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Environmental Debates

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The Environmental Impacts of the Pulp and Paper Industry

From a young age, we are educated through books. Books act as our bridge from our questions to our source of wisdom. However, through this enlightenment, we have become informed of the negative effects books have on the environment. We are instructed to reduce reuse and recycle, but the books we read prohibit the recycling process, forcing the paper into landfills. The recycling process is obstructed due to the additives included in the paper products from pulp and paper industries. By altering the composition to a more environmentally friendly alternative, we, as a society, can implement alternatives to traditional paper and inks whilst furthering our education through the use of written ideas.

Trees undergo a lengthy process to transform from a rough, woody substance into a thin, white sheet of paper. The tree must first be harvested through deforestation, the most prominent force of environmental degradation. This process is the depletion and removal of trees and ecological resources. Deforestation is often used to harvest materials to produce paper. In Elias, Pipa, and Boucher's study (2014), From 2000 to 2005, it was projected that twenty percent of the tropics were facing environmental degradation. For every tree that was logged, approximately ten to twenty trees remained. However, the trees remained were injured; they were often hit by fallen logs, damaged by equipment, or dragged down if long vines connect them to logged trees (Elias et al., 2014). The pulp and paper industry's deforestation goals harm ecosystems. In

addition, the industry also hinders the growth of trees still planted. Due to the pulp and paper industry, approximately 15 billion trees were cut down each year (Worland, 2015).

Furthermore, the article composed by Worland (2015) projects such a high increase in wood product consumption due to the increasing demand for paper products. As a world, we have experienced a growth in wood products such as paper, furniture, and construction materials, severely damaging our tropical forest. However, the wood used for paper remains the highest in demand. This demand is projected to increase over the next half-century further. It is projected that wood consumption in 2060 will surpass all paper consumption types and rise more than 100% from 2010 (Worland, 2015).

Once the wood has been logged, the newly created papers will undergo production to produce books. The process of converting single pieces of paper into books calls for the inclusion of additional chemicals. To achieve the ideal paper presentation, more than 300,000 color agents are reported to be used to transform trees into paper (Minor, 1992). Although the color agents are used to enhance the paper's color, bleach is also applied to reach the perfect white color within a sheet of paper. Paper production processes transform a natural substance into a chemicalized product that harms the environment during production and destruction. Once the paper is infused with chemicals to alter the appearance from tree bark to a smooth piece of paper, the oxidative composition is applied.

After deforestation and the harvesting of woods, the tree is transformed into a lignin polymer. The chemicals are deposited within the cell walls that compose woody, rigid materials (Minor, 1992). Since each fiber type is unique and composition and durability, each must be handled uniquely. The virgin fibers are mostly used for book production and undergo a series of bleaching methods to achieve the ideal white color paper typically has. The bleaching process is

currently an unstable solution to the pollution associated with pulps, as the bleaching allows for emissions of toxic chemicals into the atmosphere upon production. Chlorine and hypochlorite are presently used in the bleaching of recycled papers. It generates environmental damages by releasing chemicals like chlorinated-dioxins and chlorinated-benzofurans from chlorine bleaching and chloroform formation from hypochlorite bleaching. Although chlorine is deemed more environmentally conscious, hypochlorite is often used due to its inexpensive value and ability to damage fibers through cellulose depolymerization (Minor, 1992).

Additionally, hypochlorite has higher oxidizing power and is able to strip materials of dyes and pigmentation effectively. The ability to strip pigmentations from materials classifies hypochlorite as an ideal choice for the pulp and paper industry, regardless of the environmental lash back they face due to the high toxicity the paper now contains.

People will often throw the books away rather than recycle to avoid complicated rebleaching processes or adequately break down the ink particles. This can be done, however, through a lengthy process called color stripping. Although color stripping applies more chemicals into the paper materials, it breaks down the paper's ink particles from the lignin. By breaking down the insoluble dyes within the petroleum-based inks, the fibers are effectively stripped of colors for paper production, allowing the decolorization of fibers so the paper can be recycled and repurposed into another material demanding a woody lignin base (Earth 911, 2020). The purpose of color stripping is to decolorize the pulp of any petroleum-based inks without solubilizing the lignin, leaving a deteriorated substance that cannot be reused or recycled. This process can be fulfilled by reducing and using sodium hydrosulfite to break down the papers' pigmentation or oxidize the pigment with hydrogen peroxide (Duggirala, 2011). By breaking

down the colors within the paper and the lignin, the paper is separated from the insoluble substances and chemicals, allowing the papers to be recycled and regenerated into new paper.

Although color stripping is meant to allow papers to be recycled, the paper's recycling process still releases significant emissions of the toxic chemicals incorporated in the paper from production, such as hypochlorite and hydrosulfite incorporated earlier in the process. In addition, the chemicals released from color stripping include chlorinated-dioxins, chlorinated-benzofurans, and chloroform are a common byproduct of color stripping. These chemicals emitted into our atmosphere pose an equally damaging effect on the levels of pollution in our world as opposed to simply throwing the paper away (Minor, 1992). By recycling papers with numerous chemicals, the chemicals enter the atmosphere and contribute to increased atmospheric pollution levels, causing smog and asthma rates to rise (CustomMade, 2015). This leads to the need for paper to be produced without toxic chemicals. It will allow for the restoration of our environment and atmosphere. A paper process reducing the chemicals used will make recycling more accessible and require fewer trees to be deforested to produce paper demand. Therefore, a need for paper to be produced without toxic chemicals will allow for the restoration of our environment and atmosphere. A paper process reducing the chemicals used will make recycling more accessible, making the production more natural and requiring fewer trees to be deforested to produce the demand for paper!

The oxidative composition is used after the bleaching process to keep the paper's quality. The process seals the chemicals within the paper, therefore keeping the paper pristine and uniform in appearance. The oxidative composition process brightens the paper, prevents yellowing, and enhances the durability of paper products (Young, 2015). Chemicals involved to

keep paper durable and white include brightening agents, dyes, pigments, fillers, antimicrobial agents, defoamers, pH control agents, and drainage aids (Young, 2015).

As previously discussed, the lengthy chemicalized process involved in transforming a tree into a novel hinders recycling by obstructing the standard recycling and paper reproduction. The paper contains too many toxic and insoluble substances so that recycling will emit toxic emissions into our atmosphere. When the paper's chemicals surpass the amount of emissions recycling could prevent from being released into the atmosphere, the paper is deemed unfit for recycling if the book has gotten wet or lost the color's vibrancy and turned tan or brown. This appearance condemns paper books to landfills. Although recycling used paper can seem like a positive contribution to our environment, the pulp and paper book making process's bleaching makes recycling difficult. Paper undergoes a lengthy process to be recycled. Just as each fiber undergoes a unique bleaching process to produce a book, the paper's composition is unique, and each paper type requires a different chemicalization process. It has been proven by Earth 911 (2020) that only 33% of the new paper pulp comes from recycled materials; the rest must be sourced from deforestation of new trees and wood chips (Earth 911, 2020). Both books and magazines are composed similarly, as both sources of informational text are composed of mixed paper.

To begin the recycling process, these products must be separated from the cardboard, office paper, and newspaper grades. Since these products contain extra chemicals such as petroleum-based inks, and oxidative composition to preserve the appearances, they must be handled individually than traditional papers. First, the mixed paper is baled and sent to a mill. At the mill, pumping machines incorporate water and chemicals to break down the pulp into fibers further. The binding is broken down, and any ink and adhesive are removed, allowing the paper fibers to

start bonding together. To conclude the process, the fibers are rolled, dried, and then sent to be composed into new products. Since the mixed fibers are smaller than cardboard or office paper, the paper is often recycled into lesser quality products like coffee filters and paper towels. The paper recycling process has five to seven life cycles before the fibers become too short to produce new paper (Earth 911, 2020). Due to the substantial chemicals applied, excessive treatments discourage magazines and book papers from becoming new books.

The use of recycled paper is projected to increase significantly in the next forty years. Elias, Pipa, and Boucher (2006) project that recycled paper will increase by 192%, and printing and writing paper will increase by 180% in popularity and usages. Innovation, however, does not end with the use of recycled paper trumping standard paper. The method of breaking down the additives include factors introduced within the recycling process. The substances include mixed lignin contents, dyes, residual ink particles, carrier chemicals, contaminants, color reversion, and hornification. When lignin is combined with pigments, it creates ink particles that make recycling paper harder to complete in an ecologically conscious manner due to the insolubility of the inks' characteristics and makeup (Minor, 1992). The extravagant list of chemicals used in the papermaking process often obstructs the standard recycling and reproduction processes of paper procedures.

It is a personal choice to choose to recycle. As a society, we emphasize recycling and place it above, both reducing and reusing. However, there is often an incentive to recycle plastic, glass, and aluminum with a monetary reward for returning the resources, but the paper is often neglected. Compared to other resource types, the paper is the only source that is not incentivized to be recycled, making the recycling rate lower. It is believed that the rise of a more individualized response is based on market imperatives. Upon asking individuals to sort plastic,

glass, aluminum, and paper is based on the perception that companies desire the reclaimed materials. However, as companies continue to deforest land to undergo a process to produce papers, the companies reject the recycled materials they are given. Thus, deeming an individual's recycling choices pointless or even counterproductive (Steinberg, 2002). Although the desire to receive an incentive monetarily for recycling paper, people should deem recycling paper important due to the health risks associated with paper production.

Although pulp and paper production has been proven to cause adverse environmental effects, it has been proven that the pulp and paper industry has induced adverse health effects on humans. The industry creates books and paper through the use of many chemicals and resources, as previously stated. However, some of the resources have been deemed carcinogens, which means they are cancerous. The inferred carcinogens from paper products contain wood dust, various wood extracts, associated bioaerosols, reduced sulfur compounds, talc, formaldehyde, combustion products, epichlorohydrin, and acid mists auramine and other benzidine-based dyes, and a range of chlorinated organic compounds (McLean, 2006).

In the article "Cancer mortality in workers exposed to organochlorine compounds in the pulp and paper industry: an international collaborative study" by David McLean, who conducted a survey to link the chemicals and substances used to produce paper to the rate of paper factory workers developing cancer in their lifetime. The research had included 60,468 workers classified by a volatile organochlorine exposure status, with 82% of the people classified as "ever exposed" and 17%, 9,628 workers, were deemed "highly exposed." Additionally, 58,162 workers were classified according to nonvolatile organochlorine exposure status, with 45% 24,940 workers, classified as ever exposed to organochlorine's carcinogens, a toxic substance often found in paper production (McLean, 2006).

Won-Jin Lee conducted a similar survey; his survey attempted to link the mortality of workers exposed to sulfur dioxides from the pulp and paper industry to the mortality rate from lung cancer among the workers. The research team had discovered that exposure to sulfur dioxide from the pulp and paper industry had led to an increased risk of lung cancer, especially in the high exposure groups. They concluded that sulfur dioxide has a cancer-promoting effect when combined with multiple carcinogens used to produce paper. In their study, 7,613 deaths occurred among the group of workers overexposed sulfur dioxide, including 488 lung cancer deaths. The lung cancer mortality rate was slightly higher than anticipated, as the standardized mortality ratio was approximately 1.08, with the confidence interval standing at 0.98 (Lee, W. J et al., 2002). This proves that the excess of toxic chemicals in our papers is not only a plague of the environment; it is a personalized concern. The horrors of the pulp and paper industry's products are deemed environmentally destructive and destructive for our internal ecosystems: our own bodies. This research should act as a wake-up call that our environmental disregard will not only impact our Earth but ourselves both directly, from internalized cancers, or indirectly, by the excess of emissions in our atmosphere and by the act of deforestation.

To combat the detrimental environmental health effects due to pulp and paper production, the book making process should incorporate an alternative to standard petroleum ink. In books, the ink of which the text is printed is composed of petroleum. Although it is a natural resource, it is non-renewable (Hanes, 2010). Petroleum inks undergo a process of hydraulic fracking. A mixture of water, sand, and toxic chemicals is pumped under the Earth's surface, allowing for liquid natural resources to flow. The fracking process to produce the ink for book productions further harms the environment, as the average fracking job uses roughly 4 million gallons of

water per well. To put this into perspective, a single fracking job is equivalent to as much water as New York City uses every six minutes (American Petroleum Institute, 2020).

The use of petroleum is not a reliable source of printing inks, as petroleum inks must be refined and separated before making consumer products such as ink. Petroleum has been proven to be a toxic and flammable liquid; upon drying, it emits volatile organic compounds, VOCs, (Hanes, 2010). A VOC is an organic chemical that evaporates readily and forms toxic fumes. As a solution to this environmentally disapproved means of acquiring ink for books, soy-based inks should be used as a substitute. Soy inks are a preferred and promising means of printing soluble and reliable ink on to paper. Soy-based inks have been proven to work well on recycled paper, thus, encouraging a healthier production throughout the book making process. In addition, waste paper processors can de-ink soy-based ink publications due to their high solubility (Hanes, 2010). This eliminates the lengthy process of color stripping, removing toxic bleaching chemicals from papers, allowing more to be deemed recyclable. A soy-based ink product has been proven to emit less than 20% of volatile organic compounds than traditional petroleum-based ink. The alternative of soy ink is ideal, as it has fewer emissions, therefore complying with the Clean Air Act's 30% limit on ink production's VOC limit (Hanes, 2010). Soy inks will encourage the production of recycled paper and the reduction of chemicals infused into modern-day papers. As soy inks are more compatible and suited for recycled paper, it is an incentive to modernize the pulp and paper industry; to remove carcinogens from paper. This allows recycling to emphasize further the need to use an alternative resource to the petroleum-based inks used today. The soluble soy ink will allow more recycling and less fracking within our environment and the planet.

Another alternative to reduce the emissions and carbon footprint of the pulp and paper industry is electronic books. Ebooks allow people to read the same novels as a printed book. However, it will enable avid readers to receive the education they desire, without the fear of it leading to deforestation and pollution. Although ebook tablets, such as kindle or nook, contribute to environmental pollution due to the radioactive chemicals needed to produce the technology, ebooks lead to a cumulatively lessened carbon footprint. To reach the emission levels, water usage levels, and mineral composition of a single e-reader, a person would have to read approximately forty to fifty books. Ebooks are a superior alternative to book production, as consumers can read countless books on the same e-reader. Suppose consumers read at least 23 books per year on an electronic reading device, which is less than the average. The average e-reader reads approximately thirty-five books a year (Green Point Publishing, 2015). Therefore, Ebooks save energy consumed by book production, save trees from deforestation, reduce the use and production of paper, and most importantly, ebooks reduce the energy required and pollution levels reached to recycle or dispose of old books (Green Point Publishing, 2015). These statistics prove that electronic books negate the pulp and paper industry's harmful effects on the environment.

In conclusion, paper is a prominent material within our society. Through lengthy processes of color stripping, removing pigmentations and oxidative composition, and the preservation of the paper’s appearances, the recycling process of paper is hindered. Due to the inability to recycle paper, deforestation rates and carbon emission rates will continue to rise. The chemicals enforced in the pulp and paper making processes are discovered to be carcinogens, and workers exposed to the substances of organochlorine and other agents have been linked to lung cancer. To adverse the effects of pollution, the pulp and paper industry must partake in soy-based inks to

remove the color stripping process during recycling and processing pulps. A typical person, however, can make the ethical decision to turn to electronic books. Ebooks allow for more books to be read whilst reducing the carbon emissions per novel.

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