

UBC Social Ecological Economic Development Studies (SEEDS)
Student Report

Eco-Friendly Office Supplies: Post-it Notes

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APSC 261 Final Report
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ABSTRACT

The purpose of the Eco-Friendly Post-it Note Project is to help determine which Post-it note product is the most sustainable and should be purchased by UBC for use by the staff. Recently, UBC purchased 50 units of the eco-friendly Post-it notes and 331 units of the standard Post-it notes. To determine the sustainability of each of these Post-it products, this report analyzes the paper and adhesives used in the Post-its with regards to its environmental, social and economic impacts. Based on this analysis, this report proposes that UBC switch from buying the eco-friendly product to the standard product. The eco-friendly Post-it notes that are being considered are made with 100% post-consumer paper. The eco-friendly product is option environmentally by saving energy in manufacturing and reducing pollutants. The eco-friendly post-it is the most. On the other hand, there is a significant cost increase to switch all of the standard Post-it notes to the eco-friendly product. For the social indicators we conducted a survey and the results show that there is no preference for which Post-it notes are used. In the end we determined that the significant cost increase outweighed the environmental benefits of switching to the eco-friendly Post-it notes. We recommend that all purchases of Post-it notes be switched to the standard which will cause a significant cost saving that can be used for other more impactful sustainable products.

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GLOSSARY

| | |
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| Acrylic | A polymer generally found in the composition of plastics. |
| Catalyst | A substance that increases the rate of a chemical reaction. |
| Chipping | The process of turning de-barked logs into small pieces. |
| Cross-Linking | A process in which polymers are connected together to create polymer chains. |
| De-barking | The removal of bark from wooden logs prior to chipping in the paper manufacturing process. |
| De-inking | The industrial process to remove ink from paper fibres for use in recycled paper products. |
| Polymer | A large molecule made of repeated structures. |
| Polyurethane | A polymer composed of a chain of organic units joined by urethane links. |
| Post-consumer waste | A type of waste that is produced by an end consumer. |
| Pulping | The process of separating wood fibres from the wood chips for paper manufacturing. |
| Screening | The process of removing undersized and oversized wood chips along with other materials that are not wanted in paper manufacturing. |
| Solvent | A substance that dissolves a chemically different substance. |

LIST OF ABBREVIATIONS

BIR - Bureau of International Recycling

CDC - Centers for Disease Control

EIA - Energy Information Administration

EPA - Environmental Protection Agency

SFI - Sustainable Forestry Initiative

TBL - Triple Bottom Line

UBC - University of British Columbia

USA/US - United States of America

VOC - Volatile Organic Compound

1.0 INTRODUCTION

The University of British Columbia (UBC) is on the forefront of sustainable initiatives and strives to be one of the most environmentally friendly places globally. One of the factors that UBC looks into is sustainable stationery. The purpose of this report is to expand on the justification of UBC's actions in using "green" products versus standard traditional products, specifically on Post-it note consumption. The Triple Bottom Line (TBL) assessment will be used to examine the environmental, economical, and social aspects of Post-it notes. We will determine whether the eco-friendly product that UBC uses is actually sustainable in all three aspects or if they are just labels for aesthetics and false implications. The evaluation of the results will be compared with the "non-green" products to determine their feasibility, make recommendations to help UBC meet its waste targets, and provide information to aid in the decrease of campus impacts on the environment.

2.0 METHODOLOGY

The Post-it note adhesive was researched using various online sources and specification sheets. Based on what is disclosed in store specification sheets, many Post-it alternatives utilize a water-based adhesive. Manufacturers such as Redi-Tag (TTI Business Products Inc, 2014) and Bic(Bic World, 2014) use water-based adhesive on their Post-it notes. Although Post-it data sheets do not disclose the exact chemical compound, it is almost certain that Post-it is also using water-based adhesives. There is clear evidence of 3M's (the company responsible for Post-it) research and development into improved water-based adhesive solutions (3M, 2014). Jean Sweeney, the former Vice President of Environmental, Health and Safety Operations in 3M™ reveals that in the past, Post-it was using a solvent- based adhesive(Sweeney, 2008). Due to sustainability, financial and work safety incentives, research and development was put into developing a cleaner and stronger alternative. The research supposedly resulted in a water-based adhesive solution that outperformed the former solvent-based solution in strength and was environmentally friendly. After the finalization of the technology and manufacturing process, the Post-it water-based adhesives were introduced in 2003. As water-based adhesive is a key feature of Post-it Notes, it is important to confirm the validity of the claims regarding its sustainability and benefits. The two products that are being compared are 100% post-consumer paper product and a Post-it note that has no recycled content. Peer reviewed journal articles as well as online sources were used to research the advantages of using post-consumer paper products. For the economic assessment we compared the increase in cost of switching to the 100% post-consumer paper Post-it notes and the decrease in cost of switching to the standard Post-it notes. In addition, a social survey will be used to gage the social impact of both post-it products.

3.0 ANALYSIS AND RESULTS

The analysis and results contains the environmental, economic, and social impacts of Post-it notes and the results of the research.

3.1 Environmental Impact

This section outlines the environmental impacts of paper and adhesives.

3.1.1 Paper

The products that we will be comparing are Post-it notes using 100% post-consumer paper and non-recycled Post-it notes. In terms of the triple bottom line assessment the largest environmental impact imposed by Post-it notes is paper. Therefore, it is important to measure the environmental impact of the Post-it notes we are comparing the environmental impacts of recycled post-consumer paper products and non-recycled paper products. In this investigation we looked at the environmental impact of the paper manufacturing process for both types of paper. These include the energy savings, air pollution reductions, and other pollution reduction such as reduced water pollution. We will also be looking at the current de-inking process for paper recovery and potential environmental damage from using post-consumer products. Finally, we will be investigating the Sustainable Forestry Initiative (SFI) certifications on these products to see if they actually do promote strong sustainability standards across North America.

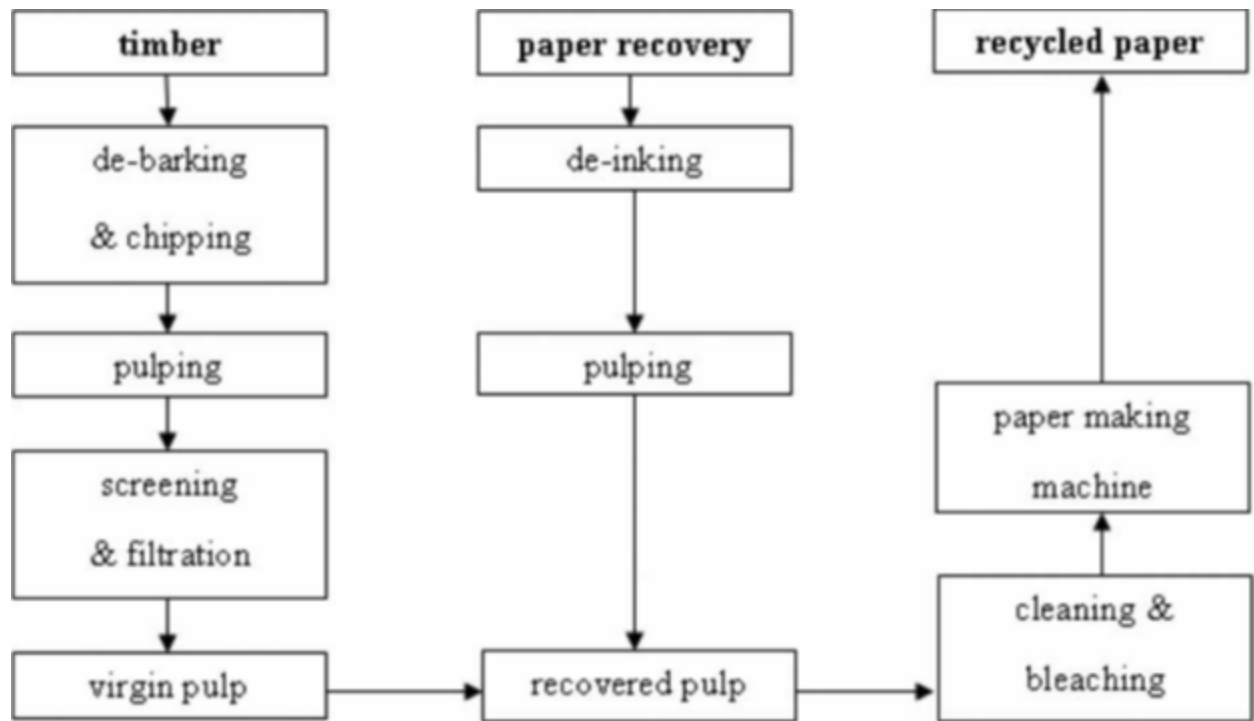


Figure 1. Paper manufacturing process (Baeyens et al., 2010, p. 154)

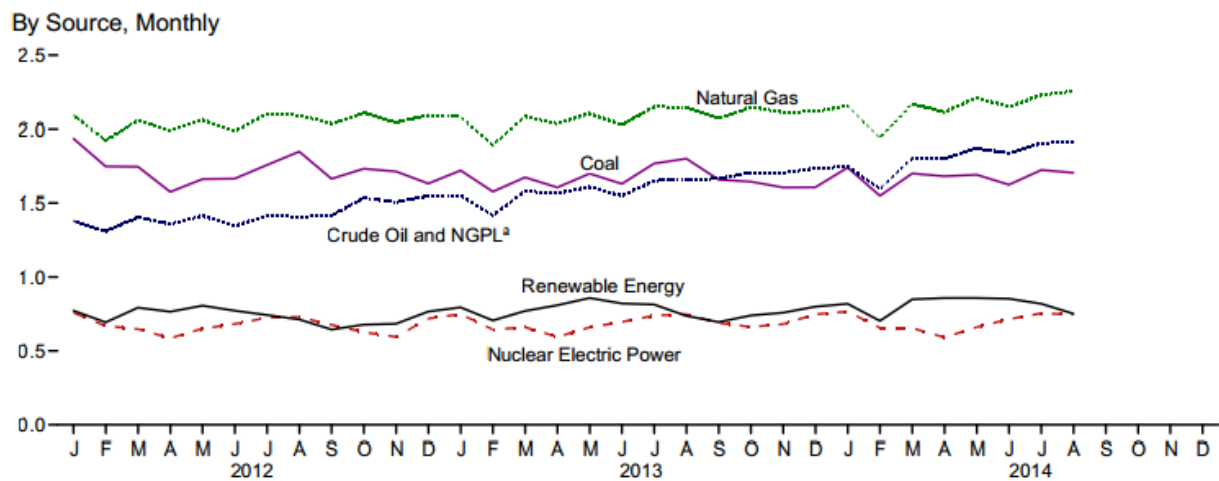


Figure 2. Monthly energy consumption for the USA (EIA, 2014)

I. Advantages of Post-consumer Paper Product

There are many environmental advantages to using Post-consumer paper products in manufacturing. One of the major factors is energy consumption. As seen in figure 1 using virgin pulp requires cutting trees, de-barking, chipping, screening, and filtration as extra steps in the paper production process. In contrast, using recycled paper only requires an extra de-inking step before the pulping step. These differences result in a significant decrease in energy consumption between 40%, according to the Energy Information Administration, and 60% claimed by the Bureau of International Recycling (Baeyens, Brems, Dewil, 2010, p. 155). Post-it notes are mostly manufactured in Cynthiana, Kentucky and “about 93% of Kentucky’s net electricity generation is generated from coal” (Energy Information Administration, 2013). From talking to 3M we found that the Post-it notes are definitely manufactured in the USA and from figure 2 we can see that non-renewable resources like natural gas, coal and crude oil are used significantly more than renewable energy.

With the reduction in energy consumption through recycling paper carbon emissions will follow. The location of Post-it note production likely uses non-renewable resources such as coal burning power plants for energy production and so the 40%-60% energy savings could cause a significantly lower carbon footprint. The US Environmental Protection Agency also cites that recycling paper products results in “74% less air pollution than making virgin pulp” (Baeyens et al., 2010, p. 155). This air pollution includes carbon dioxide, which is a major greenhouse gas, and other pollutants such as sulphur oxides, and nitrogen oxides.

There are many other advantages of post-consumer paper products that result in pollution reduction. By using recycled paper there is 35% less water pollution (Baeyens et al. 2010, p. 155). Furthermore, from recycling just 1 tonne of paper there are savings of approximately “17 mature trees, 26 cubic meters of water, 2.3 cubic meters of landfill space, 320 litres of fuel oil and 15 GJ of electricity” (Baeyens et al., 2010, p. 155).

II. SFI Certification

All the Post-it notes have an Sustainable Forestry Initiative (SFI) Certification. The SFI promotes sustainable forestry practices in North America based on 14 core practices which include “measures to protect water quality, biodiversity, wildlife habitat, species at risk, and Forests with Exceptional Conservation Value” (SFI, 2014). To be qualified for certification forest operations must be audited by an independent, objective and accredited third-party (SFI, 2014). SFI program participants must also comply with local water quality regulations and must comply with the forestry laws that apply to them (SFI, 2014). In areas with lower regulations the standard may be more easily attainable and does not seem to have a standard that should be met across North America so this may not be the “greenest” certification. Reading through program requirements document there are no numbers that seem to back the requirements and the language used is not very strong in promoting sustainable practices. Finally, even if this SFI does have the stringent standards both of the Post-it notes we are looking at have this certification and so this will not factor into our final recommendation, but will impact our overall assessment of the Post-it notes sustainability.

III. Disadvantages

Even though there are many significant up sides to the use of post-consumer paper there are also some down sides involved. For example, the de-inking process uses “chemicals and mechanical energy” (Baeyens et al., 2010, p. 155). The sludge produced from the de-inking process that is currently used contains heavy metals and other contaminants that could cause environmental damage if not treated properly (Baeyens et al., 2010, p. 155). Moreover, using recycled paper products results in a shorter fibre length making it more susceptible to tearing (Baeyens et al., 2010, p. 155). The strength of recycled paper is also reduced when compared to paper made with virgin pulp because there is less interlocking between the fibres (Baeyens et al., 2010, p. 155).

IV. Conclusion

In conclusion, we see that using post-consumer recycled paper in manufacturing can lead to a significant reduction in energy consumption between 40% and 60%. This is extremely important for sustainability since Post-it notes are mostly manufactured in Kentucky where a vast majority of their energy comes from burning coal and other fossil fuels. These Post-it notes are definitely made in the US where most of their energy is produced from non-renewable resources. Using post-consumer paper also results in a 74% reduction in air pollution in general. Products made with post-consumer recycled paper also prevents other types of pollution like reducing water pollution, reducing total water consumption, reducing landfill use, and reducing the number of tree's that are cut in the logging industry. Both of these Post-it notes also have the SFI certification saying that they are committed to sustainability, but it seems that the SFI certification does not have strong standards backing them. Even with all of these benefits there are still disadvantages involved with paper recycling like the de-inking process. The de-inking process involves chemicals that result in a sludge with heavy metals. Finally, the strength and durability of recycled paper is also reduced because the pulp fibres become shorter every time they are recycled.

3.1.2 Adhesives

I. Volatile Organic Compounds (VOCs)

In recent years, the paper adhesive industry has taken a turn from solvent-based adhesives to water-based and has since been dominating the market (Houtman, 2004). The industry has seen pressure from governmental and environmental legislations for various different reasons (Voss, 2014).

Governmental regulation of Volatile Organic Compounds (VOC) emissions is the leading reason and the source of this push.

VOCs are chemicals that can easily evaporate from liquids and solids into the surrounding atmosphere due to its low boiling point (UL Environment, 2014). VOCs are capable of forming ground level ozone and increasing air pollution. Air pollution, commonly referred to as smog is a consequence of VOC emissions. This kind of air pollution has been proven to cause negative health impacts in humans and harmful effects to the environment. Emissions of VOC can be observed in organisms like plants but the main source of VOC emissions issues from human causes. VOCs are released into the air at high volumes through countless activities ranging from firewood burning, Transportation, paints and solvents and Oil and Gas Industry (Government of Canada, 2014). Although the Oil and Gas Industry causes the majority of VOC emissions, paints and other solvent based chemicals are responsible for more than 25% of VOC emissions in Canada (Government of Canada, 2014). Unlike, solvent-based adhesives, water-based adhesives do not release harmful chemicals during normal storage and usage conditions.

2000 VOC Emissions - TOTAL = 1641 kt
(excl. Upstream Oil & Gas, Oil Sands
Development, Forest Fires)

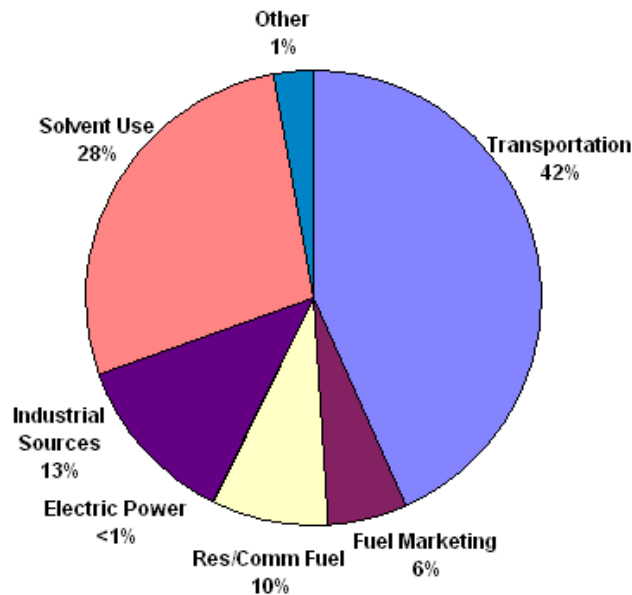


Figure 3. Percentage of VOC emissions due to Solvent Use
Government of Canada. (2014). Volatile Organic Compound Background. *Environment Canada*.
Retrieved from <http://www.ec.gc.ca/cov-voc/default.asp?lang=En&n=59828567-1>

II. Recycling Paper with Water-Based Adhesives

Recycling paper has been proven to minimize impact of the environment. The paper recycling process is carried out by shredding used paper and mixing it with water and other chemicals to form pulp. The pulp is then screened, cleaned, deinked and bleached so it can be used as paper (Tappi, 2001). During this process, there is a risk of paper being contaminated from non-paper materials. With regards to Post-it notes, it is important to confirm that papers coated with water-based adhesive can be recycled. The strength of water-based adhesives tends to create questions of its recyclability. However, when immersed in an aqueous or water-based environment, the strength properties of water-based adhesives completely change (Houtman, 2003). Water-based adhesive are considered to be non-hydrophobic recycling contaminants that can be easily removed during the deinking process which is specifically designed to

remove Post-it contaminants. This means that papers coated with water-based adhesives are recyclable since adhesive will not interfere with recycling process of paper.

3.2 Economic Impact

The following section outlines the business expenses for using recycled paper and using water-based versus solvent-based adhesives. It also outlines the cost for UBC to use the sustainable Post-it notes compared to using the standard Post-it notes.

3.2.1 Business Expenses

I. Costs and Expenses of Adhesives

Water-based adhesives are generally less expensive than solvent-based adhesives. They have a 15-20% lower purchasing cost than solvent-based adhesives (Petrie, 2003) which makes them an ideal option for consumers. The type of adhesive used in Post-it notes are likely to be water-based acrylic adhesive (Houtman, 2003), which like water-based polyurethane adhesives have a high operational temperature range, but are weaker and cost much less. When it comes to manufacturing and production, water-based adhesives continue to be less expensive when compared to solvent-based adhesives. Initial facility setup and equipment for water-based adhesives cost 8% less than solvent-based equipment and systems although operations and energy costs tend to be higher for water-based adhesives. However, water-based adhesives do not have the risks of harmful emissions like those associated with solvent-based. This means that the emission insurance for water-based adhesives will be much less. Overall, water-based adhesives are economically better than solvent-based adhesives.

Using recycled paper leads to a reduction in energy consumption of up to 60%. This ultimately means that the manufacturing locations for these recycled Post-it notes consume less energy and thus a lower cost for the business.

3.2.2 UBC's Expenses

One of the main objectives of this project is to determine if UBC's decision to "go-green" with purchasing more expensive eco-friendly Post-it notes is actually beneficial. UBC currently purchases a large amount of standard Post-it notes and a small amount of the more sustainable Post-it notes. With the provided information on what UBC purchased in the past year we can extract statistics like the amount of Post-it notes UBC requires and the cost of the two different Post-it notes options. The data is then used to calculate the difference in spending for an absolute change to either the standard option or the more sustainable option. This information will help us determine if it's advantageous to allocate more funds to this sustainable practice.

First, we calculate the cost per unit of sticky note (the cost for one sticky note) in both the Eco-Friendly Option and Standard Option

Cost per pack of either standard or eco-friendly sticky notes divided by the number of notes in each pack gives the cost of each note or each unit

Eco-Friendly Post-Its

$$\left(\frac{\text{cost}}{\text{pack}}\right)\left(\frac{\text{pack}}{\# \text{ of notes}}\right) = \frac{\text{cost}}{\# \text{ of note}} = \left(\frac{\$26.88}{\text{pack}}\right)\left(\frac{\text{pack}}{1600}\right) = \$0.017 \text{ per unit}$$

Standard Post-Its

$$\left(\frac{\text{cost}}{\text{pack}}\right)\left(\frac{\text{pack}}{\# \text{ of notes}}\right) = \frac{\text{cost}}{\# \text{ of note}} = \left(\frac{\$1.51}{\text{pack}}\right)\left(\frac{\text{pack}}{1200}\right) = \$0.0013 \text{ per unit}$$

Now, we can calculate the cost difference for an absolute change to both the Eco-Friendly Option and Standard Option

of Standard Packs Required + # of Eco-Friendly Packs Required = Total # of Packs Required

Eco-Friendly Option

$$\# \text{ of Standard Packs Required} \left(\frac{\# \text{ of notes}}{\text{pack}}\right)\left(\frac{\text{cost}}{\text{note}}\right) - \text{Original Cost} \approx \text{Change in cost}$$

Where $\left(\frac{\text{cost}}{\text{note}}\right)$ is the cost of a single unit eco-friendly note and Original Cost is the current spending for standard notes

$$331 \text{ Packs} \left(\frac{1200 \text{ notes}}{\text{pack}}\right)\left(\frac{\$0.017}{\text{note}}\right) - \$500 \approx \$6250$$

This means that there will be an **increase of roughly \$6250** if there is an absolute change to the more sustainable option

Standard Option

$$\# \text{ of Eco-Friendly Packs Required} \left(\frac{\# \text{ of notes}}{\text{pack}}\right)\left(\frac{\text{cost}}{\text{note}}\right) - \text{Original Cost} \approx \text{Change in cost}$$

Where $\left(\frac{\text{cost}}{\text{note}}\right)$ is the cost of a single unit standard note and Original Cost is the current spending for eco-friendly notes

$$50 \text{ Packs} \left(\frac{1600 \text{ notes}}{\text{pack}}\right)\left(\frac{\$0.0013}{\text{note}}\right) - \$1350 \approx -\$1250$$

This means that there will be a **decrease of roughly \$1250** if there is an absolute change to the standard option.

3.3 Social Impact

3.3.1 Social Impact of Recycled Paper

Using recycled paper in paper products can have some negative social effects. Recycled paper has a shorter fibre length when compared to non-recycled paper. This results in a recycled paper having less interconnection between fibres giving less strength and durability. According to the Centers for Disease Control (CDC) “Logging has consistently been one of the most hazardous industries in the United States” (CDC, 2014). The CDC sites that the mortality rate is 21 times higher than the overall fatality rate in the US and that there are approximately 73.7 deaths per 100000 workers (CDC, 2014). As a result using more recycled paper will result in fewer trees needing to be cut and can potentially cut down on overall mortality rates in the logging industry.

3.3.2 Social Impact of Adhesives

I. Explosive Risks of Solvent-Based Adhesives

Solvent-based adhesives have explosive risks due to their combustible and flammable properties. To ensure safety of users, solvent-based adhesives must always be kept away from heat sources and electrical equipment (Petrie, 2003). In manufacturing facilities, all equipment must be explosion-proofed for the safety of the workers and equipment. The issues associated with solvent-based adhesives can cause inconvenience as it requires careful attention when using, storing or disposing it. Alternative adhesive solutions such as water-based systems, radiation cured adhesives and hot melts were developed to address these issues.

II. Safe Operating Temperature Range

Water-based adhesives were known to have a high operational temperature ranges. When water-based adhesives are properly cured, they can withstand temperatures ranging from extreme heat to high humidity environments (Voss, 2014). The high temperatures would cause the solvent-based adhesives to combust whereas water-based adhesives would remain stable and retain their adherence. Some water-

based adhesives are able to withstand temperatures as high as 90° C which is only restricted by the boiling point of water at 100° C (Simalfa, 2014). This makes them ideal and more flexible for various situations where the solvent-based adhesives are unable to perform and loses practicality and safety for users.

III. Improved strength via Cross-Linking

Cross-linking catalyst technology greatly improved the strength of water-based polyurethane adhesives (Voss, 2014). These catalysts are used to speed up cross-linking, a process in which polymers are connected together to create polymer chains from polymers like polyurethane. The result is a fast drying and strong water-based adhesive. Currently, these water-based polyurethane adhesives are the strongest water-based adhesives and provide strength closest to the solvent-based adhesives. Cross-linking technology has allowed water-based adhesives to replace solvent-based adhesives in many applications. As a result of its improved strength, water-based adhesives have become widely accepted and used in today's industries.

3.3.3 Social Preference Survey

One of the social aspects we looked into is user preference. Are eco-friendly Post-it notes better or worse than standard Post-it notes? Questions like the difference in stickiness, writing quality, and paper quality are the main objectives. We came up with the following survey procedure to obtain the results we need in order to analyze this social aspect:

1. Write on the Post-it note and observe the feel
2. Take the Post-it note and stick it somewhere
3. Peel off the Post-it note to stick it elsewhere
4. Rate the Post-it notes in order of preference

We will be using three different Post-it note options:

1. 100% post-consumer Post-it note (eco-friendly)
2. Standard Post-it note
3. Alternative Post-it note

The alternative Post-it note is a generic Staples supplied Post-it note; there is no information or data on it. But the purpose of this is to see if there are differences between any random Post-it notes that a normal consumer can identify.

The results are as follows:

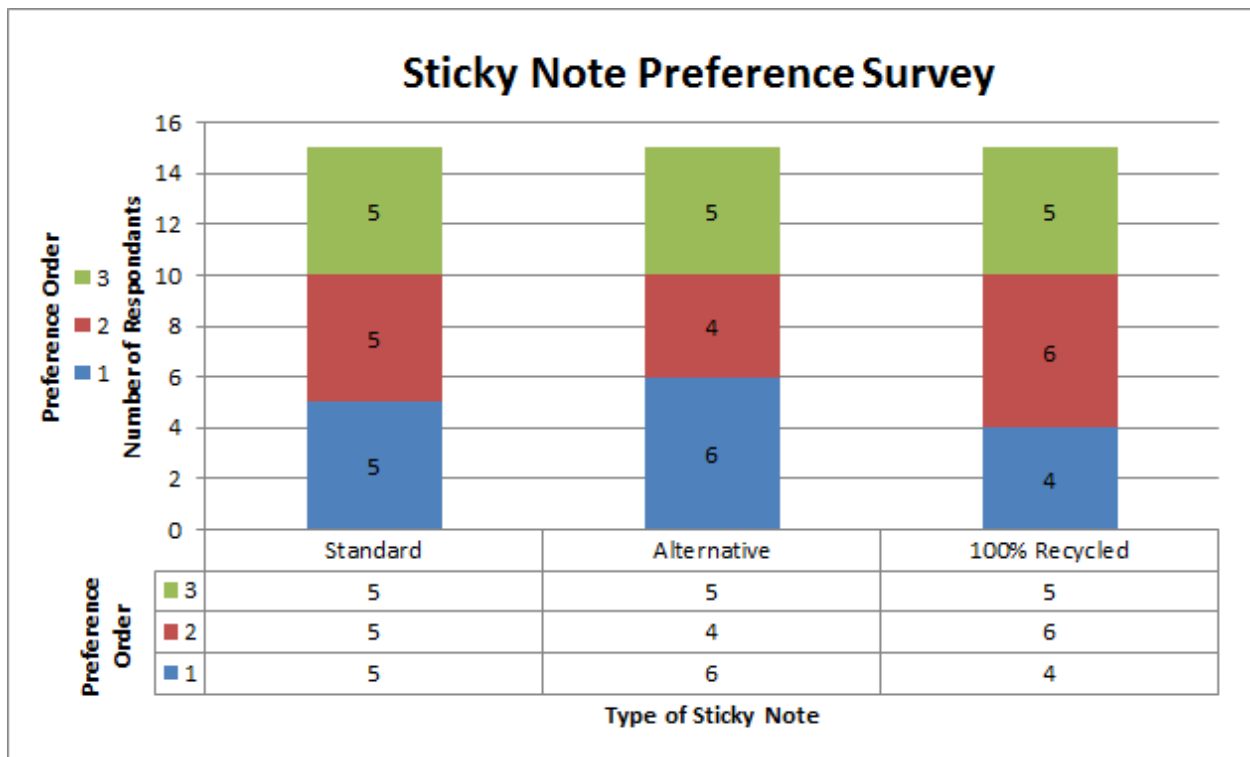


Figure 4. Post-it note preferences survey

After 15 different participants, we came to a conclusion that there are no noticeable differences in the three Post-it notes. Participants ordered their preferences and the results show that it's completely random, meaning there is no social aspect in terms of end user.

3.4 **Results**

In the end the many environmental upsides to using 100% post-consumer paper significantly outweighs the disadvantages. There is a significant decrease in air pollution, water pollution, water usage and energy usage. The heavy metal in the water is a major problem but as long as there are proper filtration systems for the waste water it becomes a much smaller problem.

Water-based adhesives have been around for several decades but were not always replacements for solvent-based adhesives. In certain situations, it was better to use solvent-based adhesives since water-based adhesives were not as fast to dry and did not provide the strength of the solvent-based adhesives (Petrie, 2003). The performance gap between solvent-based and water-based adhesives has been shrinking with development of new technologies like crosslinking catalysts (Voss, 2014). Today water-based adhesives are used in many different applications because of their benefits. These benefits include larger temperature range of operation, comparable adhesive strength, cost reduction and greatly reduced environmental impact. Based on these factors, it is safe to conclude that the current acrylic water-based adhesives used in Post-it notes is the most sustainable option in terms of its environmental, economic and social impact.

The social preference survey showed that all three Post-it notes were equally likely preferred. There are no user differences when using the eco-friendly Post-it notes or the standard Post-it notes, moreover, the alternative random Post-it notes.

When comparing the environmental aspects of the two types of Post-it notes using the 100% post-consumer paper product is better since the many environmental benefits outweigh the small disadvantages for this product.

4.0 RECOMMENDATIONS AND CONCLUSION

After analyzing the differences and comparing UBC's eco-friendly Post-it notes with the standard Post-it notes, we can determine if UBC's purchasing decisions are justified. The Triple Bottom Line assessment was used and the environmental, economical, as well as social aspects were investigated. All the data and recommendations are based off of what can be sourced out and what is available; information was very limited due to trade secrets and other manufacturing factors.

Environmentally, it is better to use Post-it notes with a water-based adhesive. This is because traditional solvent based adhesives are part of the 28% solvent VOC emissions released into the atmosphere which issue in harmful effects to people and the environment. In terms of paper, 100% post-consumer paper has a highly reduced environmental impact and minute disadvantages like shorter fibre lengths. But end user consensus does not suggest any differences in the paper quality of the paper made from shorter fibre lengths.

Economically, there is a significant difference for UBC. The eco-friendly Post-it notes cost on average 13 times for than standard Post-it notes. With UBC's current purchases and requirements for Post-it notes, this results in an increased cost of \approx \$6250 more if UBC switched to only the eco-friendly Post-it notes, alternatively a saving of \approx \$1250 if it went with only the standard Post-it notes.

Socially, through a survey of a wide variety of Post-it note users, there is no consensus on any favourable Post-it note. This means that no one noticed the differences between the eco-friendly, standard, or alternative Post-it notes.

In terms of feasibility, because of the huge cost difference between the two Post-it notes it is recommended to purchase only standard Post-it notes; the eco-friendly option is just not worthwhile. With the reduced spending UBC receives, it is recommended that the savings be used towards other sustainable actions that are more environmentally beneficial. The environmental impact of Post-it notes

does not justify the choice to go with the more eco-friendly option. Other opportunities for UBC to “go-green” are likely more effective than Post-it notes.

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APPENDIX A

SOCIAL SURVEY

Step 1: Write on each of the Post-it notes.

Step 2: Stick each Post-it note onto something.

Step 3: Take each Post-it note off and stick it to something else.

Step 4: Rank each Post-it note in order with your favorite being 1 to least favorite being 3.