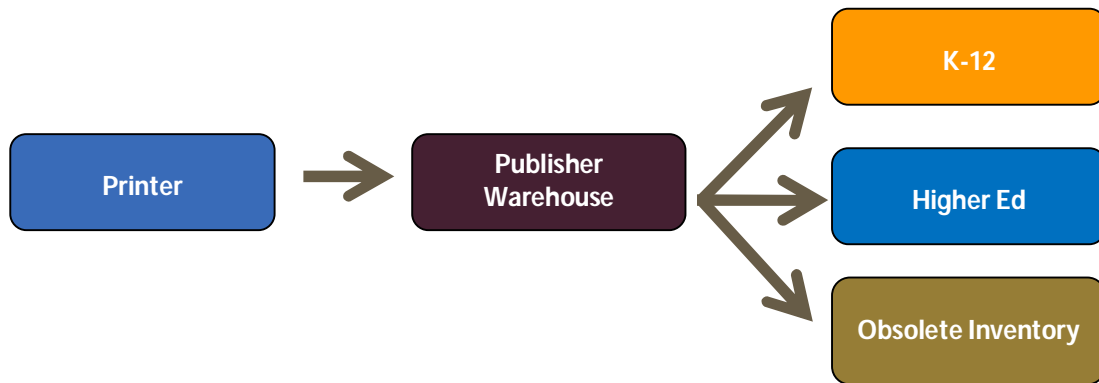


Textbook End-Of-Life Cycle

STEP 1: Distribution to Schools and/or Disposing of Obsolete Inventory



After a textbook has been printed, the publisher works with its own distribution chains to deliver the finished books to K-12 or higher education learning institutions. The publisher also manages its own inventory and makes decisions on how to handle obsolete inventory. From a publisher's perspective, obsolete inventory can contain unsold textbooks, inventoried textbooks that have been replaced by more current editions or titles, or printer overruns.



The vast majority of books that have reached the end of their useful life at publisher warehouses that cannot be used in some other manner are to a very large extent recycled.

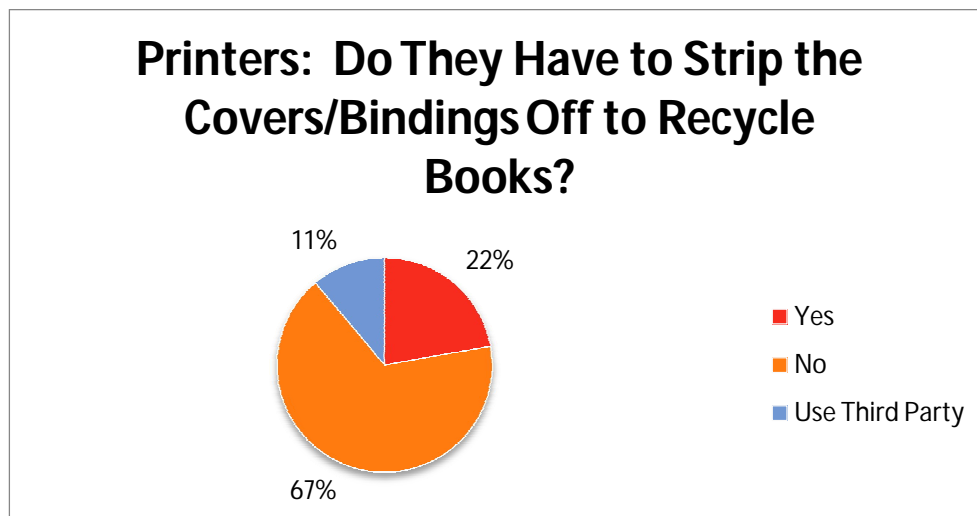
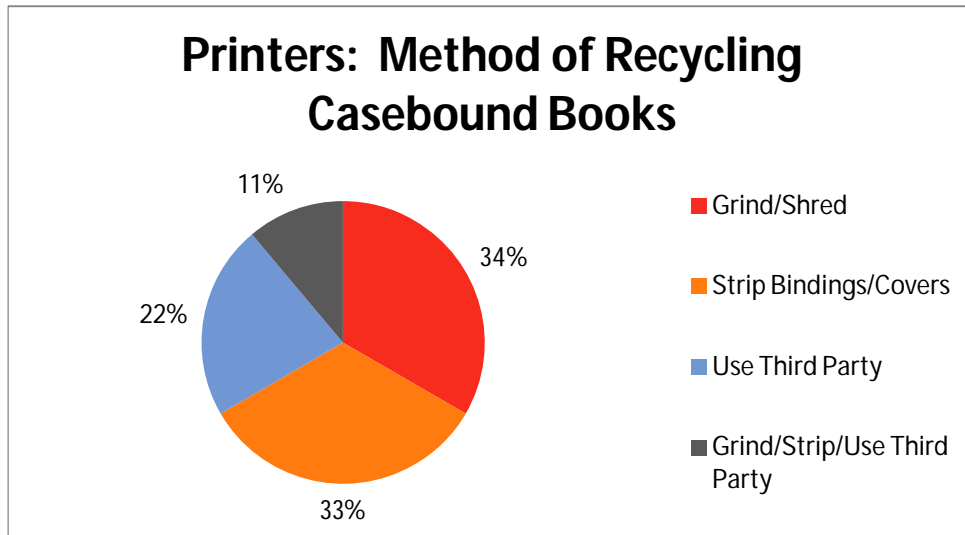
Economies of scale, cost efficiency, and environmental stewardship combine to make the process of recycling much more prevalent.

Conversely, while educational institutions share a desire to process hard-cover books in a responsible manner, they lack the aforementioned scale and cost advantage.

- David W. Schaefer
Vice President, Paper Operations
Global Procurement & Manufacturing
Services
The McGraw-Hill Companies

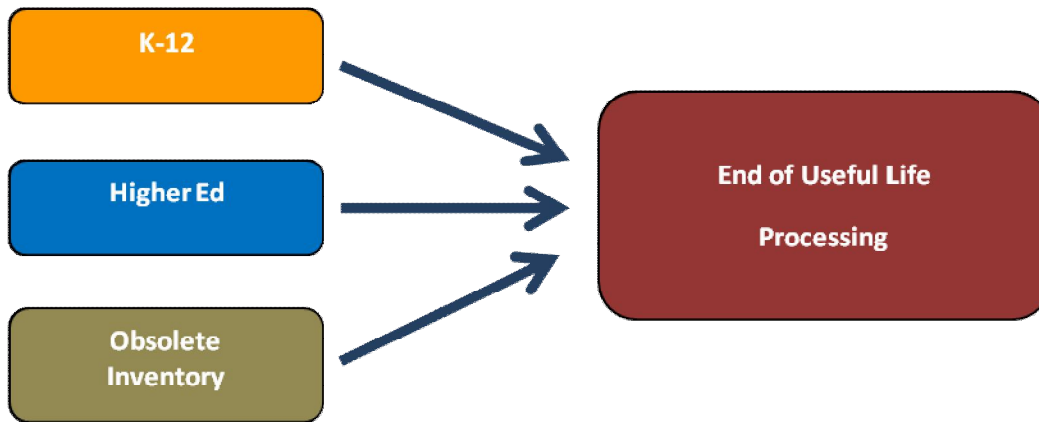
Printer Surveys

In reviewing the textbook manufacturing supply chain, we felt that it was important to understand how textbook printers address recycling of rejected casebound books, i.e., from the production/quality control process and/or via obsolete inventories that might be stored for a publisher at the printer's facility. Survey emails were sent to 25 printers located in multiple states. We received ten in-depth responses. All respondents reported that at any given time, they can have rejected casebound books and/or obsolete publisher inventory, and that they recycle what they have through a variety of processes. Some survey responses are below:



Several surveyed printers indicated that the method of handling casebound books for recycling varied depending upon where the books were physically located, the volume of books that needed processing, and the size and composition of the books. For example, one large national printer indicated that if a particular plant possessed a large enough shredder, the books could be shredded "as is," meaning with the covers and bindings intact. Other options would be to send the books out "as is" to a local processor who would either shred them, blend them as is into baled low grades, or remarket them to a processor in the region that possessed the specialty equipment to "de-case" the books, thereby allowing the recycling of each component separately.

STEP 2: Barriers to and Opportunities for End of Useful Life Processing



As indicated previously, both K-12 and higher education institutions are interested in finding ways to recycle their textbooks at the end of the book's useful life. However, both survey groups indicated that there are barriers and challenges to recycling textbooks and that these would need to be addressed so that they could make better informed decisions. Over 50 percent of both respondent sectors felt that textbooks and workbooks are under-recovered for recycling.

Perceived K-12 Barriers and Challenges to Textbook Recycling

Based on the 27 K-12 survey respondents, perceived barriers to recycling textbooks include:

- Highly labor intensive with no assigned personnel to do it
- Too much cost involved to recycle them
- Lack personnel to remove the covers and bindings
- Lack of information and awareness regarding recycling of textbooks
- Lack of locations on where books could be sent for recycling
- Lack of recycling incentives
- Lack of protocols for disposal of paper-based materials
- Having a convenient option for recycling textbooks



Perceived Higher Education Barriers and Challenges to Textbook Recycling

Based on the 374 higher education survey respondents, perceived barriers to recycling textbooks include:

- Student interest and buy-in
 - Storage of books until a disposal action is taken
 - Advertising the event with enough notice prior to the event
 - Finding staff time and resources to manage such a program
 - Not having multiple, convenient drop-off locations on campus
 - Books that are bound with spiral wiring cannot be recycled
 - Convenience and education about the program
 - Labor and transport after collection
-

Perceived Hauler/Recycler Barriers and Challenges to Textbook Recycling

Eighteen haulers/recyclers responded to our survey posted on a SWANA listserv. Over 61 percent felt that books (both casebound/hard-cover and soft-cover) are under-recovered, and that the main barriers and challenges to recovering more books are:

- Education to the schools about local recycling opportunities and programs
- Collection and transportation costs
- Binding removal costs
- Steady markets creating economical means for generators, brokers, and consumers

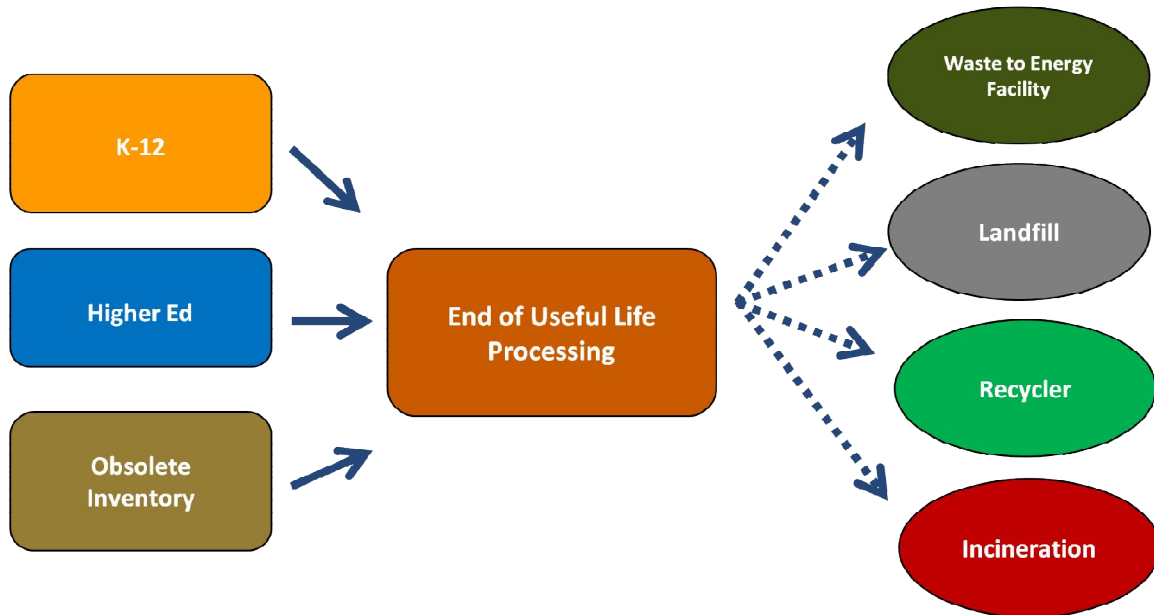
Perceived Opportunities by Learning Institutions

Our survey respondents – both K-12 and higher education – indicated that most of them have some sort of paper recycling in place, but lack knowledge on how to effectively and efficiently recycle textbooks as part of their overall program. This is a huge informational and knowledge gap that needs to be addressed with both sectors so that the perceived barriers can be overcome.

School districts use valuable time and storage space packing, stacking, moving, and storing obsolete materials, such as used textbooks. Additionally, the disposal costs for a large quantity of used textbooks can be significant. At the end of a book's useful life, schools need to know that recycling the books can provide maximum environmental efficiency and value, and that several different avenues for instituting the recycling processes exist.



STEP 3: End of Useful Life Processing



There are a number of choices to be made by various sectors and individuals at the end of a textbook’s useful life. Although donating or selling a book after one has used it is always an option, the book still has a “useful life,” albeit with a new owner. Therefore, we have not addressed these options in this study and instead have focused on what choices occur when a book can no longer be used, donated, or sold. Primary options at the end of a book’s useful life are four-fold: sent to a waste-to-energy facility; sent to the landfill; recycled; or incinerated. There is an acknowledged hierarchy of waste reduction and waste management that is helpful in reviewing options for when a product has met its useful life end. This chart prepared by the Columbia University Earth Engineering Center shows that – from an environmental standpoint – landfills are the least desirable option, and recycling is the most desirable option. There are, however, some intermediary options that are also choices that schools and publishers sometimes consider.



Figure: EEC Hierarchy of Waste Management, Columbia University, Earth Engineering Center

Least Environmentally Preferable Option: Landfills

Municipal Solid Waste (MSW)—more commonly known as trash or garbage—consists of everyday items we use and then throw away, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries. This waste comes from our homes, schools, hospitals, and businesses. The U.S. EPA reports in their 2010 MSW Characterization Report that books make up a small portion (0.4 percent) of the municipal solid waste disposed of each year.⁶

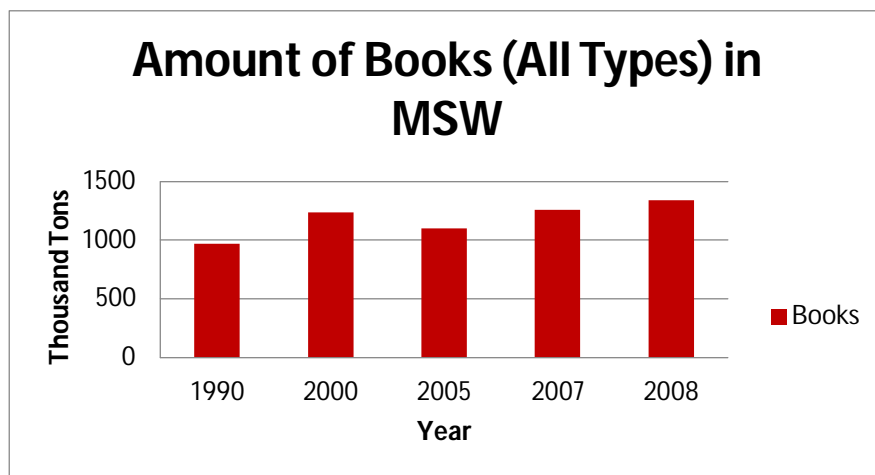
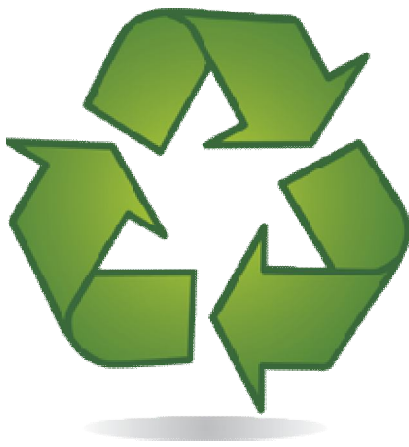


Figure: U.S. EPA MSW 2010 Characterization Report



The waste hierarchy generally refers to the three (or four) **R's** of **Reduce, Reuse, Recycle (and Recover)**, and **Re-Think**. In Europe, the waste hierarchy has five steps: Reduce, Reuse, Recycle, Recovery, and Disposal. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste.

In the U.S., while the millions of tons of MSW generated has increased, so too has the amount of waste that has been recovered for recycling. In 2005, 245.7 million tons of MSW was generated, and 58.4 million tons were recovered for recycling and 20.6 million tons recovered for composting. This has increased dramatically from 29 million tons for recycling and 4.2 million tons for composting in 1990. That said, there still remains a large component of paper-based products that are being sent to landfills instead of recovered and diverted from landfills⁷. The *2011 State of the Paper Industry Report* prepared by the Environmental Paper Network indicates that while paper is the most commonly recycled product, it is still one of the largest single components of U.S. landfills, comprising over 16% of landfill deposits equaling 26 million tons annually.⁸

⁶ It should be noted that during our peer review, several questions arose about the reliability of the EPA MSW Characterization Report regarding whether or not EPA's numbers were based on the total number of books sold versus sampling landfills to statistically determine that percentage. However, we are not aware of other waste characterizations that include books so this could not be verified.

⁷ U.S. EPA, Municipal Solid Waste 2010 Characterization Report

⁸ *The State of the Paper Industry, 2011*, Environmental Paper Network, p.4.

In 2009, there were 1,908 municipal solid waste landfills reported in the U.S. The following table shows the number of landfills in each region. The South and West had the largest number of landfills. Thirty-eight percent of the landfills are located in the West, 35 percent in the South, and 21 percent in the Midwest. Less than 7 percent are located in the Northeast.

Landfill Facilities, 2009	
Region	Number of Landfills
Northeast	128
South	668
Midwest	394
West	718
U.S. Total Landfills (2009)	1,908

A March 2012 report by *Waste & Recycling News*⁹ indicated that there is a proposal in the New York Assembly which would ban hard-cover books from disposal in solid waste landfills or by incinerator. Assembly Bill 9574 would also force every municipality in the state to establish a program to recover, redistribute, reuse or recycle hard-cover books within two years of the bill's passage. Under this bill, municipalities may establish joint programs with other municipalities or contract a third party to handle the program. The bill is sponsored by Assemblyman Alan Maisel, D-Brooklyn, and has been sent to a committee on environmental conservation.



U.S. Landfills, 2009, BioCycle October 2010

Most Environmentally Preferable Option: Recycling

After a textbook has met the end of its useful life, the most environmentally preferable option for disposal is to recycle the book responsibly. There are several methods for doing so, but they are not well known or widely advertised and will be discussed in more detail in the next report section.



As part of our research, National Wildlife Federation joined the Solid Waste Association of North America (SWANA) as a way to gather information from national haulers and recycling organizations, including municipal recycling and landfill entities. We received 18 survey responses from haulers/recyclers and municipal solid waste agencies in 14 states and Canada.

Of the respondents, more than 60 percent were local recyclers; 25 percent were regional recyclers; and approximately 15 percent were national recycling companies. Surprisingly, more than 80 percent of the respondents said that they do recycle hard and soft-bound books, and the volumes recycled were relatively high. Almost half pick up

⁹ Waste & Recycling News, March 26, 2012, "New York May Ban Hardcover Books from Landfills."

books weekly or bi-weekly, and is evenly split between whether or not the recycler picks up the books themselves or if they use a third-party hauler. Fifty percent use a guillotine flatbed cutter to remove the bindings/covers, but 70 percent of those who don't remove the covers, chip and shred them together. For those that do remove the covers and binding, 25 percent send these materials to a landfill; 25 percent send them to energy recovery; and 50 percent of them send the covers and binding to paperboard or corrugated manufacturers.

We also asked the frequency of textbook pick up from K-12 schools or higher education institutions, and 40 percent indicated that they pick up weekly. In terms of how the books are prepared for pick up, 27 percent of respondents said that students deposited the books in mixed paper recycling bins; while 46 percent reported that books are collected by the school and placed on a skid. Another 27 percent reported that books are dropped off at a special book recycling bin left at the school by the recycler.

There are national recycling resources, such as Earth911, that help groups identify recycling companies in their areas that will accept textbooks and it seems that soft-cover books are now being collected more easily in paper recycling bins. There is no special preparation necessary if the soft-cover's binding is stapled or glued; if it has a spiral, wire or plastic binding, recyclers request removal of the binding before discarding the soft-cover into a bin.

Recyclables Processing

Processing recyclable materials at the municipal level is usually performed at Materials Recovery Facilities (MRFs), mixed waste processing facilities, and waste composting facilities. Some materials are sorted at the curb and require less attention, while others are sorted into broad categories at the curb (such as a paper category and a container category), with additional sorting at a facility (MRF). There is a trend towards MRFs that can sort recyclable materials that are picked up unsorted (single-stream recycling).

Materials Recovery Facilities, 2009		
Region	Number	Estimated Throughput (TONS PER DAY)
Northeast	147	23,769
South	161	19,699
Midwest	144	21,320
West	126	21,565
U.S. TOTAL:	578	86,353

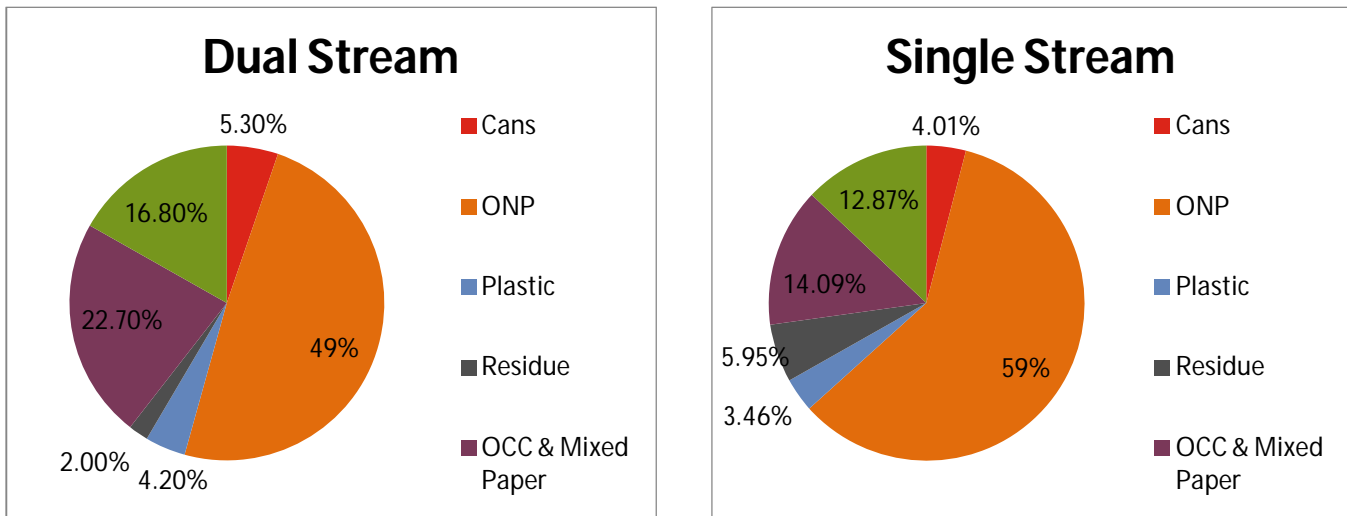
Source: Governmental Advisory Associates, Inc.

There are many debated advantages and disadvantages associated with the single-stream recycling method. A table of these is provided as follows:

ADVANTAGES	DISADVANTAGES
Reduced sorting effort may mean more recyclables placed at curb and increased participation in recycling	Initial cost for new carts, different collection vehicles, upgraded the processing facility
Reduced collection costs because single-compartment trucks are cheaper to purchase and operate	Processing costs may increase compared to multiple stream systems
Collection can be automated	Possible reduced commodity prices due to contamination of paper
Collection routes can be serviced more efficiently	Increased “down-cycling” of paper, i.e., use of high quality fibers for low-end uses like boxboard due to presence of contaminants
Worker injuries may decrease because the switch to single-stream is often accompanied by a switch from bins to cart-based collection	Possible increase in residual rates after processing (due chiefly to increased breakage of glass)
Can provide an opportunity to add new materials to the list of recyclables accepted	Potential for diminished public confidence if more recyclables are destined for landfill disposal due to contamination or unmarketability
More paper grades may be collected, including direct mail, telephone books, and mixed residential paper	



One analysis of the change in MRF product streams was performed for a specific location, Vadnais Heights, MN, as illustrated below¹⁰:

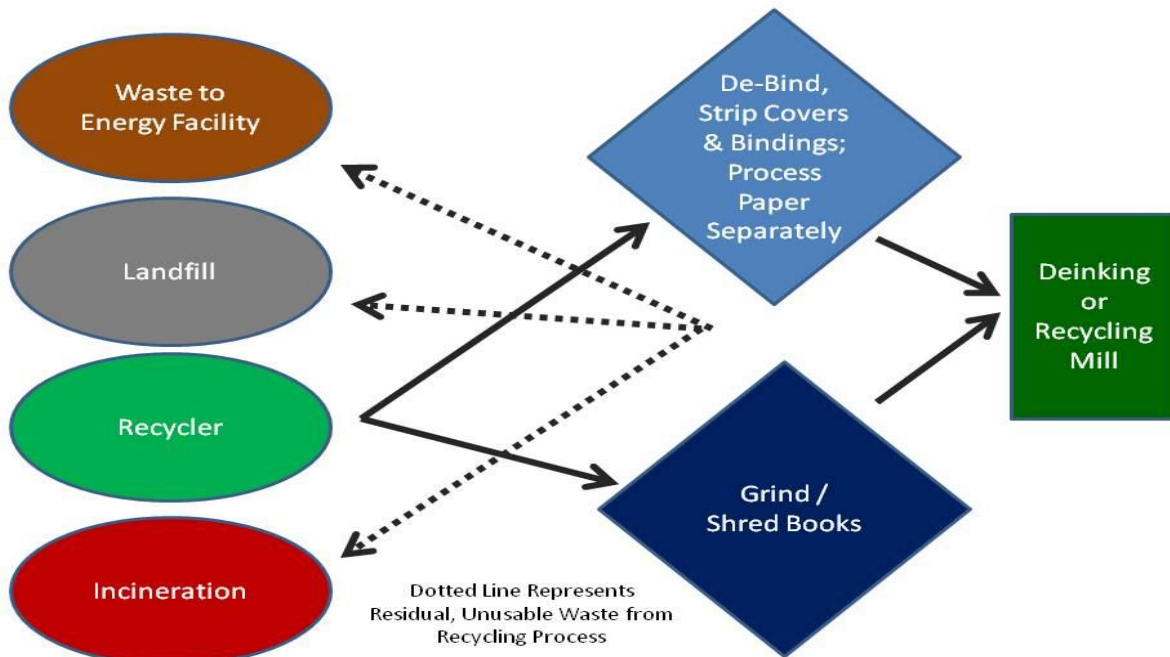


While recovery of some recyclables increased (i.e., old newspapers [ONP]), others such as old corrugated containers (OCC) and Mixed Paper decreased dramatically most likely due to source contamination.



¹⁰ Ibid.

STEP 4: Textbook Recovery and Recycling



Choices for Disposed Textbook Processing for Recycling: De-Casing or Grinding/Shredding

The most prevalent options for processing of disposed textbooks are de-casing and grinding or shredding. Each has its own unique advantages as described in the following sections.

Book De-Binding or De-Casing Process and Equipment



NorTech, Incorporated
P. O. Box 5
50 Lower Street
Valley, AL 36854
P: (334) 756-0296
W: www.nortech-incorporated.com
E: sales@nortech-incorporated.com

Through all of our research, we were only able to find one equipment manufacturer in the U.S. that produces equipment solely designed for de-binding or de-casing books – NorTech, Incorporated, located in Valley, Alabama.

NorTech, Incorporated was founded by Norman Milner in Lanett, AL as a machinery and electronics manufacturer in 1954. Since 1978, NorTech has manufactured a “book de-binder” that separates paper from covers and bindings. Many innovations in book feeding, paper separation and process automation have been developed since their first binder remover was built. Today, NorTech Book DeBinders™ are machines that feed books from a hopper to automated binder removal, with paper separation from covers and output of paper to a conveyor at a rate of approximately 1,800 books per hour. With the addition of an automated book feeder, random and different size books can be processed during the same run.

Additionally, Mr. Milner indicates that at the de-binding level, coated freesheet and groundwood could be separated which would create added value in the waste fiber collected. NorTech’s de-binding machine can be equipped with

computers and scanners that are capable of grading the books based on paper grade. To determine the economic advantage of de-binding versus shredding a book, Mr. Milner suggests that the books be either graded manually or with an automatic machine using ISBN numbers, but there exists potential problems with this method due to changes made by publishers in papers used. If less than 25 percent of the books are constructed of groundwood body stock, he indicated that it would be more cost-effective to de-bind them. If the percentage of groundwood is higher than 25 percent, then he suggested that it would be more economical to shred the entire book rather than debinding and de-casing it due to the higher value of freesheet paper versus groundwood. The book titles are read and run through conveyors to sort them by paper grade, with freesheet having the higher value. He indicated that he thought that most of the books being processed today are coated groundwood. These de-binding machines may be better suited at facilities such as printing companies where there is a more steady volume and known fiber types.

NorTech produces two models of book de-binders. One is the Model # AFS1800s with a Random Auto Book Feeder and Separator. This equipment can process up to 1,800 books per hour, and costs approximately \$55,000; the other is Model # DB1000, with a manual feed that can process up to 1000 books per hour and an approximate cost of \$24,000. NorTech does not rent or lease their equipment; all equipment is made to order four weeks after receipt of order and deposit. NorTech indicated that there are approximately 60 of their de-binders in operation nationwide, but would not provide contact information so that we could verify claims of processing quantities, return on investment and net profit, ease of operation, or target markets.



Book Grinding or Shredding Process

BOOK DESTRUCTION

Book-Destruction.com

52 Westerville Sq. #317, Westerville, Ohio 43081

P: (614) 895-1303

F: (614) 895-9330

E: Steve @Creativegreenmarketing.com

W: <http://book-destruction.com/>

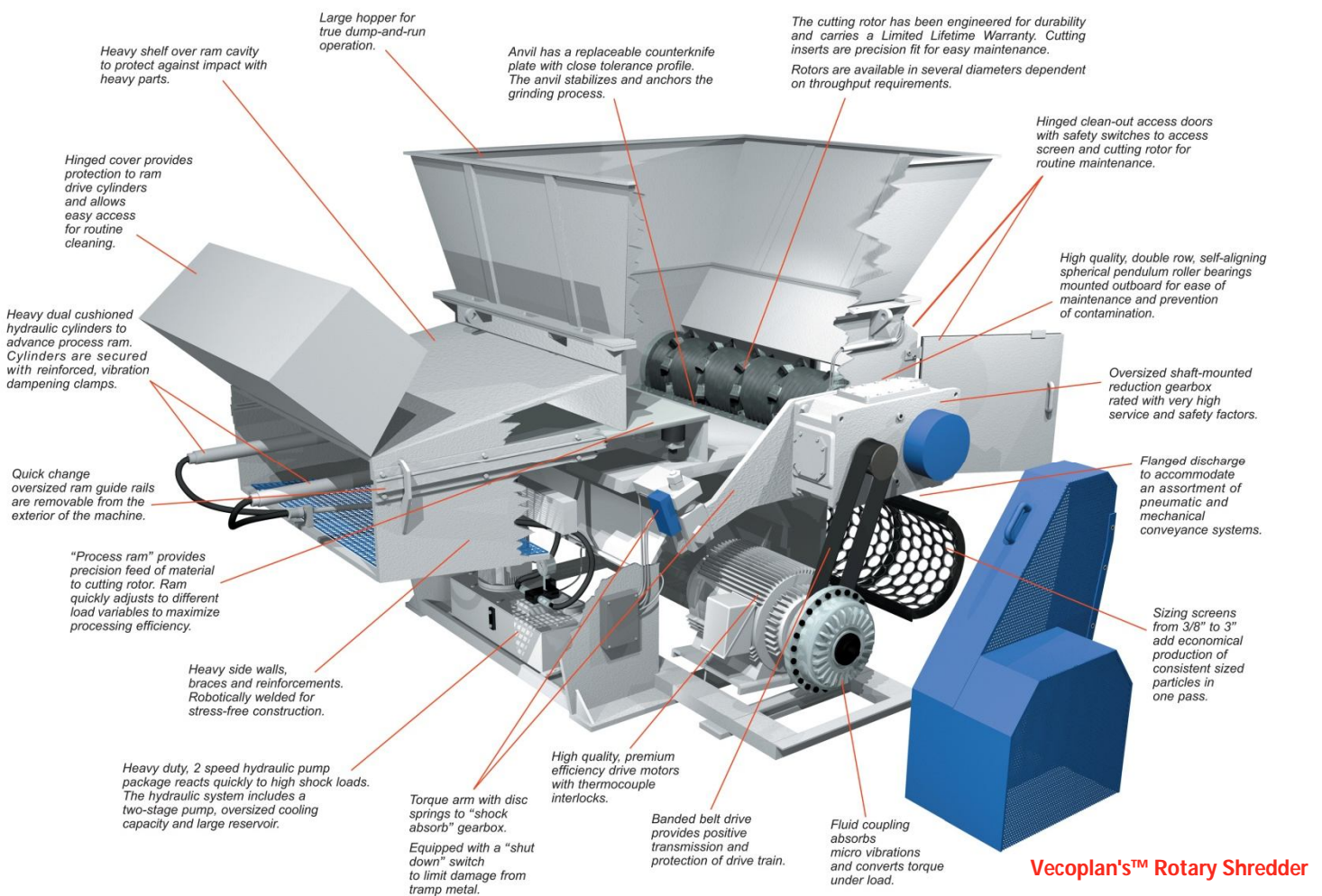
There are several firms that recycle both casebound and soft-cover textbooks, and the process that they utilize is grinding or shredding the entire book. This is a much less labor intensive process than stripping off the cases or bindings. One company that we surveyed, Book Destruction.com, is owned and operated by Mr. Steve Grossman, and is located in Westerville, Ohio. Book Destruction.com and its sister company, Green Marketing, LLC, focuses solely on recycling books of all varieties: hard-cover, soft-cover, spiral bound books and pamphlets. They recycle in excess of 500 tons of books per month, and cover the entire continental U.S. and parts of Canada.

Book Destruction.com utilizes a third-party hauler to pick up books and deliver them to specified locations. They pick up from both K-12 and higher education institutions. The books are gathered by the schools through students, faculty, or volunteers, and are placed in cardboard boxes, large Gaylord boxes¹¹, and on skids. Because the covers and bindings are not removed prior to destruction, the resultant fiber is sold as mixed paper and is generally used to make newsprint, commercial toweling and tissue as well as cellulose insulation. Their process of destruction is to chip and shred the book. Mr. Grossman indicated that there could be multiple phases of grinding necessary, depending on the book's construction. The finished size is approximately thumb sized, and goes into a vertical baler. They sell the chipped/shredded fiber to a variety of deinking and recycling pulp or paper mills, including Georgia Pacific and Kimberly Clark. Mills that can receive this type of fiber must have the ability to screen out contaminants in the hydropulper.



Vecoplan™ RG42U Rotary Shredder

One of the manufacturers of rotary shredding equipment, Vecoplan™, has a video that demonstrates how the equipment works, and is worth viewing. It can be accessed at <http://www.youtube.com/watch?v=FTc5izTzdA0>.



Vecoplan's™ Rotary Shredder

¹¹ The term "Gaylord box" is sometimes used to refer to triple-wall corrugated pallet boxes used for storage and shipping of bulk quantities.

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W: www.vecoplanllc.com

In terms of the types of recovered fiber that can be produced through this process, these include purely groundwood, freesheet, and a combination of groundwood and freesheet. Mr. Grossman said that about 75 percent of what he processes and/or sells is in the mixed or groundwood grades.



End Use of Recovered Fiber

For the most part, the recovered fiber from both the book de-binding and book grinding/shredding processes usually does not go back into printing and writing grade papers, but rather is used for lower grades such as cardboard, linerboard, boxboard, tissue paper, and insulation. While the recovered fiber is not replacing virgin fiber in office paper per se, it is still being used as a replacement for virgin fiber in other products, thereby freeing up other, higher grade recovered fibers for use in printing and writing grade papers.

