Life Cycle Assessment of Reuse System for Surgical Gowns

Naoki Yoshikawa,*[1] Nobumitsu Kitanishi,[1,2] Koji Amano,[1] and Koji Shimada[1]

[1]*Ritsumeikan University, Japan;* [2]*Takasago Thermal Engineering Co., Ltd., Japan*
*Corresponding author: n-yoshik@fc.ritsumei.ac.jp

1. Introduction

An important role of surgical gowns is preventing the medical staffs and patients from infection. Suppliers must ensure that standards of sterilization and liquid barrier performance meet this function. Disposable products have a large share of the surgical gown market in Japan. However, reusable products and systems recently developed by some companies, which have same level of the function, seem to be able to reduce medical waste and the consumption of fossil resources because both products are made from chemical fibers. However, no existing study evaluates the life cycle environmental load of surgical linen reuse systems, including commercial laundries. This study evaluates the life cycle environmental load of reusable surgical gowns as compared to disposable gowns. We also surveyed the interest of medical institutions in introducing reuse systems and estimated the potential reduction of greenhouse gases (GHG) emissions.

2. Methodology

This study evaluated two types of surgical gown, disposable and reusable. Details of the gowns are shown in Table 1. Both gowns have roughly the same level of liquid barrier performance. Figure 1 illustrates the system boundaries of the two products. The life cycle stages of the reusable products consist of raw material procurement, manufacturing, delivery, maintenance, and waste management (disposal). The disposable product stages are raw material procurement, manufacturing, delivery and waste management (disposal). The average number of uses of reusable products in a life cycle is assumed to be 50 times. After using the reusable gowns 50 tim es and the disposable gowns once, both types of gowns are incinerated. Foreground data of reusable products was obtained from a questionnaire presented to manufacturers of gowns and service providers and deliverers of laundry. Data related to disposable products in raw material procurement and manufacturing processes is based on Ponder [1] and METI [2].

Table 1. Detail of products compared

	Reusable	Disposable
Material	Polyester (100%)	Polypropylene (100%)
Liquid barrier performance	Level 3 or 2 (AAMI Standard)	Level 3 (AAMI Standard)
Usage (time)	50	1
Weight	0.460kg	0.115kg
Sterilization	Autoclaving	EOG

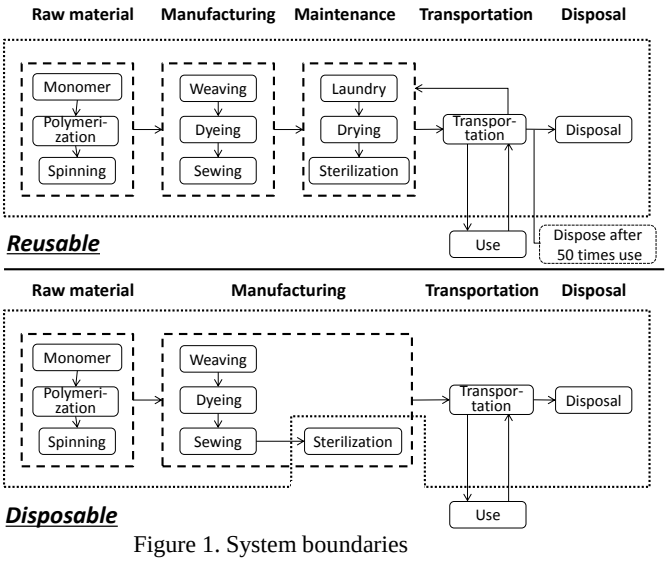

Figure 1. System boundaries

The potential of GHG emission reduction was based on a questionnaire to medical institutions. Questionnaires were sent to 994 facilities, of which 9.2% responded. The survey asked about their awareness of reuse systems and the conditions they would need to have met to change to such systems.

3. Results

Figure 2 shows the life cycle GHG emissions of the reusable and disposable products per use. Most GHG emissions come from the washing, drying, and sterilizing processes for the reusable products. Manufacturing and waste management (incineration) processes are the main factors in GHG emissions for the disposable products. Results showed that the reuse systems can reduce life cycle GHG emissions (0.38kg-CO_2eq/use) by 35% in case of 50-times use. GHG emissions start to diminish after 14-times use, which is lower than expected.

The results of the questionnaire to medical institutions showed that about 11% of gowns used are supplied by a reuse system. Additionally, 11% of medical institutions are considering introducing reuse systems, if the liquid barrier performance and cost of the system meet their demands. This way, about 500t-CO_2eq of GHG can be reduced per year.

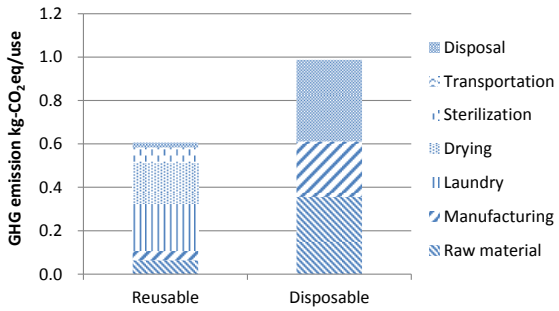

Figure 2. Comparison of GHG emissions from reusable and disposable products

6. Conclusion

This study compared life cycle environmental loads of reusable and disposable surgical gowns. Results showed that after 50-times use, reusable products reduce GHG emission from disposable products by 35%. Comprehensive assessment covering other medical supplies is needed to support decision making for sustainable procurement by medical institutions.

References

[1] Ponder, C.S. PhD thesis, North Carolina State University, 2009, 87–106.

[2] METI, *Research report on LCA of fabric products (clothes)* (in Japanese), http://www.meti.go.jp/policy/fiber/downloadfiles/LCA-hontai.pdf (Accessed 05.09.2014).