer oil is listed in the Table below.²

Table 2: Biobased Transformer Oil Manufacturing Energy

<i>Requirement</i>	<i>Quantity (per kg oil)</i>
Production Energy	1.6 MJ (0.44 kWh)

Transportation

Trucking is the mode of transport used to represent shipment of the product from the transformer oil production plant to the transformer to be filled at the point of use. The transportation distance is modeled as a variable of the BEES system.

Use

For BEES, generic biobased transformer oil is used in a transformer with a capacity of 1.89 m³ (500 gal). Any type of transformer oil needs to be reconditioned or reclaimed over the life of the transformer: transformer aging, thermal problems, or electrical problems can generate dissolved gas, which results in deterioration or contamination of the fluid. Included in the BEES use phase modeling is the electricity required to recondition the oil when dissolved gas analysis tests indicate the need. Reconditioning is assumed to occur every five years.³ The transformer itself is assumed to have a lifetime of 30 years.

End of Life

At the end of the 30-year life of the transformer, generic biobased transformer oil is modeled the same as most other transformer oils in BEES: at year 30, the product is assumed to be further reconditioned and reused in another transformer, with reconditioning electricity included in the end-of-life modeling.

References

Life Cycle Data

National Renewable Energy Laboratory (NREL): *U.S. Life-Cycle Inventory Database*. 2005. Golden, CO.

Found at: <http://www.nrel.gov/lci/database>.

PRé Consultants: *SimaPro 6.0 LCA Software*. 2005. The Netherlands.

² This data is based on confidential energy requirement data gathered from a biobased transformer oil producer (summer 2005).

³ Information on dissolved gas analysis testing can be found in the U.S. Bureau of Reclamation (USBR) website's Facilities Instructions Standards and Techniques (FIST) document, <http://www.usbr.gov/power/data/fist/fist3-30>. Energy information on reconditioning was provided during telephone conversations with S.D. Myers, a transformer and transformer fluid contractor, November 2001.