

An Investigation into Sustainable Cutlery Solutions at UBC

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APSC 262

April 09, 2015

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Tutorial Section A
Date Submitted: April 9, 2015

Abstract

Plastic cutlery is widely used in many places from food establishments to potluck parties because it is cheap and convenient. However, everyday use of plastic cutlery poses environmental, social and health impacts.

The University of British Columbia has been putting significant effort to be a zero-waste campus. There are still a number of restaurants in UBC campus that provide plastic cutlery and UBC is actively seeking an alternative to phase out this unsustainable and potentially harmful cutlery option.

This paper proposes three alternative cutlery options that the food establishments in UBC may want to consider as options, and assess the three options based on the triple bottom line assessment from the economic, environmental and social aspects. The three options include polypropylene plastic, stainless steel and biodegradable wooden cutlery.

Primary and secondary sources are consulted to collect useful information. Primary sources include email contact to the local biodegradable cutlery suppliers. Secondary sources include peer-reviewed journals and articles from the internet and UBC library. Each option reveals unique benefits and drawbacks. Through the assessment it was concluded that a combination of biodegradable wooden cutlery and stainless steel cutlery presents the best alternative to plastic cutlery. Although biodegradable cutlery has the higher cost, the environmental and social benefits outweigh the economic factor. Because wooden cutlery is disposable, it provides customers with an option to take out the food. The fact that stainless steel cutlery is indefinitely reusable mitigates the drawbacks linked to the production process such as high initial cost and poor environmental performance. However, stainless steel cutlery must be washed after each use; this imposes the limitation that it can only be used at certain places where washing facility is available.

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Glossary

Polypropylene: Material used to make plastic cutlery.

List of Abbreviations

UBC: The University of British Columbia

GJ: Gigajoules

mt: metric tons

CO₂: Carbon Dioxide

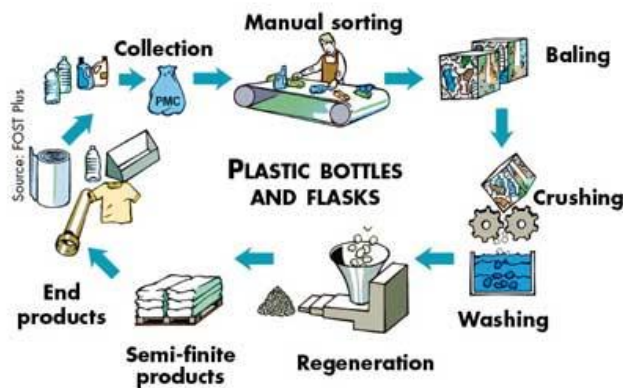
GHG: greenhouse gas

1.0. Introduction

The convenience of plastic cutlery is hard to beat. Plastic cutlery is used everywhere from fast food restaurants to home parties for the convenience of disposal after each use without worrying about who will have to wash them. However, the majority of plastic cutlery is typically thrown into a garbage bin after a single use, ending up in landfills and causing numerous environmental side-effects such as ever-growing landfill areas and potential groundwater and soil contamination.

Recycling plastic cutlery is possible with the current technology, but recycling plastic is a labour and energy intensive process as outlined in the figure below. Recyclable plastic cutlery was not considered as a viable option because it was determined that the process of recycling plastic cutlery cannot justify the overwhelming economic and social expense for such a small volume, especially when purchasing readily available new sets is a reasonably cheap alternative.

Figure 1.1: Plastic Recycling Process.



Retrieved from <http://valorlux.lu/en/plastics>

UBC has been moving towards becoming a zero waste campus by encouraging transformation toward using recyclable and compostable materials rather than those that end up in a landfill. There are still many restaurants at UBC that provide plastic disposable cutlery, however there are a few places on campus such as Reboot Cafe that are starting to offer biodegradable cutlery. This project hopes to continue this transformation by identifying three different types of possible cutlery solutions and using a triple bottom line assessment to determine a recommendation for food vendors on UBC.

Through the assessment of the problem, we have come up with three different types of cutlery: polypropylene plastic, stainless steel and biodegradable cutlery. For biodegradable cutlery, we are focusing on wooden cutlery from local suppliers. Walking through the life cycle analysis, the benefits and drawbacks of each material will be discussed from the perspectives of economic, environmental and social aspects.

2.0. Economic Indicators

2.1 Introduction

The main focus in this category is to determine the costs associated with each of the selected types of cutlery. This includes initial costs, up keeping costs (such as cleaning) as well as recurrent costs. Since it was not possible to acquire bulk discount prices for all of the different types of cutlery each of the prices listed below are at consumer value.

2.2 Polypropylene Cutlery

Polypropylene or plastic cutlery is the least expensive option as far as the initial cost is concerned, which is the main reason why it is the most commonly used type of cutlery on campus. The initial cost for an average vendor at UBC would be around \$25 to purchase 1000 forks, knives and spoons (Costco Business Delivery). However, this may not be the best economic option depending of the consumption rate in the long run. Since all of the plastic cutlery is disposed of after each use, the stock would have to be refilled at regular basis, which will eventually add up to a significant amount over time. After use, the cutlery must be disposed of; however the cutlery only contributes to a small portion of the total waste generated by most facilities. Therefore the facilities disposal costs will not be significantly affected. After looking at these different costs it was estimated that plastic cutlery will have an approximate monthly cost of \$100.

2.3 Stainless Steel Cutlery

While stainless steel cutlery will have the largest initial cost it will also have the lowest recurrent cost since the cutlery is reusable. The initial cost for an average food vendor would be \$250 for 500 sets of forks, knives and spoons (Food Service Warehouse). While these should not need to be replaced very often there will still be some recurrent costs associated with cleaning the cutlery. These costs will make the approximate monthly recurring costs to be \$30 for the 500 sets.

There is some risk that stainless steel cutlery may be stolen from establishments. While it is assumed this will not be a large issue, it is still something that needs to be considered as it will increase the up keeping costs. Additionally, people may occasionally throw out the cutlery along with the rest of their waste by accident. These factors would increase the rate at which the cutlery would need to be replaced, though signage reminding patrons to not dispose of or take cutlery could reduce this.

2.4 Biodegradable Cutlery

Due to the higher cost materials and the fact that the biodegradable cutlery is single use only they will be the most expensive option. Similarly to the plastic cutlery approximately 1000 forks, knives and spoons will be required to be purchased every week and at a cost of \$120/set of 1000 this creates a monthly cost of \$480 (Ecoware Biodegradables). While this cost is substantially larger than the cost of the plastic cutlery, it may become lower if UBC was able to partner with one of the local companies that are producing the cutlery such as Aspenware or BSI Biodegradable Solutions.

2.5 Conclusion

After looking at all three options and their appropriate costs, it was determined that the best economic option to be the stainless steel cutlery. While the initial cost of the stainless steel cutlery is much more than the plastic and even the biodegradable due to the low upkeep costs after only four months the initial investment would have paid for itself. Therefore since this project is looking for a long-term solution the stainless steel is determined to be the best economic option.

3.0. Environmental Indicators

3.1 Introduction

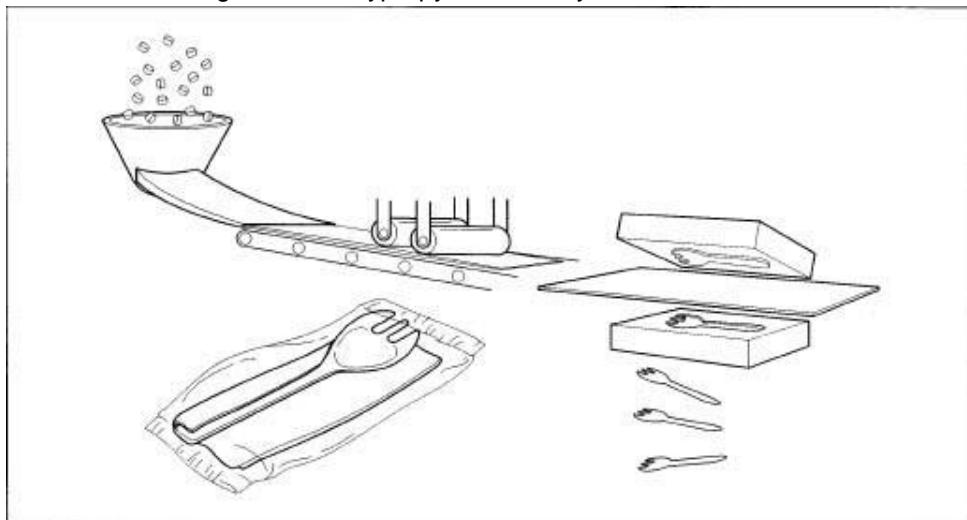
This analysis will focus primarily on three environmental indicators involved through the life cycle of the three different cutlery productions. These indicators are CO₂ emissions, energy use, and source materials.

3.2 Polypropylene Cutlery

Polypropylene plastic cutlery is conventional and perhaps the most popular option widely adopted across many fast food restaurants and at UBC Campus as well. However, this form of cutlery has negative environmental impacts throughout its lifecycle.

The number one ingredient of polypropylene plastic is the hydrocarbon, which comes from fossil fuel. The dependency on fossil fuel imposes numerous environmental concerns related to the extraction and transportation processes. Once the fossil fuel is extracted, it is then shipped to manufacturing plants to produce plastic cutlery. In the plant, fossil fuel is turned into small pellets. The pellets are melted into a sheet of plastic, from which utensils are stamped out (See Figure 3.1). The utensils are then packaged and shipped to retailers (Romanowski, 2012). The production of 1000 kg of polypropylene requires the use of 4.0 GJ of energy and produces approximately 76 kg of CO₂.

Figure 3.1: Polypropylene Cutlery Production Line.



Retrieved from <http://www.madehow.com/Volume-7/Spork.html>

After all the extensive production process, polypropylene cutlery is typically only used once, especially at large institutions like UBC. While it may be practical and worthwhile for a household to reuse their plastic cutlery, it is much easier and perhaps even cheaper for UBC to dispose of plastic cutlery after each use. Only expensive, high quality polypropylene cutlery can

survive multiple uses and washes. Polypropylene can be recycled into new materials and products, however only 1% of polypropylene is recycled in the United States (LeBlanc). Instead, the vast majority of polypropylene ends up in a landfill, or being incinerated to produce toxic fumes. Landfills are structured such that oxygen is sealed when buried. In the environment where oxygen is depleted and UV layer is out of reach from the sun, anaerobic bacteria is pretty much the only catalyst that enables the decomposition of the plastic. At this point, plastic and other materials around it will slowly turn into sludge-like substance, finding its way down to the bottom of the landfill through cracks due to gravity and in contact with the soil underneath. This results in serious environmental issues such as soil and groundwater contamination and harms communities around it that depend on these resources (Parajuli, 2011).

Another environmental concern is the greenhouse gas emission due to packaging and shipping of the products overseas. A set of cutlery is packaged using electricity using petroleum wrapping, contributing more energy usage and GHG emissions for packaging. In addition, because most of the cheap plastic cutlery is made in developing countries, primarily in mainland China, there is an enormous amount of carbon footprint related to shipping.

3.3 Stainless Steel Cutlery

The production of stainless steel requires a significant amount of energy. Producing 1 metric ton of virgin stainless steel suitable for cutlery requires an average of 76 GJ of energy. This figure can be reduced to 56 GJ if a standard mixture of virgin and recycled steel is used. Furthermore, if 100 percent recycled material is used, only 26 GJ is required (Johnson et al., 2008). Approximately 90% of end-of-life stainless steel is recycled, providing about 60% of the material used in the manufacturing of new steel products (Bureau of International Recycling). Stainless steel production also produces a significant amount of greenhouse gas emissions. The production of 1 metric ton of virgin steel, the standard mixture of virgin and recycled steel, and pure recycled steel produce respectively 5.3 mt, 3.6 mt, and 1.6 mt of CO₂ (Johnson et al., 2008). Additional energy is required and CO₂ is emitted to manufacture the cutlery from the steel.

The raw materials for stainless steel, mainly iron, chromium, and nickel are all non-renewable and must be sourced either from recycled products or mining which can result in significant environmental damage including the contamination of groundwater, erosion, and deforestation among other impacts.

Despite the high environmental cost of producing stainless steel cutlery, it can be reused to a great extent, possibly thousands of times before it needs to be replaced. This greatly reduces the per use environmental impact.

3.4 Biodegradable Cutlery

Aspenware biodegradable cutlery is made from aspen, paper birch, and poplar trees, all three of which are a fast growing and highly renewable resource, and are normally discarded by the lumber industry as a waste product. The environmental impact of producing biodegradable wooden cutlery is very low, only using materials that would otherwise go to waste. Aspenware strives to reduce the environmental impact of all its operations, stating on its website

“Everything we do is firmly rooted in sustainability. Our facility runs on clean, renewable hydroelectric energy. The majority of which is used to convert a single log into about 20,000 individual, 100% compostable, utensils.”

(Aspenware)

Aspenware’s production facility is entirely run on hydroelectric energy, producing no emissions. After use, aspenware cutlery is entirely biodegradable and compostable, taking an average of 49 days to break down completely, as confirmed by numerous third party tests, and produces useful compost (Aspenware).

Using biodegradable cutlery instead of disposable plastic cutlery has numerous environmental benefits including reducing energy consumption, greenhouse gas emissions, and waste production. The production of plastic biodegradable cutlery, similar to the products produced by BSI Biodegradable Solutions, consumes only two-thirds of the energy consumed by the production of traditional plastic cutlery and after composting, produces next to no solid waste material (Razza et al., 2009).

Figure 3.2: The Aspenware Lifecycle.



Retrieved from <http://aspenware.ca/about/>

3.5. Conclusion

Both biodegradable and steel cutlery have significantly better environmental assessments than disposable polypropylene cutlery. Stainless steel has by far the largest environmental impact in all categories during production however it is the only option that is highly reusable, lasting for years or possibly decades without being replaced, bringing its environmental cost per use down greatly. The biggest single advantage of stainless steel and biodegradable cutlery over polypropylene cutlery is that neither produces any significant solid waste that must be stored in a landfill or incinerated. Biodegradable cutlery degrades naturally over a short period of time, and the vast majority of stainless steel is recycled.

4.0. Social Indicators

4.1. Introduction

The purpose of this analysis is to study any health risks, user perception and contribution to the local communities through using each type of cutlery. Some of the specific items that were compared were the taste perception, perceived quality as well as where each of the products were produced.

4.2. Polypropylene Cutlery

Like most disposable plastic products, polypropylene tends to be viewed as a non-environmentally friendly and cheap product. Poor quality polypropylene cutlery can be difficult to eat with, especially when trying to cut through something with a dull and flexible plastic knife. This can cause frustration, impacting the overall experience of eating. People may be less likely to frequent establishments that offer only plastic cutlery. This, of course, bars the fact that polypropylene has become socially repulsive to the point where even media coverage often condemns such products as a wasteful and underwhelming approach to cutlery needs (The Think Beyond Plastic Initiative, 2014).

As a result, recycling and reuse of polypropylene cutlery is often encouraged or, in many cases, its use is avoided entirely for more favorable alternatives. The later can be applied onto early learning levels where schools take the initiative to use alternatives (often stainless steel) to promote environmental consciousness.

Polypropylene cutlery does have the advantage of being very convenient. Due to its low value, weight, and non-reusability, people can take plastic cutlery with them if they wish to take their food away from the establishment before eating.

4.3. Stainless Steel Cutlery

Stainless steel is traditionally used in household cutlery due to its strength, reusability, and ease of use, especially in regards to sterilization. Over time, as reuse becomes less viable of an option, worn stainless steel cutlery can be 100% recycled without any loss of its original physical properties. As a result, demand for stainless steel cutlery has doubled in the last ten years (Bureau of International Recycling). Research has also implied that stainless steel affects taste perception. When test participants were given identical food, but different types of cutlery, their ratings and impressions of the food were significantly increased when using metal cutlery as compared to disposable plastic cutlery (Harrar et al., 2013). This effect appears to be entirely physiological, as cutlery tends not to be in contact with the food nearly long enough to impart any actual flavour changes. Food establishments wishing to improve their customer's

perceptions and overall experience may then wish to use higher quality metal cutlery over disposable plastic alternatives.

With its higher value, and reusability, the possibility of theft also becomes a factor. Some students may take advantage of establishments offering steel cutlery and may take it home with them, either on purpose or even accidentally.

Due to its costly nature, stainless steel cutlery is generally ignored in applications that require mass distribution and disposal like the various fast food establishments in UBC with exceptions in some restaurants equipped to properly sterilize utensils after use. Such sites more often see consumers opting for convenience provided by polypropylene cutlery or utensils brought from home which may include other cutlery options.

4.4. Biodegradable Cutlery

Biodegradable cutlery is the newest form of cutlery and was introduced as an environmentally friendly replacement to standard plastic cutlery. Along with its social appeal due to the fact that it is biodegradable, it also has a number of other positive social factors. One of these is that it is manufactured locally by a number of different companies such as Aspenware (Vernon, BC), BSI Biodegradable Solutions (Vancouver, BC), and Enterprise Paper (Coquitlam, BC). There are numerous social benefits from choosing a local supplier over a supplier from far away. The decision will improve the well-being of the community by increasing the local job opportunities, encouraging local entrepreneurship and keeping dollars within the local community. Another factor associated with biodegradable cutlery is that it often has a much higher quality than standard plastic cutlery and you don't need to worry about washing it as you would with stainless steel cutlery, instead you can just throw it in the food waste bin.

In an increasingly environmentally conscious world, there can be considerable social impact of choosing 'green' and sustainable products. The word biodegradable has positive environmental connotations, prompting people to view any product labelled as such as more environmentally friendly, regardless of its actual environmental impact. Many people wish to present themselves as environmentally conscious and thus be more likely to choose a biodegradable option when given a choice.

4.5 Conclusion

With both steel and biodegradable cutlery offering significant social incentives, the choice comes down to historical practicality versus environmental innovation. Stainless steel offers high reusability fit for areas of long term use such as within common households. On the other hand, biodegradable cutlery acts as better replacement for polypropylene cutlery and presents a more environmentally friendly visage than stainless steel. Overall, both biodegradable and stainless steel cutlery act as socially superior alternatives to polypropylene and the two together cover practically any cutlery user requirement.

5.0. Final Conclusions

Through analyzing each type of cutlery using the triple bottom line, it was determined that both the stainless steel and biodegradable cutlery options are viable depending on the situation. When looking at environmental indicators both of these options showed many positive qualities and their few negative qualities were often covered by the other option. However the largest difference found between the two types of cutlery was in their financial costs. While the stainless steel cutlery requires a slightly higher initial investment, in the long term it becomes much cheaper than the biodegradable and even defeats the polypropylene option. If only the environmental and financial indicators had been looked into, it would seem to be a clear choice to recommend the stainless steel cutlery; however there are a few key social issues which prevent such a clear conclusion. The largest of these issues is that most food vendors at UBC do not have a proper method of cleaning and sterilizing the steel cutlery so it can be reused. Also there are many vendors such as fast food that specialize in take out which makes the use of steel cutlery very difficult to maintain. Along with both of these issues theft is another issue that may present itself when stainless steel cutlery is used.

Due to these social issues it was decided that biodegradable cutlery be used by vendors that are unable to easily clean and sterilize their cutlery or vendors that specialize in take-out. While biodegradable cutlery is substantially more expensive than standard polypropylene cutlery, it is much higher quality and is better for the environment. For all other vendors at UBC that are not impeded by these issues, stainless steel cutlery will be recommended as it has the highest quality of all three is nearly indefinitely reusable and also the cheapest option in the long run.

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Aspenware. (24 March 2015). Email Message

BSI Biodegradable Solutions. (30 March 2015). Email Message

Through this project two local companies were contacted, unfortunately neither of them responded however their respective contact information is:

Aspenware

Email: info@aspenware.ca

Website: <http://aspenware.ca>

BSI Biodegradable Solutions:

Email: office@bsibio.com

Website: biodegradablesolutions.com