The Re-invention of Molded Pulp

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Molded pulp is no longer just a resource for packaging dunnage and egg cartons. It is quickly becoming a popular primary and secondary package due to its sustainable qualities. The manufacturing of molded pulp is improving, making it easier for companies to design more developed molded pulp packages. Companies are also taking the sustainability aspect of the material into account when designing their packages. Molded pulp can be made completely from scrap or recycled material (Twede and Selke, page 276, [14]). It can also later be recycled with normal paper recycling or disposed of in other creative ways such as planting.

History of Molded Pulp

Molded pulp is made from fiber slurry similar to that in the paper making industry (Twede and Selke, page 275, [14]). According to Wever and Twede [13], the first US Patent for a Fiber Pulp Mold was created in 1903. It became a popular packaging mechanism and was improved upon quickly. Within a year of the first patent, another patent improving the machinery to produce molded pulp was written. M.L. Keyes wrote both the first and second patents (M.L. Keyes [5,6]).

The original molded pulp machine is described in the patent as having a porous mold that is dipped in the pulp slurry. That mold is then compressed into a sister mold, also with pores, so that the excess slurry and liquid will drain out of the molds. The invention uses suction to help coat the mold with slurry and uses

compressed air to help release the molded part after it has been formed between the two halves. The molded part is then put in an oven to be dried (M.L. Keyes [5]).

As Twede and Wever [13] describe in their paper, "History of Molded Fiber Packaging," molded pulp was originally used with paperboard to make a fully functional package. Soon users would manipulate the process and designs to make packages that are made entirely out of molded pulp.

Eggs were packaged in molded pulp early on. The packages were designed for eggs, in addition to other products (Twede and Wever, page 3 [14]). Users began to design multi-functional packages for similar round products, such as fruit or light bulbs. The patents for this multi-use package dates back to 1920 (Twede and Wever, page 3 [14]). These package systems could also be made from a paperboard and molded pulp combination.

Currently there are four categories of molded pulp, but it was not always that way. Originally they separated molded pulp into two categories, Plain Molded and Precision Molded (Twede and Selke, page 275, [14]). Plain Molded is similar to the original process where the mold picks up the fiber and removes the water. The molded pulp is then dried in an oven. It will have one very rough side and one smoother side, where the slurry touched the mold. It is an economical and fast way of producing molded pulp.

In Precision Molding a second mold is utilized during the drying process (Twede and Selke, page 275, [14]). This condenses the fiber and creates a more "precise" molded part. Also the second mold allows both sides of the product to be smooth making it have a more attractive appearance.

About Molded Pulp

Currently there are four different types of molded pulp based on the manufacturing process and quality of materials put into the process (www.imfa.org, [4]). The first is called "Thick Walled" referring to the usual 3/16 to 3/8 inch thick walls (www.imfa.org, [4]). It is made primarily out of scrap and Kraft paper (Twede and Selke, page 276, [14]). Due to its unfinished surface and thick profile this type of molded pulp is used in packaging primarily for holding objects in place during shipping. The process for making this type of molded pulp is similar to plain molding as discussed in the previous section.

The second type of molded pulp is slightly thinner ranging from 1/8 to 3/16 inch thick (www.imfa.org, [4]). It is called "Transfer Molding" and is similar to Precision Molding. Both sides are finished as the pulp is transferred from one mold to another. This is why it is called "Transfer Mold." Egg cartons are an example of this type of molded pulp (www.imfa.org, [4]).

The third type is called "Thermoformed Fiber," where heated molds are utilized. These molds make the product more precise in shape and the material denser. The heated molds also make it unnecessary to have a drying step (Twede and Selke, page 276, [14]). This molded pulp is the closest in appearance to plastic once finished (www.imfa.org, [4]). It can be used in packaging applications and for such products as molded plastic tableware (www.imfa.org, [4]). This is also the newest molded pulp process (Twede and Selke, page 276, [14]).

The final type is called “Processed Pulp” and takes one of the other three types of molded pulp and “finishes it.” This could be adding printing, additives, coatings and items such as seeds, which will be discussed later (www.imfa.org, [4]). This would be considered a Type 4 “Processed Pulp” package (www.imfa.org, [4]).

Molded pulp has similar properties to expanded polystyrene and is therefore a good cushioning material (www.PacificPulp.com, [10]). The cushion curves from Pacific Pulp, shown in Figure 1, compare the performance of expanded polystyrene to molded pulp. It measures how much acceleration, in G’s, the cushion is able to absorb over a range of static loadings. The molded pulp was actually a better protective cushion then the expanded polystyrene. The performance shown on a cushion curve is dependent upon the manufacturer of the material and the thickness, size and shape of the cushion. This not only helps in

Figure One: Cushion Curves [10]

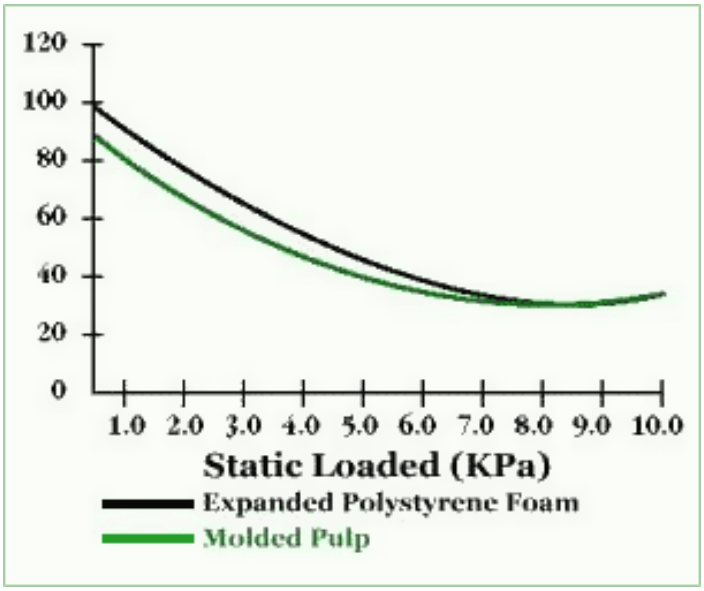
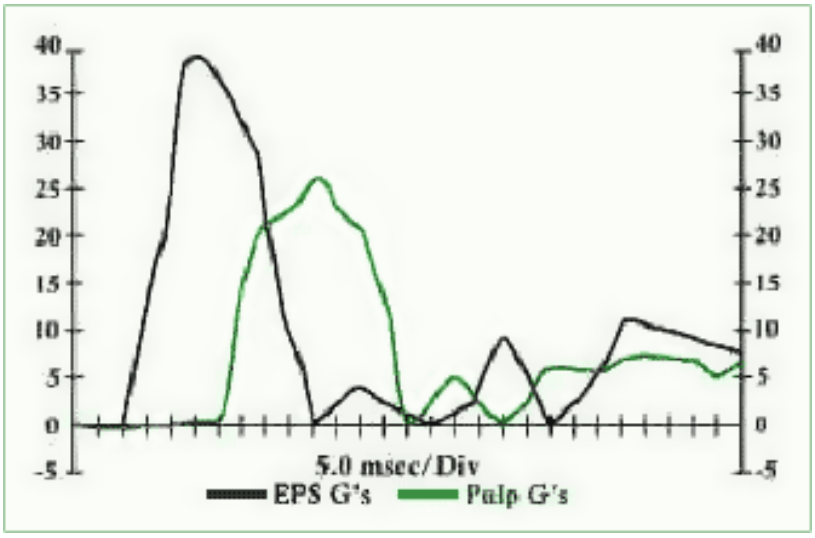


Figure Two: Drop Test [10]



dunnage, but also helps when using molded pulp as a primary or secondary package, since it has strong protective qualities.

If your package is exposed to shock, then the molded pulp package will be capable of absorbing that shock and the product would be protected. The drop test shock pulses shown in Figure 2 illustrate the shock, or acceleration, in G's, experienced during impact (www.PacificPulp.com, [10]). Results show that the molded pulp cushion had lower peak acceleration than the expanded polystyrene cushion (www.PacificPulp.com, [10]).

It is important to understand transmitted shock levels in order to design a package that has a balance between material usage and protection. If you over-package, in an attempt to eliminate all breakage, you will likely increase costs beyond an acceptable level. By researching and understanding shock performance, as well as other tests, the package will have a balance between cost, material consumption and protection.

Manufacturing of Molded Pulp

To create molded pulp you must begin with a fiber. The fiber used will be based on the end product desired (Twede and Selke, page 276, [13]). For example, when creating a stabilizer or cushion you can use recycled corrugated and Kraft materials (Twede and Selke, page 276, [13]). This will result in a thick, dark-colored pulp. You would most likely use the Thick-Walled manufacturing process with this kind of pulp. In the "New Uses for Molded Pulp" section, the Method Company adds bamboo fiber to increase strength (www.Method.com, [9]). Virgin material rather

than recycled material has been proven to be stronger as well. With molded pulp, the shape and size of the molded piece will play a large part in how strong the piece will be.

In manufacturing, fiber is mixed with water in a giant blender. As it mixes, a slurry is formed (Twede and Selke, page 276, [14]). The slurry has the same consistency and thickness of pancake batter and is also quite heavy. If additives were to be used, they would be mixed into the slurry. An additive could be used to make the product stronger, printable, smoother, or to add color or bleach the slurry.

The slurry is then put into the mold. The mold has either perforations (M.L. Keyes, [5]), mesh (Twede and Selke, page 276, [14]) or a mixture of both, that help assist in coating the mold with the pulp. They utilize suction and/or vacuums to create an even coat of slurry in the mold (M.L. Keyes, [5]).

Process changes occur at this point, based on which molded pulp process is being utilized. If the process were to continue via the Thick-Walled process it would go directly to the heater (Twede and Selke, page 276, [14]). If a smoother surface and denser pulp is desired, a second mold would to be utilized via the Transfer Molding process before continuing to the dryer (Twede and Selke, page 276, [14]). The last option is to have the mold heated and allow the pulp to dry right in the mold and eliminate the need for a secondary dryer (Twede and Selke, page 276, [14]).

New Uses for Molded Pulp

Currently molded pulp is being used as a green statement. Companies are realizing the protective benefits of molded pulp and consumers are aware of the sustainable aspects of the material. Packagers are considering both factors, as they design and market their products.

Pangea Organics is a company whose focus is on environmentally friendly practices and holistic products (www.pangea.com, [12]). As their website states, they are "a community of like-minded people who believe in creating products that help rather than harm at every stage of their lifecycle" (www.pangea.com, [12]). Their soap packaging utilizes molded pulp to meet this objective.

Figure Three: Pangea Organics Packaging [11]

Their soap (in addition to other products) is packaged in a clamshell in the shape of a soap dish. The clamshell is made completely out of Processed Pulp. Within the molded pulp slurry the company added plant seeds (www.pangea.com, [11]). The consumer can take the used package and bury it in their backyard. The package will decompose and the seeds will grow a plant or flower in its place. The package is then wrapped in a recycled paperboard sleeve that holds the clamshell closed and is used to market and label their product (www.pangea.org, [11]). This sleeve also tells the consumer what plants will grow from the package.

The addition of seeds allows the package to become a part of a new ecosystem. This generates an innovative package from a classic manufacturing

process. In addition, if all of the slurry is from recycled material then this is giving yet another life to the material that has already been used twice.

As mentioned earlier, the Method Company is adding bamboo to the pulping process to create a stronger pulp (www.Method.com, [8]). Since bamboo is known to be a fast growing renewable resource, it is an environmentally friendly way of adding virgin material to the molded pulp (Cusack, page 1). They use molded pulp as a secondary package (along with a paperboard sleeve) for a "floor care kit" and as a primary package for refills for that kit (www.Method.com, [9]).

Figure Four: Method Floor Cleaning Kit Package [9]

Method uses what they call a "karmic packaging" approach (www.Method.com, [8]). They try to make everything "in balance." They explain that they will use recycled material to make a recyclable container and that they offset their carbon emissions by planting forests. While doing all of this they want to have a package that will be user friendly and attractive. Their website illustrates this by saying "Form, meet function. Function. Form. You two play nice," (www.Method.com, [8]). Finding the right balance of form and function is key in packaging. They use molded pulp to create a package with smooth lines and curves, while still being user friendly. Their packages will protect the product and they are sustainable.

Figure Five: Newton Running Shoe Box [1]

Molded pulp has been used in other product package systems. Newton Running Shoes created a shoebox made from molded pulp (www.treehugger.com, [1]). The outline of the shoebox curves around the shape of the shoes. This design creates strength in the package, compared to the standard rectangular box. It also saves material by not adding extra tissue paper to fill the void between the rectangular shape of the box and the shape of the shoe. In addition the company puts a sock in one shoe and a reusable bag in the other shoe rather than more tissue paper (www.treehugger.com, [1]).

Sustainability of Molded Pulp

Laws across the United States are currently changing, banning the use of certain plastics. Some of those plastics can be replaced by molded pulp. For instance, expanded polystyrene containers can easily be replaced by molded pulp, due to the similarity in performance of the product. In places like San Francisco where the use of expanded polystyrene as a take out container for food is banned, molded pulp can be the replacement (www.treehugger.com, [3]). In this case however the molded pulp would have to be bleached or virgin materials used, to conform to FDA food contact regulations (Lenz, page 2 [7]). This does take away from the sustainability of the material. However, the material is not made from petroleum, it can be broken down and recycled, unlike plastics, and in some cases can be produced in a closed system.

While molded pulp is a great alternative to many plastics there are some disadvantages to the material. The heavy weight of molded pulp may raise the

emissions from transport vehicles. When shipped long distances it may not be cost effective or environmentally friendly (Twede and Wever, page 5).

Conclusion

While molded pulp might not be a new material, the new uses for it are innovative and continue to develop. It has been shown that it can be used as an environmentally friendly replacement for expanded polystyrene, whether as shipping dunnage or as primary packaging. Changes in production of the material, from using heated molds to adding seeds or other additives, helps expand its uses. A material like molded pulp has endless possibilities and the innovations will continue to evolve.

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