Integration of life cycle assessment software with tools for economic and sustainability analyses and process simulation for sustainable process design

The sustainable future of the world challenges engineers to develop chemical process designs that are not only technically and economically feasible but also environmental friendly. Life cycle assessment (LCA) is a tool for identifying and quantifying environmental impacts of the chemical product and/or the process that makes it. It can be used in conjunction with process simulation and economic analysis tools to evaluate the design of any existing and/or new chemical-biochemical process and to propose improvement options in order to arrive at the best design among various alternatives. Although there are several commercial LCA tools, there is still a need for a simple LCA software that can be integrated with process design tools. In this paper, a new LCA software, LCSoft, is developed for evaluation of chemical, petrochemical, and biochemical processes with options for integration with other process design tools such as sustainable design (SustainPro), economic analysis (ECON) and process simulation. The software framework contains four main tools: Tool-I is for life cycle inventory (LCI) knowledge management that enables easy maintenance and future expansion of the LCI database; Tool-2 is for estimation of environmental impact characterization factors using group contribution(+) method (GC)(+) in order to calculate environmental impacts for a wide range of chemicals; Tool-3 performs LCA calculations based on a library of models; and, Tool-4 provides interfaces for integration with other tools. To test the software, a bioethanol production process using cassava rhizome is employed as a case study. Results from LCSoft highlight the estimated environmental performance in terms of various aspects such as carbon footprint, resource and energy consumptions, and various environmental impacts. (C) 2014 Elsevier Ltd. All rights reserved.

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