Racine Industries HOST Dry Carpet Cleaning System

Product Selection and Description

Racine Industries' HOST Dry Carpet Cleaning System uses a Green Seal-certified, biobased cleaning compound. The HOST cleaning compound is a mixture of moisture, cleaning agents, and recycled organic fibers that work as tiny sponges to absorb dirt from the carpet. The compound is worked through the carpet with a brushing machine when working on large areas, or with a hand brush or one's fingers when working on spots. The soiled compound is then vacuumed, leaving a clean, dry carpet. The used product, being dry, does not require wastewater treatment; it can be composted. HOST is used to clean commercial and residential carpets, including those comprised of wool and other natural carpet fibers (it is also used to clean grout). Use of this dry system reduces water use and avoids the energy and time associated with use of dehumidifiers or air conditioners to dry carpets cleaned with wet systems. According to the manufacturer, the HOST System also removes mold, dust mites, and allergens and is manufactured in an EPA-registered facility (074202-WI-001).

For the BEES system, the function defined for carpet cleaning is cleaning 92.9 m^2 (1 000 ft^2) of carpet, which amounts to use of 4.25 kg (9.37 lb) of HOST.

Flow Diagram

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

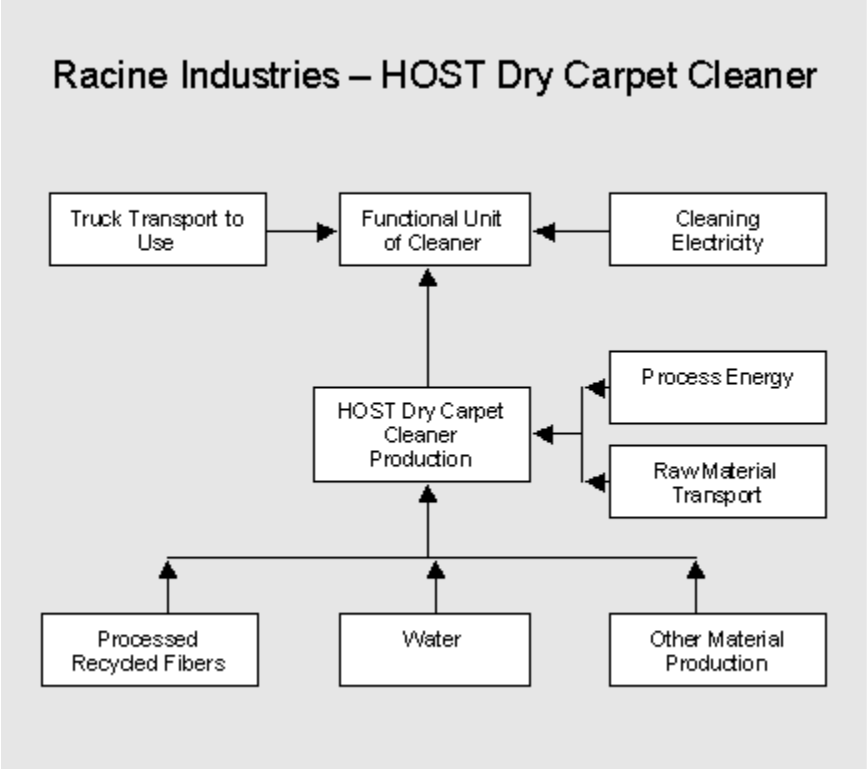

Figure 1: HOST Dry Carpet Cleaning System Boundaries

Raw Materials

HOST is made up of the materials shown in the Table below.

Table 1: HOST Dry Carpet Cleaning System Constituents

Constituent	*Mass Fraction (%)*
Water	63
Processed organic fiber	31
Other material inputs	6

Processed organic fiber. Processed organic fiber (POF) is comprised of 100 % pre-consumer waste from industrial processing. Because this fiber would otherwise be a waste material, no impacts from fiber production or fiber-based product production are accounted for. However, transportation of the fiber to the Racine plant, as well as energy requirements for manufacturing the fiber into usable material in HOST, are accounted for in BEES, as described below under Manufacturing.

Other material inputs

Emulsion Polymer. Production data for methyl methacrylate, used to represent the emulsion polymer, comes from publicly available European data.[1]

Citrus extract. For production purposes, this extract from citrus rind is considered a coproduct of orange production. It is assumed to comprise 0.5 % of the total mass of useful orange products, which include orange juice, cattle peel feed, and alcohol. Orange production data comes from a variety of sources.[2,3,4]

Other ingredients. Data for remaining ingredients comes from several sources, including a United Nations publication on fertilizer production,[5] elements of the U.S. LCI and SimaPro databases, engineering calculations, and a European life-cycle inventory containing late 1990s data on European detergent production.[6] A solvent is modeled as naphtha, whose production data comes from petroleum refining process data found in a National Renewable Energy Laboratory LCA study on biodiesel use in an urban bus,[7] in which petroleum-based diesel fuel is compared to biodiesel.

Manufacturing

Energy Requirements and Emissions. A total of 0.022 MJ (0.06 kWh) electricity is used in processing HOST, and covers the following processes:

- Blending the constituents
- Conveying and blending the liquid and POF
- Fill line packaging
- Lighting, controls, and ventilation associated with producing HOST

[1] Boustead, I., "Report 14: Polymethyl Methacrylate," (Association of Plastics Manufacturers of Europe, September 1997), pp. 27-29. Found at: http://www.apme.org.

[2] National Agricultural Statistics Service, 2005. Found at: http://www.nass.usda.gov:8080/QuickStats/index2.jsp.

[3] Reposa, J. Jr. and Pandit, A., "Inorganic Nitrogen, Phosphorus, and Sediment Losses from a Citrus Grove during Stormwater Runoff" (Melbourne, FL: Civil Engineering Program, Florida Institute of Technology). Found at: http://www.stormwaterauthority.org/assets/023PLreposacitrus.pdf.

[4] Extrapolation of data on agricultural production in the U.S. LCI Database.

[5] International Fertilizer Industry Association, "Part 1: the Fertilizer Industry's Manufacturing Processes and Environmental Issues," ISBN: 92-807-1640-9 (Paris: United Nations Environment Programme, 1998).

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

[7] Sheehan, J. et al., NREL/SR-580-24089 (Washington, DC: US Department of Agriculture and US Department of Energy, #244 (St. Gallen: EMPA, 1999).

Electricity is modeled using the U.S. average grid, and data for electricity are from the U.S. LCI Database. Natural gas is required to process the organic fiber and amounts to 1.2 MJ (0.33 kWh) per kilogram of HOST. Data are from the U.S. LCI Database.

Processing Materials. A sanitizer is used to sanitize process equipment. Water is used to rinse the blending tank and to clean and sanitize the POF processing and conveyance system and filling line. Quantities of these ancillary materials are reported in the Table below.

Table 2: HOST Processing Materials

Material	*Quantity per kg*
Sanitizer	0.015 g (0.0005 oz)
Water	0.0076 L (0.002 gal)

Solid Waste. Some waste is generated during processing, and includes quality assurance samples, filling line start-up waste, and plastic container waste, all of which amount to 0.003 kg (0.008 lb) per kg product. A portion of this waste is landfilled, while a portion is stored as samples.

Transportation. The transportation distance for all the, constituents besides organic fiber and sanitizer is approximately 80 km (50 mi). The fiber is transported about 563 km (350 mi) to the facility, and sanitizer is supplied locally (within 8 km, or 5 mi). All materials are transported by diesel truck, whose burdens are modeled based on data in the U.S. LCI Database.

Transportation
Product transport to the customer via diesel truck is a variable in BEES, and is modeled based on the U.S. LCI Database.

Use
A total of 4.25 kg (9.37 lb) of HOST are needed to clean 92.9 m^2 (1 000 ft^2) of carpet. HOST is distributed on the floor, brushed, and then vacuumed away. Electricity use associated with brushing the cleaner through the carpet and vacuuming is obtained by averaging the cleaning time based on use of the following three types of vacuum cleaners, for an overall average of 12.5 min per 92.9 m^2 (per 1 000 ft^2):[8]

- Upright Vacuum (from 30 cm to 61 cm in width, or from 12 in to 24 in)
- Large Area Push-Type Vacuum (66 cm to 91 cm, or 26 in to 36 in)
- Backpack Vacuum & Orifice Carpet Tool (30 cm to 61 cm, or 12 in to 24 in)

Assuming a 1 500 W (2.012 hp) motor and taking into account the first stage of brushing and the second stage of vacuuming, the electricity required to clean 92.9 m^2 (1 000 ft^2) is 135 MJ (37.6 kWh), or 32 MJ (8.8 kWh) per kilogram of HOST.[9] Electricity is modeled based on the U.S. average electric grid from the U.S. LCI Database.

End of Life
The contents of the vacuum filter bag or hopper are typically emptied into a waste bin for landfilling. The mass of the cleaner is accounted for in the landfill modeling for this product. While some residential and commercial consumers compost vacuum waste, this is not considered in the BEES product model.

[8] International Sanitary Supply Associations (ISSA), "Cleaning Applications and Tasks," The Official 358 Cleaning Times, 1999.
[9] This assumes the brushing stage uses the same quantity of energy as the vacuuming stage.

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.

Boustead, I., "Report 14: Polymethyl Methacrylate," Eco-profiles of the European Plastics Industry (Association of Plastics Manufacturers of Europe, September 1997), pp. 27-29. Found at: http://www.apme.org.

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

Sheehan, J. et al., Life Cycle Inventory of Biodiesel and Petroleum Diesel for Use in an Urban Bus, NREL/SR-580-24089 (Washington, DC: U.S. Department of Agriculture and U.S. Department of Energy, May 1998).

Industry Contacts

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