

## Reprocessing Waste Cigarette Butts into Usable Materials

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### Abstract

Cigarette smoking started near about in ancient 5000BC phase till now it's going on. The main reason behind smoking cigarette is nicotine. People take nicotine forgetting immediate refreshment like caffeine, tannin. Therefore, the best sustainable solution for these environment problems is to recycle cigarette butts and use them for the manufacturing of some useable products. Cellulose Acetate is a natural plastic, which is manufactured from purified natural cellulose. Natural cellulose of the appropriate properties is derived primarily from two sources, cotton linters and wood pulp. The presence of this great amount of cellulose in the cigarette butts makes them an ideal candidate for the recycling purpose. So if we are able to reduce the toxicity level of the used butts and remove the bad sniff from them we can certainly use them for making of usable products which will be explored in much greater detail in the research work.

**Keywords:** Cigarettes, Environment, Cellulose Acetate, Natural Cellulose, Recycling.

### 1. Introduction

Cigarette smoking started near about in ancient 5000BC phase till now it's going on. The main reason behind smoking cigarette is nicotine. People take nicotine forgetting immediate refreshment like caffeine, tannin. Because nicotine immediately dissolves or absorbed in blood, that's why people and young generation started smoking to reduce stress for a while. When any person take Cigarette after smoking last part remains called "filter/butts" and now butts are everywhere....walk down the street, across a parking lot...anywhere, and you will see.



**Fig 1. Waste cigarette butts disposed around streets.**

The real environmental culprit is the filter. The main ingredient in the manufacture of cigarette filters is a product called *cellulose acetate*, a type of slow-biodegrading toxic plastic. And with five trillion discarded cigarette butts finding their way into the environment every year, the impact can be nothing short of catastrophic. There are, however, a few bright lights on the horizon. The cellulose-acetate filter was added to cigarettes in the 1950s in the wake of increasingly convincing scientific evidence that cigarette caused lung cancer and other serious diseases [1]. Filters were found to reduce the machine-measured yields of tar and nicotine in smoked cigarettes, and at first this seemed to be a healthy technological improvement in the cigarette product.



**Fig 2. Cellulose acetate fiber in cigarette filter bundle**

Whatever their direct health impact on or benefit to smokers, cigarette filters pose a serious litter and toxic waste disposal problem. Cellulose acetate is photodegradable but not bio-degradable. Although ultraviolet rays from the sun will eventually break the filter into smaller pieces under ideal environmental conditions, the source material never disappears; it essentially becomes diluted in water or soil [2,3]. While the environmental impact of a single disposed cigarette filter is minimal, there were 1.35 trillion filtered cigarettes manufactured in the United States in 2007, and of these, more than 360 billion were consumed there [4]. About 680,000 tons of cellulose acetate was used in the production of these filtered cigarettes. With 5.6 trillion filtered cigarettes consumed worldwide in 2002, and nine trillion expected by 2025, the global environmental burden

of cigarette filters is also significant [5]. It is estimated that 1.69 billion pounds (845,000 tons) of butts wind up as litter worldwide per year [6]. Therefore, the best sustainable solution for these environment problems is to recycle cigarette butts and use them for the manufacturing of some useable products. Cellulose Acetate is a natural plastic, which is manufactured from purified natural cellulose. Natural cellulose of the appropriate properties is derived primarily from two sources, cotton linters and wood pulp. The presence of this great amount of cellulose in the cigarette butts makes them an ideal candidate for the recycling purpose. so if we are able to reduce the toxicity level of the used butts and remove the bad sniff from them we can certainly use them for making of usable products which will be explored in much greater detail in the research work. Butt waste is everywhere: 99% of the 360 billion cigarettes sold have cellulose acetate (plastic) filters; at least one-third of those – 120 billion – are discarded into the environment. Washed into rivers, lakes and the ocean, and eaten by birds, animals and fish, they are the most littered item in the world. Smoking-related debris is 1/3 or more of all debris items found on beaches and in rivers and streams.

### Objectives

- ✚ To recycle cigarette butts in to usable materials
- ✚ To decontaminate the cigarette butt to reduce toxicity
- ✚ To produce fashionable products form cigarette butts
- ✚ To study the possibility of using the fibre material in butts for textile and clothing purpose.

## 2. Literature Review

Not much research work has been done on reprocessing waste cigarette butts in to usable materials, except few trials, and some of the related works has been tries to be addressed below. A company called *Terra Cycle*® reprocess filters to make picnic tables, backpacks, flower pots, garden chairs and even— irony of ironies—plastic ashtrays, which can be purchased online at Terra Cycle or at places like Wal-Mart and Dwells mar.



**Fig 3. Backpacks developed from waste cigarette butts by Terra Cycle ®**

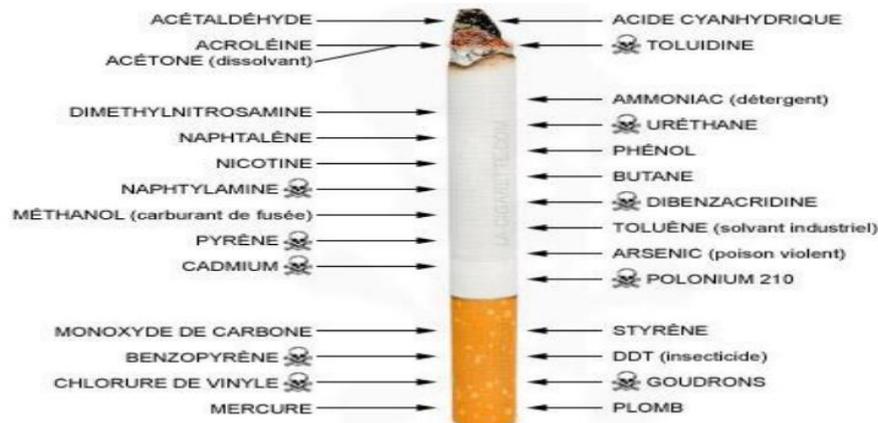
Bricks Aeslina Abdul Kadir, and Abbas Mohajerani, had worked a research on Possible Utilization of Cigarette Butts in Light Weight Fired Clay, and the results were very good that the work will encourage further investigation on the same topic.



**Fig. 4 Compacted bricks, beams, and cubes (Soil\_CBs mix)**

### 3. Methodology

Cellulose Acetate is a natural plastic, which is manufactured from purified natural cellulose. Natural cellulose of the appropriate properties is derived primarily from two sources, cotton linters and wood pulp. The presence of this great amount of cellulose in the cigarette butts makes them an ideal candidate for the recycling purpose. Waste cigarette butts has more than 300 toxic chemicals and impurities, So if we are able to reduce the toxicity level of the used butts and remove the bad sniff from them we can certainly use them for making of usable products which has been explored in much greater detail in the current research work.



**Fig 5. Composition of cigarettes**

Different chemical treatments and processing's had been used to remove the bad sniff or odor of waste cigarette butts and to decrease the toxicity level of the innate chemicals found in the used cigarette butts.

#### Research Techniques

For the current research we have user certain consecutive processes and stages of processing in order to achieve the objective, accordingly the steps required to reprocess the waste cigarette butts are listed below:

- i. Collection of waste cigarette butts from round the town.
- ii. Separation of filters from any ash and unused tobacco.
- iii. Washing of the butts to remove dirt.
- iv. Bleaching of the fiber material to reduce toxicity and clean them.
- v. Purification in autoclaves
- vi. Washed in polar solvent,
- vii. Rinsing and drying
- viii. Carding and fiber tuft formation
- ix. Create clothing

#### Material & Equipment needed

For the current research, the following machineries and equipment are needed:

**Table 1. List of materials and equipment needed**

S/N	Name of materials & equipment	Remark
1	Plastic bags	<i>For storing the butts in the collection process</i>
2	Scissors	<i>For trimming the charred ends of the butts</i>
3	Gloves	
4	Galvanized washing bath	
5	Electric stove/heater	<i>For bleaching process</i>
6	Pressurized nozzles	<i>For washing activity</i>
7	Miniature carding machine	<i>For opening activity</i>
8	Fusing machine	<i>For bonding activity</i>
9	Sewing machine	
10	Ironing machine	

### IV. RESULTS & DISCUSSION

For the purpose of collecting waste cigarette butts we have used plastic bags to prevent the decaying of butts, and we have collected 35,000 waste cigarette butts from different areas of Bahir Dar town.



**Fig. 6 Collected waste cigarette butts**



**Fig 7. Trimming of the butts to remove**

The next process is bleaching of the trimmed and washed cigarette butts to remove impurities and enhance the whiteness of the fiber material. The recipe and the chemicals used for the bleaching process are listed below:

**Table 2. List of chemicals for the bleaching process**

S/N	Chemical used	Amount
1	Hydrogen Peroxide	350 ml
2	Hypochlorite	250 ml
3	Sodium <i>n</i> -non anoyloxy benzene sulfonate	125 ml
4	sodium hydrosulfite	100 ml

Accordingly we have come up with the bleached fiber bundles with removed impurities and improved whiteness.



**Fig 8. Picture of the bleaching process**

The next step is to open the already bleached butts using the mini carding and opening Machine, the process was very difficult since the miniature carding machine is specifically designed for processing cotton fiber whereas we are opening a very dense and synthetic fiber so this creates a lot of short fiber generation and to overcome this problem we have blended the bleached cigarette butts, with that of carded cotton to increase the strength and decrease the breakage rate.



**Fig 9. Picture of the opened fiber tuft**

The next step is to create a lap or sheet of opened fiber using the laboratory based miniature single roller carding machine, so the process outputs a lap of fiber which is ready for further processing using one of the different fabric manufacturing methods. The web of fibers is laid using different laying techniques, accordingly some of the webs of fiber bundles are laid parallel and the rest are laid using cross laying techniques. Laying fibers webs in parallel will increase the longitudinal strength of the web and cross laying will increase the lateral strength of the fiber web.



**Fig. 10 Web of fiber made by carding machine**

For the process of fabric formation we have used a non-woven fabric manufacturing technology, since the technology is very suitable for the manufacturing of fabrics and related products from a range of short fibers, here the appropriate strength of the bond is achieved through two methods: Using of a cross laid and parallel laying web formation technique to increase the strength of the resulting fabric. Application of different adhesives in the actual thermal bonding process, specifically for this project we have used PVA (Poly Vinyl Alcohol) as an adhesive agent.

**Process parameters:**

**Table 3. Parameters of the selected fabric manufacturing technique**

<b>Selected technology for fabric formation</b>	<ul style="list-style-type: none"> <li>✓ Non-woven</li> <li>✓ (Thermal bonding)</li> </ul>
<b>Parameters</b>	<ul style="list-style-type: none"> <li>✓ Temperature : 145°C</li> <li>✓ Bonding time: 30s</li> <li>✓ Adhesive used: PVA(poly Vinyl Alcohol)</li> <li>✓ Lay technique: Cross laid web formation.</li> <li>✓ Machine used: Fusing Machine and Heat transfer machine.</li> </ul>

#### 4. Sample development

The process of sample development is done to create sample products made from the reprocessed cigarette butts to create an awareness and motivation for further innovations and products. This will create a gate for future product development ideas for new and under discovered areas of the textile and clothing sector. Accordingly we have tried to develop some sample products like below including home carpets, shoulder pads for men's suits and jackets, home decors and other accessories like pillow and pillow cases. For the creation of the selected products a single needle lock stitching machine is used and to prevent the fraying of the cut ends over lock sewing machine is used, and finally ironing pressing and finishing techniques have been used to increase the aesthetics and final look of the samples developed. The developed sample products are basically used for outdoor products, which mean the samples developed products are made in such way that they did not have a direct contact with the human skin to prevent the adsorption of remnant chemicals found in the products developed, since the available technology at hand is not sufficient to totally remove all the toxic chemicals found in the waste cigarette butts. As a result we have made the following samples which are totally made from reprocessed waste cigarette butts in the process described above; the first developed sample is an outdoor carpet:



**Fig 11. back view bonded sheet**

Another sample usable product developed from the reprocessed waste cigarette butts is a pillow and pillow case, the opened fiber tuft is used as a filling material for the pillow case and a bonded sheet of fiber is used to make the inner lining of the pillow.



**Fig 12. Sample Carpet for Sample Carpet making**



**Fig 13. Sample pillow case making process**



**Fig 14. Sample pillow case sewing process**



**Fig 15. Sample Pillow and pillow cases**

The last set of sample products developed are home decors and shoulder pads for making of suits and jackets:



**Fig. 16 Home decors**



**Fig 17 Shoulder pad for men's suit and jacket**

Generally there can be a lot more usable products which can be developed from reprocessed waste cigarette butts, like toys, notice boards and different components of clothing's which are enclosed under garments, so this research will create a good insight for those who want to further work on similar works.

## 5. Conclusion

Whatever their direct health impact on or benefit to smokers, cigarette filters pose a serious litter and toxic waste disposal problem. Cellulose acetate is photodegradable but not bio-degradable. Although ultraviolet rays from the sun will eventually break the filter into smaller pieces under ideal environmental conditions, the source material never disappears; it essentially becomes diluted in water or soil. Therefore, the best sustainable solution for these environment problems is to recycle cigarette butts and use them for the manufacturing of some useable products. Cellulose Acetate is a natural plastic, which is manufactured from purified natural cellulose. Natural cellulose of the appropriate properties is derived primarily from two sources, cotton linters and wood pulp. The presence of this great amount of cellulose in the cigarette butts makes them an ideal candidate for the recycling purpose. So in this particular research work we have tried to reprocess waste cigarette butts in to usable materials, the first step is to remove the sniff and dirt from the surface of the butts, and then thorough cleaning is done in polar solvents and bleaching is followed to increase the whiteness, then opening, carding and web formations are done and finally sample making of usable products has been undertaken just to highlight and create awareness that waste cigarette butts can be used for different types of usable materials.

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