

An Investigation into Cigarette Disposal
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An Investigation into Cigarette Disposal

**APSC 262
Final Report**

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Abstract

Cigarette butt litter is mainly a consequence of improper disposal of cigarette waste by smokers. Cigarette butts are still considered the most littered item worldwide leading to environmental, social and economic problems. This report reviews TerraCycle's cigarette recycling program, investigates other recycling programs and recommends other initiatives that UBC should develop to minimize the adverse effects of cigarette butt littering. Also, this project main purpose is to perform a triple-bottom-line (TBL) assessment of the Cigarette Butt Recycling. After analysing the social, economic and social impacts using TBL analysis, it is noted that recycling programs are worth considering rather than opting for no-recycling option. Positive education, anti-litter legislation and enforcement, and appropriate infrastructure are some of the proposed solutions. Cigarette litter can be significantly reduced if the proposed solutions are applied in a coordinated manner with strong connections between smokers, industry, and official bodies.

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1.0 Introduction

Cigarette butt littering is a widespread problem that accounts for 32% of all waste collected in street and beach cleanups^[1]. Although cigarette smoking has decreased by 10% from 1999 to 2013 in Canada, cigarette butts still remains the most littered item nationally and in the world^[3]. Like other environmental problems, cigarette butt littering presents social, aesthetic, environmental and financial burdens on the society and individuals. Many projects have been developed to limit the extent of littering and thus far, no perfect solution has been found.

1.1 Why Smoke?

According to the butt count initiative that surveyed 700 UBC students^[4], there are three main reasons that contribute to students smoking at UBC. The social aspect of smoking is of the greatest reasons that students and young adults start smoking. Observing older people around them smoke, such as their parents or movie stars, young adults become inspired by smoking simply to look more mature. Moreover, young adults become influenced and 'peer-pressured' by their friends, classmates or older teens in their school or society that smoke. Young adults take up smoking to fit into social groups, to look like the others or simply for the exciting experimental act of it. Moreover, since smoking is illegal for groups under a certain age, the illegal act makes it even more attractive for young adults. Other reasons for smoking are the calming and soothing effect it offers. University students that move away from home carry a heavy load of weight on their shoulders that they might not have been used to. Paying bills, rent, working at a part-time job, long hours of studying, paying student loans and other financial and personal problems can put a big toll on a student. Some students find smoking helps with their day-day problems and sudden load of responsibilities they have to carry. Nicole Gehring, a former UBC student that was interviewed by the UBYSSEY regarding the butt count initiative was quoted saying, "When you're smoking, it feels calming, and then it becomes a habit. Like when you're

studying, ‘I need a minute to take a [smoke] break.’ Long hours studying and exams can put a lot of stress on university students, and some find smoking a good break. The third main reason why UBC students were found to smoke based on the survey was because of social smoking. Social smokers do not buy cigarettes often, and usually request from people at parties, coffee shops, bars or other social gathering places. Craving for smoking is also intensified with liquor^[2], and many students find themselves buying cigarette packets or smoking more often than usual at bars and parties. Such habits can escalate into more addictive habits if young adults do not administer themselves appropriately.

Although there are other reasons for why people might smoke, such as for weight control or to move away from drug abuse, the butt count initiative has found the above three reasons the most common within UBC students.

1.2 Cigarette Butt composition

A cigarette butt consists of three parts: the un-smoked tobacco, cigarette butt filter and cigarette butt paper. Each of the three parts consists of toxic and environmentally harmful ingredients that need to be identified for proper regulation.

1.2.1 Tobacco

Tobacco is prepared from the leaves of green plants, and the main crop that is used for cigarette tobacco is *N. tabacum*. *N. rustica* and 68 other crops are also used for tobacco depending on the taste required. Farmers use different chemicals to grow the plant, along with the chemicals that are used to prepare the soil and insecticides. After the tobacco is harvested and dried, they are processed and further chemicals along with artificial flavorings (such as glycerol) are added. There are approximately 600 ingredients in cigarette tobacco and many of them were found to be toxic.

Some of the chemicals found in cigarette tobacco that are toxic include:

- Acetone
- Acetic Acid
- Ammonia
- Arsenic
- Benzene
- Butane

Most of the above mentioned chemicals are used either as additives or to enhance the taste. US Government has approved 599 additives for the use in the manufacture of cigarettes and most of them are not tested by burning. It is burning that changes the property of many of these additives, making them worse^[26].

Tobacco also consists of natural toxic chemicals. Nicotine, a famous stimulant, is a highly toxic alkaloid naturally found in tobacco. When leached out to the environment, nicotine can have toxic effects on aquatic and terrestrial wildlife. It is assumed that the ingestion of 40-60 mg of nicotine is lethal to human^[6].

1.2.2 Cigarette butt filter and paper

Figure 1 below shows some of the compounds found in cigarette tobacco and filter. 95% of cigarette filters consist of a slowly biodegradable plastic known as cellulose acetate^[5]. Cellulose acetate fibers are packed tightly together to form the cigarette filter. The 'tightness' of the packing changes the strength of the cigarette and it is what differs a 'light' cigarette from a 'regular' cigarette. The cellulose acetate plug is then wrapped to limit the exposure of air to the plug. The more ventilated and porous the inside wrap is, the 'lighter' the cigarette. A polyvinyl acetate emulsion is used to glue the cellulose acetate plug to the inner wrapping paper. The outer wrapping paper or commonly known as the 'tipping paper' is wrapped around the filter and the column of tobacco.

Although several experiments have found no adverse chronic effects of cellulose acetate on rats, it is important to note that cigarette filters are designed to accumulate particulate smoking components that result from the burning of the tobacco. Approximately 600 ingredients were found in tobacco, however, when burnt, approximately 4,000 chemicals are released. Many of the chemicals released are captured in the cigarette filter to prevent human consumption. When littered, such chemicals can leach out of the cigarette filter.

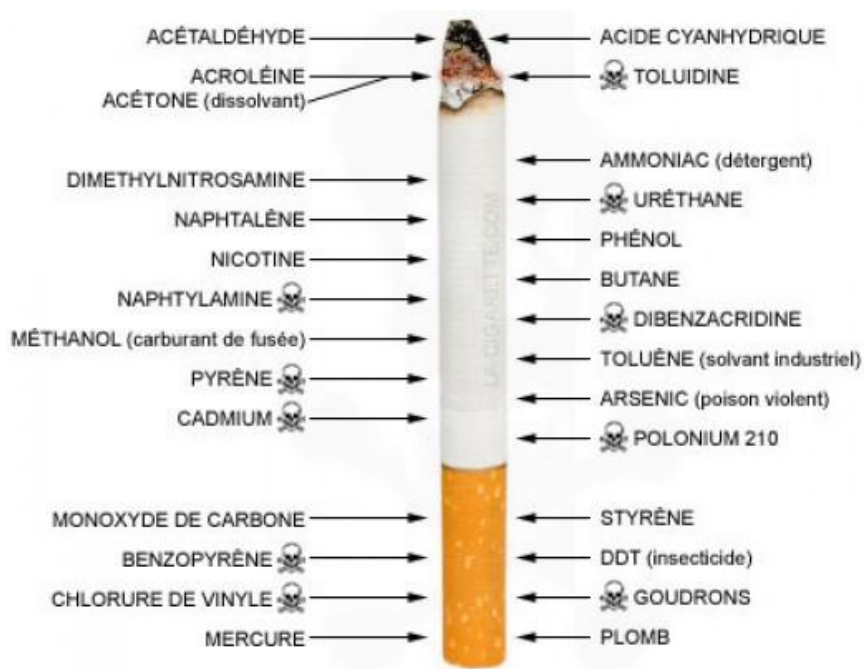


Figure 1: Compounds found in Cigarette tobacco and filter^[12]

Source: Thompson, D. (n.d.). Smoke, Choke, Croak- Radioactive Cigarettes. Retrieved April 9, 2015, from <http://dallas93444.hubpages.com/hub/Smoke-Choke-Croak-Radioactive-Cigarettes>

2.0 Approach

This project is mainly designed to review TerraCycle's cigarette recycling program, investigate other recycling programs and recommend other initiatives that UBC should develop. TerraCycle is a private U.S business that provides free collection waste programs and makes products from the pre-consumer and post-consumer waste it collects. UBC is looking into collaborating with TerraCycle to start collecting cigarette butts found on campus and shipping them off for recycling. TerraCycle is also launching a pilot butt-recycling program in Vancouver, and has already started by installing several butt receptacles in downtown Vancouver.

To review TerraCycle's butt-recycling program and recommend initiatives for UBC to develop, secondary sources of data were analyzed as well as peer-reviewed literature work is studied for a more comprehensive outlook on the size and distribution of littering. As for the secondary source, the data was mainly based on a recent survey that was conducted by a group of UBC students on Facebook. The survey that was posted on a UBC Engineering Facebook group had 184 Responses, 171 of whom allegedly attend UBC. Littering habits of UBC students was mainly analyzed based on the survey results.

Moreover, peer-reviewed literature work was reviewed to investigate littering habits of young adults and university students across North America. Careful attention is paid to which literature work is reviewed to ensure it reflects appropriately or is close to the littering habits of UBC students. Although such work might not reflect purely on the littering habits of UBC students, the diversity of students on UBC campus allows a flexible diversity in the locations of where the literature work has conducted their surveys.

2.1 Findings and Results of Recycling Program

2.1.1 Terracycle

Terracycle is a waste management company located in Trenton, New Jersey. The company has been working with the city of Vancouver to take initiative and control the growing problem of cigarette butt litter in the city ^[19]. Terracycle also manages the cigarette butt problem at UBC.

Terracycle's recycling program is called the "Cigarette Waste Brigade." In order to reduce the effect of cigarette butt waste in landfills and the environment Terracycle collects the litter from receptacles across downtown Vancouver and extracts the harmful chemicals that would endanger the environment. Cigarette butts contain cellulose acetate which is extremely dangerous to the environment and wildlife. Terracycle extracts the cellulose acetate from the collected cigarette butts and recycles them by melting them down to be used to industrial plastic production. This allows the environment to see less of the damage caused by cigarette butts being carried by water to harm the sustainability of the environment. This solution has received criticism due to the fact that it depends on smokers actually using the cigarette receptacles as opposed to throwing the butts on the ground or elsewhere^[19].

To achieve the greater success smokers must be educated to the harmful effects of littering their butts and must make a change to reduce that littering. Although it is clear that to really avoid a problem such as this, Vancouver must try to reduce the amount of smokers and push people towards quitting, this perspective goes to try to solve the cigarette butt litter at the root cause of smoking, but such an effort is seen as more of a long term goal and would take much more planning and time to be successful.

TerraCycle's pilot project claims not only reduce the environmental impact of cigarette litter, they also help to keep the streets of Vancouver free of cigarette butts which reduce the attractiveness of city which is important in maintaining social and economically sustainability.

2.1.2 Issues with Terracycle

Currently, the city of Vancouver is moving away from the Terracycle program due to many factors. TerraCycle is linked to a big tobacco company called Imperial Tobacco. This link is said to have a negative aspect to TerraCycle's initiative as it encourages people to smoke thus creating more revenue for the big tobacco companies that are looking for profit. The city is taking responsibility of the recycling program into their own hands and is providing the cost needed for the city to collect the cigarette butt litter. Vancouver has even paid TerraCycle for the receptacles that the company has provided a cost that comes to \$12,000^[16]. TerraCycle's partnership with Imperial Tobacco brought along many ethical concerns to the project. The move away from TerraCycle will create many issues that the city now has to deal with but avoids the conflict of interest that TerraCycle had by being partners with Imperial Tobacco.

2.1.3 Other Initiatives

Campuses around the world are pursuing initiatives that reduce the amount of litter caused by cigarettes in different ways. A concept of smoking Gazebos- designated smoking areas- is taken by UBC Okanagan and has made a reasonable reduction in the impact of smoking. UBC Okanagan campus is one giant no smoking area with seven gazebos around campus set designated for smoking^[14]. By law smokers are not allowed to smoke within six meters at the UBC campus and recently this has been changed to eight meters. The truth is, however, that this makes little difference in smoking habits of students and staff and the signage does not reduce the amount of litter found at the campus. The gazebos have created

a place where students may smoke, and includes receptacles to collect the litter. A survey has shown that about 85% of the students smoke at these designated zones^[14]. This offers a way for non-smoking students and staff to avoid second-hand smoke and accumulate the waste in one place making it easier to collect the waste as opposed to having litter everywhere on campus. It is worth noting that if UBC Vancouver were to use the same initiative, it would be on a much larger scale than UBC Okanagan with quite a few gazebos scattered around the campus, including signage in many places to guide the smokers towards the gazebos and reminding them of the smoking policy of the campus.

A more extreme effort in reducing the amount of litter contributed by smokers includes a concept of a smoke-free campus. According to a survey taken at UBC 72% percent of students were in favour of a smoke free campus^[15]. There are many health and environmental benefits gained from having a smoke-free campus because the problem is fully extinguished. Economical problems arise when dealing with such a solution because of the fact that many international students would not want to study at UBC Vancouver because of the no-smoking policy. As a result UBC Vancouver might be at financial loss. There has been uncertainty regarding this issue which continues today.

A survey conducted in New Zealand about a smoke-free campus found that both students and staff were for a smoke free campus. The majority of people that are for a smoke-free campus are non-smokers but it has been found that students have a desire to quit smoking and so they are also vote for a smoke-free campus^[20].

2.1.4 UBC Students Response and Solution

The facebook survey was conducted on 185 people as shown by Table 1 below. The results of that survey showed that most UBC students would only throw litter away if the cigarette receptacles were available. Approximately 22.7% said they would not go out their way to throw the cigarette butts in a receptacle and would resort to littering. This number is far

greater than students who are willing to find a receptacle to dispose of the litter. 48.1% said they would support a ban on smoking on campus and 42.7% said they wouldn't. This shows that the concept of a non-smoking campus is almost split between the students and it is difficult to find an answer that would help the decision to actually create a campus that bans smoking. There is a vast difference however, in the number of students that want designated smoking areas such as the gazebos of UBC Okanagan. 73% say they want designated smoking areas while only 16.2% are not in support of designated smoking areas. Majority students are in favour of gazebo-type areas but do not believe that the money should come from their tuition, granted most non-smoking students are highly against an increase tuition in order to enforce and regulate an initiative to decrease the litter on campus.

Table 1: Survey Questions and Responses

Question	YES	NO
Are you a UBC student?	93%	7%
Do you smoke cigarettes?	23.2%	76.8%
Would you use a cigarette butt collection receptacle? (A trash can just for cigarette butts)	27%	14.1%
Would you support the banning of smoking at UBC?	48.1%	42.7%
Would you support designated smoking areas at UBC?	73%	16.2%
Would you support increased tuition costs to pay for a "return for cash incentive" cigarette butt collection program?	19.5%	78.9%

3.0 Triple-Bottom-Line Assessment

3.1 Cigarette Butts environmental effects

The environmental effects of cigarette butt littering go beyond the aesthetic problems associated with butt littering. Littered cigarette butts can wash away by rain or wind into our waterways, lakes and rivers as well as reside in the gardens, forests and recreational areas. Since cigarette butts are the number one littered item in Canada and the world, their effects on the environment take a huge toll.

Below is a beautiful advertisement that is used by California Department of Public health to make the community aware of how the cigarette butts are toxic to the environment.



Figure 3: Tobacco Free California Advertisement ^[22]

Source: Home - TobaccoFreeCA. (n.d.). Retrieved April 9, 2015, from <http://www.tobaccofreeca.com>

Hundreds of chemicals that are present in the filter and that are accumulated in the cigarette butt paper leach into the environment. The 'Butt really? The environmental impact of cigarettes' journal article demonstrates that heavy metals present in cigarette filters form a

‘soup’ of toxic chemicals when mixed with water. It was shown that only one cigarette butt could kill half the fish exposed to the water-metal toxic mixture in a controlled laboratory setting^[7]. Moreover, since cellulose acetate is very slow to degrade, the presence of the plastic plugs in the waterways can choke many aquatic wildlife or terrestrial animals that try and ingest it. Lightened cigarette butts that are tossed are a major fire risk. The Australian Fire Authorities estimate that more than 12 fires a day start by cigarettes or smoking materials^[11].

At least 4.5 trillion [non-biodegradable] filter-tipped cigarettes are deposited annually somewhere in the world ^[21]. If there was no recycling done, the non-biodegradable highly toxic cigarette butts would be left around polluting the environment. Recycling of the cigarette butts requires an effort starting from a smoker and ending at a recycling facility which includes receptacles/ashtrays to collect the cigarette butts, transportation of butts and finally being dealt with at the facility.



Figure 2: Cigarette Butt-Water mixture^[13]

Source: Lewis, L. (2009, May 27). The Butts Remain - EcoSalon. Retrieved April 7, 2015, from <http://ecosalon.com/cigarette-litter/>

3.2 Cigarette Butts Social effects

The sight of cigarette butts can have different social effects on individuals and the society as a whole. The presence of cigarette butts near building entrances degrades the status of the building. The sight of cigarette butts influences other littering habits and can spur disgusted and dirty thoughts within individuals that would distress their feelings. The presence of cigarette butts in parks and other outdoor recreational areas would de-motivate people from going there and such incidents would limit the social well-being of a neighborhood

The handling of cigarette butts would come up when removing the accumulation of butts in a receptacle like those placed by the TerraCycle initiative. Without the recycling of cigarette butt litter, the cellulose acetate from the filters would leak out to bodies of water causing harm to aquatic life. In a social perspective the recycling does not cause any health risks in recycling. The cellulose acetate is used in the creation of plastics which are in turn low carbon. This makes the cigarette butts re-usable and reduces the amount of sustainable damage cause by creating this plastic. Overall, the handling and recycling of cigarette butts do little to no harm to the persons involved.

The current process for disposing cigarette butts is through the garbage and several designated receptacles. The process would have to isolate the disposed cigarette butts from the other waste which requires cooperation from waste management companies currently in charge of recycling. The separate butts would have to be treated in a different way than the treatment of aluminium or plastic recycling. Since cigarette butt filters contain harmful chemicals they must have the cellulose acetate removed which would harm the environment. The labour required would increase because there must be individuals available who are willing to separate cigarette butts from other recyclable start a separate process to recycle them. A team must be initiated to collect all the cigarette butts in the receptacle and send them off to be extracted.

One major social concern arises from the view smokers have towards littering cigarette butts. Smokers must be educated on the issues that arise from discarding their cigarette butts on the ground or water. Currently many smokers do not believe cigarette butt to be litter let alone a problem ^[23]. Once current smokers realize that the litter they are producing can create a process of destruction to the environment and to the community, it will be easier to start a program to recycle cigarette butts, otherwise any initiative taken will not have as much impact. In order to do this advertisement-like campaigns are needed to get the attention of smokers and to help learn more about the damage currently being caused and how it can be reduced.

3.3 Economic Aspects of recycling programs

The only recycling program that was launched in Vancouver was Terracycle. The City of Vancouver was paying a nominal one dollar fee for each of the cigarette recycling receptacles apart from the payment of \$12,000 for the receptacles to the company ^[16]. Terracycle covers the costs of shipping to New Jersey for recycling which decreases the financial burden on the City of Vancouver.

Estimated cigarette litter removal cost ranges from \$3 million to \$16 million for major cities and municipalities. According to a report the city of San Francisco has estimated that it spends \$11 million per year cleaning up butts^[24].

An approach to stay sustainable and cut on the financial cost is to work on the source reduction. Reducing source waste results in economics savings. For instance, using biodegradable filters or switching to unfiltered cigarettes is more economic in the long run. Some companies have developed biodegradable and compostable cigarette filters using natural fibers like hemp, cotton, and food-grade starch. These alternative filters are

intended to help reduce environmental pollution from cigarette butts, since they decompose more quickly in the environment, as well as in smokers' lungs^[25].

3.4 What to do with the cigarette butt

Apart from the Terracycle's method of recycling, there are several other ways the used cigarette filters can be recycled. They can be treated to prepare energy storage materials. A group of South Korean scientists have converted used-cigarette butts into high-performing material that could be integrated into various electrical devices. It is also shown that this material's performance is better than the commercially available carbon, graphene, and carbon nanotubes. This is very informative for our research as it gives a final solution to close the loop and a sustainable answer to the problem. This research shows that used-cigarette filters can be transformed into a high-performing carbon-based material using a simple one step process, which simultaneously offers a green solution to meeting the energy demands of our society^[17].

Another way of recycling the cigarette butt is the possibility of incorporating them into fired clay bricks. Five different soil–cigarette butt mixes with different percentages of cigarette butts are used and tested in a research. According to the research, it is concluded that cigarette butts can be regarded as a potential addition to the raw materials used in the manufacture of lightweight fired bricks and that recycling cigarette butts in bricks is a very practical and potentially significant contribution in terms of a sustainable solution. This proposes a way to recycle the disposed cigarette butts, a green solution to the problem^[18].

4.0 Recommendations

Cigarette butt litter is of great concern to the environment. Several approaches can be adopted to reduce the socially accepted cigarette butt littering norms. After analysing the surveys and data collected, following are a few of the preliminary recommendations.

4.1 Education and Law Enforcement

First of all, education should be the most important tool to wake one's inner voice and make them aware of their obligation towards the environment. Education campaigns targeting smokers should be carried out once every four months. By creating an environmentally conscious culture, UBC can move closer to achieving UBC's sustainability goals. For broader community awareness of the issue, education programs should be started out with stakeholders, such as retailers, office managers, university staff or other officials in charge of the society.

Furthermore, enforcement of cigarette littering legislation is increasing, for instance there is province-wide regulation that bans smoking within three metres of doorways, open windows and air intakes ^[27]. But there are a very few laws that are actually being implemented and dealing with littering cigarette butts. According to the law, smokers who toss lit cigarette butt on ground could be fined up to a \$1000^[28]. But who is actually taking the lead on campus to make sure that a smoker who is littering around is fined. One of the recommendations is to have more officers or workers in charge of keeping the things in place.

4.2 Infrastructure

In the most populated parts of the UBC campus, designated smoking areas like gazebos should be introduced along with increase in the number of signage. Moreover, despite the fact that Vancouver health officers are opting out of the Terracycle program, it should still be considered better than no alternative as it deals with an already existing problem. The program can be further improved to serve the community better and abide by the city laws.

4.3 Programs or Initiates

Programs like swapping cigarette butts for cash can be used as an initiative. Deposit and refund program requires customers to deposit an extra fee when purchasing cigarettes and

the consumers are reimbursed on returning used filters the place of purchase. One of the requirements to carry out this program is that each pack of cigarettes should include a bag for used filters.

5.0 Conclusion

Cigarette butts are more than mere litter. Littering of toxic and non-biodegradable butt appears to be the norm among smokers thus significant measures need to be taken to minimize the adverse public health and environmental effects of cigarette waste. After analysing the social, economic and social impacts using TBL analysis, it is to be noted that recycling programs are worth considering. Cigarette litter can be significantly reduced if the proposed solutions are applied in a coordinated manner with strong connections between smokers, industry, and official bodies.

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