# Life Cycle Assessment of Multiple-Use Surgical Gowns with Disposable Gowns

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Products that can be reused are often viewed more favorably with respect to environmental impact than single-use disposable options. True environmental impact depends on system and boundary conditions established for a particular application and use profile. Life cycle assessment (LCA) has been developed as an analytical tool to evaluate a product's environmental performance. LCA is often used to quantitatively compare the environmental impact of products or processes including raw material extraction, production processes, use requirements, and end of life impacts of the system. (ISO 14040 and ISO 14044 (2006): Environmental management – Life cycle assessment – Principles and framework, International Organization for Standardization (ISO), Geneva.) This document briefly describes the results of an impact study comparing multiple-use polyethylene terephthalate (PET) surgical gowns with disposable polypropylene (PP) gowns used in a healthcare setting. Specifically, the analysis compares the solid waste generation at the point of disposal and the relative environmental impact factors for gowns required for 50 surgical procedures: one multi-use gown with 50 wash cycles compared with 50 disposable gowns.

## Solid Waste Generation at End of Life

Although the per unit weight of the multi-use gown is nearly three times that of the disposable gown, when comparing the products over the course of 50 use cycles, the multi-use gown results in considerably less overall solid waste generation at the point of disposal. Adjustment must be made to consider the comparative solid waste generation at the end of 50 use cycles. Under this scenario, the weight of multi-use gown waste is approximately 6% that of the disposable gown waste. This means for every 1,000 surgical gowns required, the weight of disposable gown solid waste generated would be 300 pounds, while the weight of multi-use gown solid waste generated would be 17.2 pounds.

## Life Cycle Assessment

The framework for the LCA is defined according to the ISO 14040 and ISO 14044 guidelines. Chain Management by Life Cycle Assessment software has been used to conduct the LCA analysis (CMLCA – Leiden University, The Netherlands). Ecoinvent 2.01 (Swiss Centre for Life Cycle Inventories, Dübendorf, 2007) is the database used for life cycle inventory data on materials and process impacts. Additionally, the Tools for the Reduction and Assessment of Chemical and other Environmental Impacts (TRACI – US EPA) methodology has been used for environmental impacts and normalization of the results. General system boundaries for the two surgical gown options are shown in Table 1. Differences in transportation requirements and laundering exist between the two systems.

Figure 1 compares the normalized environmental impacts of the two cases, 50 single-use disposable PP gowns and one multi-use PET gown laundered 50 times. Reusable gowns have an improved environmental profile compared with the single use gowns in all human health[*] and most environmental[**] impact categories. The improved environmental profile coupled with the significant decrease in solid waste generation described above suggest that, in this case, the multi-use surgical gown option is the more environmentally preferred option.

Table 1 – System Considerations

| | Multi-Use Gown | Disposable Gown |
|---|---|---|
| Raw Material | Petroleum Based | Petroleum Based |
| Process Impacts | PET Production<br>PET Fiber/Fabric Production<br>Gown Production | PP Production<br>PP Extruded Film Production<br>Gown Production |
| Transportation | US Producer to Hospital<br>Hospital/Laundry round trip (50)<br>Hospital to Disposal | China to Hospital<br>Hospital to Disposal |
| Times Through Process | 1 | 50 |

Figure 1 – Normalized Environmental Impacts

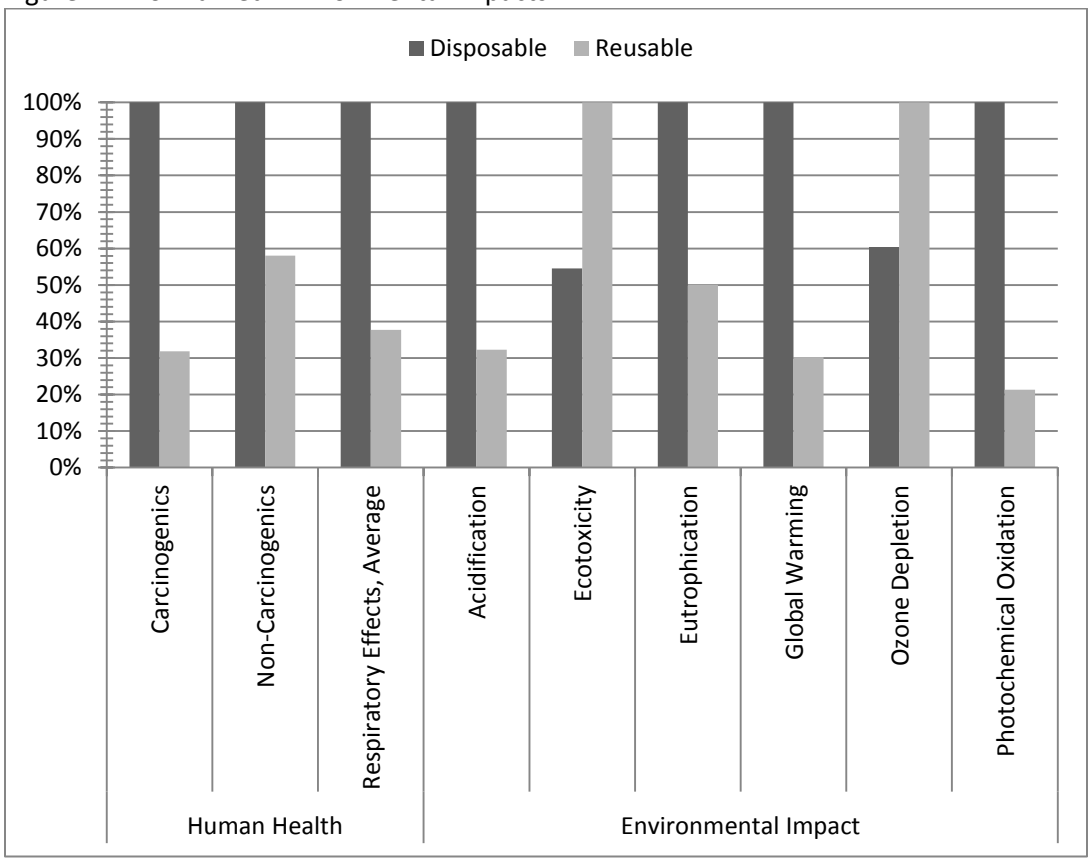


**Figure 1**

*Impact Categories - Human Health
Carcinogens (kg benzene Eq.) – potential of a chemical to cause human cancer
Non-carcinogens (kg toluene Eq.) – potential of a chemical to cause human non-cancer effects
Respiratory Effects (kg PM2.5 Eq.) – exposure to elevated particulate matter <2.5 micrometers
**Impact Categories – Environmental
Acidification (H+ Eq.) – potential to cause wet or dry acid deposition
Ecotoxicity (kg 2,4D Eq.) – potential of a chemical to cause ecological harm
Eutrophication (kg N) – potential to cause eutrophication of waterways
Global Warming (kg $CO_2$ Eq.) – potential for global warming based on radiative force and lifetime
Ozone Depletion (kg CFC-11 Eq.) – potential to destroy ozone based on reactivity and lifetime
Photochemical Oxidation (kg $NO_X$ Eq.) – potential to cause photochemical smog