NCASI Fact Sheet

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Is Paper Compostable?

NOVEMBER 2018

Introduction

Consumers of paper and paper products are increasingly looking toward composting as an alternative to the traditional practice of disposal in a landfill. While there are many general recommendations available from governmental authorities and gardening organizations for composting paper, relatively little attention has been given in the scientific literature to paper's biodegradability and compostability. A review of some of the research on this subject was conducted by NCASI to provide further insight as to the impacts, if any, of using paper products for composting.

Biodegradation of paper in a compost environment

As a wood-based product, the biodegradation of paper is similar to that of wood in a natural soil environment, where soil bacteria and fungi use the organic carbon in the plant's cellulose, hemicellulose, and lignin as an energy source (known as microbial mineralization).

Composting is the controlled, accelerated biodegradation and transformation of organic material under primarily aerobic conditions producing carbon dioxide (CO_2), biomass, heat, and a complex, stable organic material (known as humus). Compost piles must be carefully maintained throughout the composting process to ensure optimal conditions are present. Some of the more critical conditions for composting paper are related to moisture content, carbon to nitrogen ratios, oxygen content, material particle size, and temperature. Microbial mineralization of cellulose fibers is a relatively slow process compared to that of more readily-available carbon sources, such as those found in food scraps. Therefore, it is important when composting paper products to maintain ideal conditions for microbial activity over a sufficient period of time (12-15 weeks) for complete biodegradation of the cellulose fibers. If done properly, the final compost product can be used to improve the growth of plants, enhance water holding and nutrient holding capacities of soil, increase soil aeration and carbon content, and fight plant diseases.

Photo Source: www.epa.gov 1

Composting bleached paper

Lignin is one of the three main components in wood, providing structural strength to woody plants. Lignin compounds are large, complex molecular structures that are difficult for microbes to break down. Bleaching pulp removes lignin that remains after the

chemical pulping process. Removal of lignin increases microbial access to the cellulose in bleached paper when it is composted and, ultimately, increases the biodegradability of the final product. Studies have shown that uncoated, bleached paper products show the fastest rate of biodegradation compared to other paper products. Bleached paper products were also shown to exhibit the highest degree of biodegradation, often resulting in close to 100% mineralization of the organic carbon present.

Composting Unbleached Paper

Unbleached paper products have relatively high lignin content, which can reduce overall biodegradability. Some laboratory experiments show significantly lower biodegradability rates for unbleached paper compared to bleached products because the lignin in the unbleached paper products is harder to break down. Note, however, that while part of the lignin can be broken down during composting, most lignin in paper is degraded into a stable humic substance that provides many of the benefits associated with compost and can therefore be a desired end product.

Composting paper with surface coatings or additives

Surface coatings and additives (e.g., wet strength additives) are typically applied to paper products to produce or improve a desired quality in the final product. The wide-ranging and unique chemical properties of these materials can impact how they behave in a compost environment. It has been shown that certain additives can reduce biodegradation rates early in the composting process, but some experiments using longer time periods showed paper with additives can achieve near 100% biodegradation. Similarly, the biodegradation of some coated/laminated papers has been shown to be slower compared to uncoated products, but for certain types of coatings such as silicone and paraffin wax, the overall decomposition process was unaffected. For paper products using non-biodegradable polyethylene coatings, experiments have shown that given sufficient time, the paper portion will biodegrade but the plastic film lamination remains in the final compost product.

Full-scale field trials

Full-scale studies specifically investigating the use of paper for composting have highlighted the impact and variability of results in the final compost product when ideal degradation conditions were not provided. Compost piles that did not have adequate conditions (i.e., time, aeration, nutrients, particle size, etc.) produced undesirable results. However, the field trials that did provide adequate conditions have shown that when compost piles are properly maintained, paper as a feedstock can produce a stable and valuable final product, confirming similar conclusions reached during laboratory experiments.

For More Information Contact

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