Spartan Green Solutions Glass Cleaner

Product Selection and Description

Spartan Chemical Company, Inc. Green Solutions Glass Cleaner is formulated to penetrate, emulsify, and remove dirt with minimal effort. Green Solutions contains no fragrances, dyes, or VOC. It is Green Seal-certified and it meets Green Seal's environmental standard for industrial and institutional cleaners based on its reduced human and aquatic toxicity and reduced smog production potential.

For the BEES system, 3.785 m^3 (1 000 gal) of ready-to-use glass cleaner is studied.[1] Green Solutions is produced in concentrated form and diluted at the point of use. For 3.785 m^3 (1 000 gal) of ready-to-use Green Solutions, 56 kg (120 lb) of concentrate is used.

Flow Diagram

The flow diagram below shows the major elements of the production of this product, as it is currently modeled for BEES.

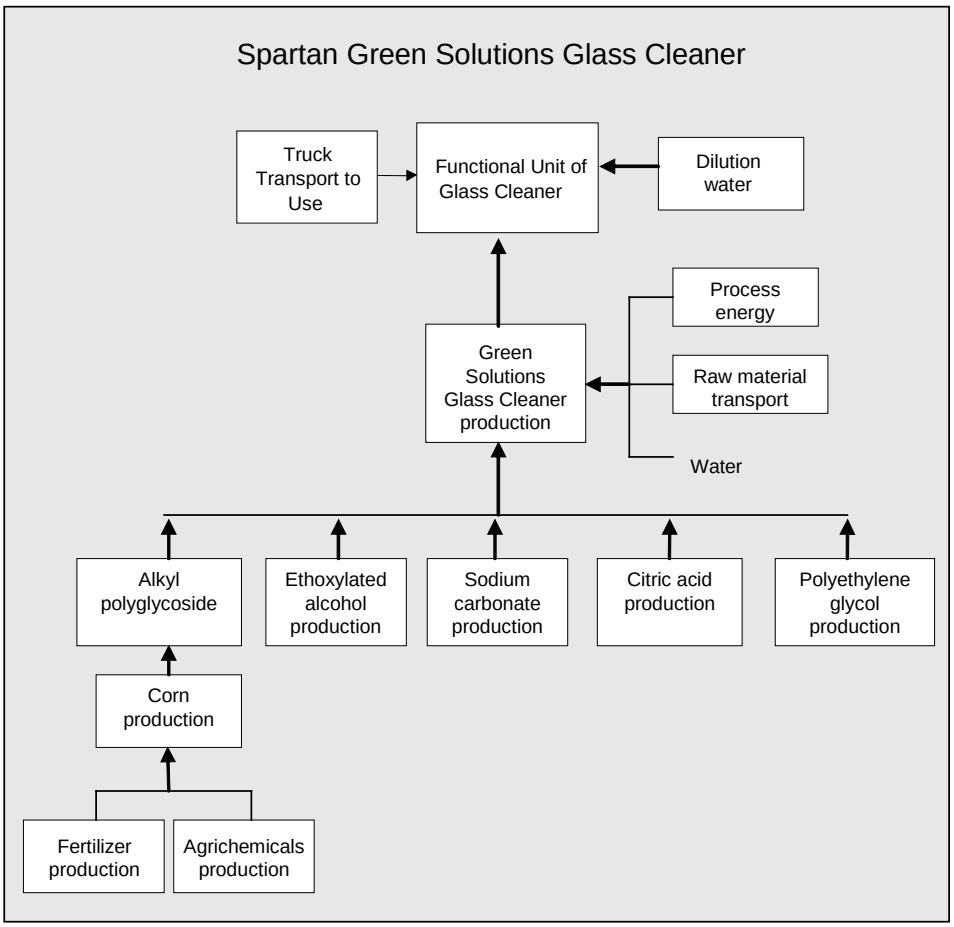

Figure 1: Green Solutions Glass Cleaner System Boundaries

Raw Materials

Green Solutions glass cleaner is comprised of the following materials.

[1] While it is unrealistic to assume a need for such a large quantity at a given time, this amount is used so that the environmental impacts for the product are large enough to be reported in the BEES results.

Table 1: Green Solutions Glass Cleaner Constituents

Constituent	*Mass Fraction (%)*[2]
Water	94
Polyethylene glycol	1-5
Alkyl polyglycoside surfactant	1-5
Ethoxylated alcohol	1-5
Sodium carbonate	1-5
Citric acid	1-5

A portion of the alkyl polyglycoside surfactant is corn-based and assumed to be corn ethanol, for which production data is based on an average of wet- and dry-milling processes. Data for production of corn comes from the U.S. LCI Database. Process inputs and outputs for ethanol from dry milling come from two ethanol studies.[3,4] Wet milling data comes from a corn wet milling study addressing energy efficiency.[5] The U.S. Environmental Protection Agency AP-42 emissions factors provide air emissions data on wet and dry milling.[6,7]

Polyethylene glycol is assumed to be a copolymer of ethylene oxide and propylene oxide. Data for these substances comes from a source with late 1990s European production data[8] and from elements of the SimaPro and U.S. LCI Databases. An LCA study on detergents[9] provides the data for alcohol ethoxylate, which is used to produce the ethoxylated alcohol in the product.

The production of sodium carbonate is based on the U.S. LCI Database module for soda ash. Citric acid is not included in the model in the absence of available data. Overall, however, the small quantity of citric acid use is judged to contribute little to the raw materials burdens for the product.

Manufacturing

Energy Requirements and Emissions. Product manufacturing consists of a simple chemical blending operation requiring virtually no heat or pressure. Items in the formulation are drum or bulk storage materials that are added to the open top mixing vessel via an air-operated drum lift or air actuated valve. The batching water is used at ambient temperature so no heating is required. The quantity of electricity required to blend one gal is 0.0025 MJ (0.0007 kWh). Electricity is modeled using the U.S. average electric grid from the U.S. LCI Database.

Transportation. Materials are transported varying distances ranging from 14 km (9 mi) to 885 km (550 mi) to the plant. Materials are transported by diesel truck, which is modeled based on the U.S. LCI Database.

Transportation

All final product shipping occurs via diesel semi-truck to approximately 450 points of distribution around the country, averaging a distance of 1 207 km (750 mi) to the customer. This default transportation distance may be adjusted by the BEES user. Diesel trucking is modeled based on the U.S. LCI Database.

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[2] Some mass fractions are presented as ranges to protect confidential information.

[3] Graboski, Michael S., (National Corn Growers Association, August 2002).

[4] Shapouri, H., "The 2001 Net Energy Balance of Corn-Ethanol" (U.S. Department of Agriculture, 2004).

[5] Galitsky, C., Worrell, E., and Ruth, M., LBNL-52307 (Ernest Orlando Lawrence Berkeley National Laboratory, July 2003).

[6] U.S. Environmental Protection Agency, "Grain Elevators and Processes," Volume I: Section 9.9.1 (Washington, DC: US Environmental Protection Agency, May 2003). Found at: http://www.epa.gov/ttn/chief/ap42/ch09/final/c9s0909-1.pdf.

[7] U.S. Environmental Protection Agency, "Corn Wet Milling," Volume I: Section 9.9.7 (Washington, DC: US Environmental Protection Agency, January 1995). Found at: http://www.epa.gov/ttn/chief/ap42/ch09/final/c9s09-7.pdf.

[8] European Commission, "Reference Document on Best Available Techniques in the Large Volume Organic Chemical Industry" , February 2002.

[9] Dall'Acqua, S., et al. , Report #244 (St. Gallen: EMPA, 1999).

Use

According to user directions, two ounces of concentrated cleaner are used per gal of water, a dilution ratio of 1:64. The density of Green Solutions glass cleaner is 3.8 kg (8.4 lb) per gal. As a result, 0.067 m^3 (17.6 gal) of water are used per kilogram of concentrate. For 3.785 m^3 (1 000 gallons) of ready to use glass cleaner, 56 kg (120 lb) of the concentrate are used. Other data on use, such as application rates and frequencies, are neither available nor uniform among users.

End of Life

No end-of-life modeling is required, since the product is fully consumed during use.

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.

Galitsky, C., Worrell, E., and Ruth, M., Energy efficiency improvement and cost saving opportunities for the corn wet milling industry, LBNL-52307 (Ernest Orlando Lawrence Berkeley National Laboratory, July 2003).

Graboski, Michael S., Fossil Energy Use in the Manufacture of Corn Ethanol (National Corn Growers Association, August 2002).

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European Commission, "Reference Document on Best Available Techniques in the Large Volume Organic Chemical Industry", Integrated Pollution Prevention and Control (IPPC), February 2002.

Dall'Acqua, S., et al., Life Cycle Inventories for the Production of Detergent Ingredients, Report #244 (St. Gallen: EMPA, 1999).

Industry Contacts

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