RESOURCE OPTIMIZATION AND SUSTAINABLE MANUFACTURING IN THE DEVELOPMENT OF A SELF-CHILLING BEVERAGE CAN

Noemi Arena, Centre for Environmental Strategy, University of Surrey
n.arena@surrey.ac.uk
Jacquetta Lee, Centre for Environmental Strategy, University of Surrey
Roland Clift, Centre for Environmental Strategy, University of Surrey

Key Words: Sustainable manufacturing; Life Cycle Engineering; Beverage cans; Resource optimization; Waste minimization

Every year in Europe more than 30Mt of CO2e are emitted from retail refrigerators (Cowan et al., 2010). This is due to the leakages of HFC and HCFC that have adverse impacts on climate change not only because they are powerful greenhouse gases, but also because leaking systems are less energy efficient (Bovea et al., 2007; Cowan et al., 2010). Both the energy consumption worldwide and the high emissions of greenhouse gases have directed interest to alternative solutions to conventional refrigeration systems.

To this end, a new technology has been designed to supply cooled products on demand using the cooling effect provided by the endothermic desorption of carbon dioxide previously adsorbed onto a bed of activated carbon. The principles of life cycle engineering have been utilized to evaluate the overall environmental performance of one possible application of this technology: a self-chilling beverage container with a steel outer can to contain the beverage and an inner aluminium can to contain the adsorbent.

All the life cycle stages of this product have been considered to develop a delivery and use system manufacturing process with reduced life cycle impacts, including manufacturing of all parts of the beverage container (activated carbon, aluminium, steel), utilization of industrial waste gas (CO2), use, recovery of the used can, and management of the waste by reuse, recycling and landfilling.

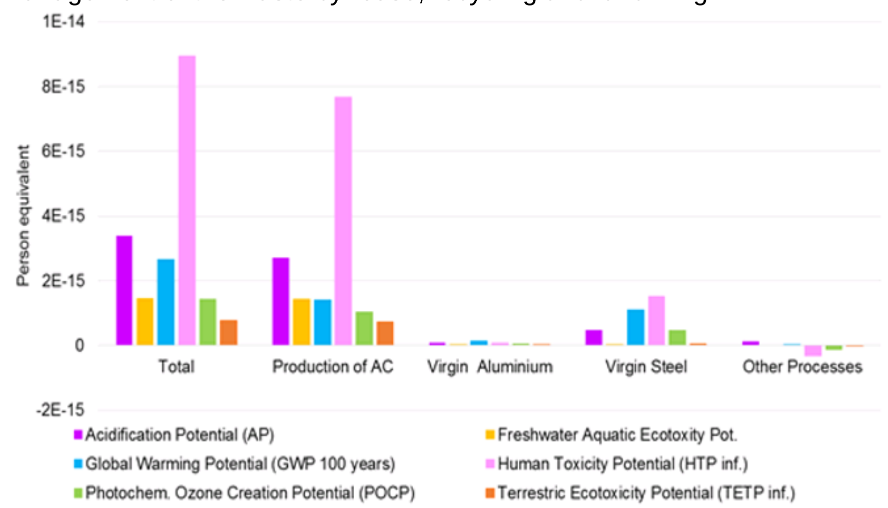

Figure 1 - Results of the LCIA of self-chilling beverage can system (normalization: world, year 2013 CML-2001 person equivalents).

First results, reported in Figure 1, showed that production of the adsorbent dominates the overall environmental impacts of the delivery system; therefore production of activated carbon was investigated in detail (Arena et al., 2016). The contributions of aluminium and steel were also investigated by analysing the environmental burdens related to virgin and recycled materials. A sensitivity analysis explored alternative scenarios for activated carbon production and for recovery of the can components post-use for reuse or recycling. The results, also compared with a conventional beverage can refrigerated in a single door refrigerator and a large open-front cooler, highlight two key aspects: the importance of using activated carbon derived from biomass, produced by a process with efficient use of low-carbon electric energy, energy recovery from waste streams and appropriate air pollution control; and the crucial roles of recovery, re-use and recycling of the cans after use.

References:

Arena, N., Lee, J. and Clift, R. (2016) Life Cycle Assessment of activated carbon production from coconut shells. Journal of Cleaner Production, In Press.

Bovea, M. D., Cabello, R. and Querol, D. (2007) Comparative Life Cycle Assessment of Commonly Used refrigerants in Commercial Refrigeration Systems. Int J LCA, 12(5), pp. 299-307.

Cowan, D., Gartshore, J., Chaer, I., Francis, C. and Maidment, G. (2010) REAL Zero-Reducing refrigerant emissions & leakage- feedback from the IOR Project. Proc. Inst. R., 7.