RECYCLING OF TETRA PAK ASEPTIC CARTONS

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1.0 Abstract

Aseptic packages are made of several laminated layers, including paper, aluminum and low-density polyethylene. High amounts of non-wood materials and lack of knowledge on the manufacturing of the package has made recycling aseptic packages an issue for the paper industry. The demand for high-grade fibers for recycling led paper mills to look for alternative solutions. Furthermore, studies on recycling aluminum and low-density polyethylene residuals at plastic recycling mills were held in Brazil and showed great results for both paper mills and plastic recyclers.

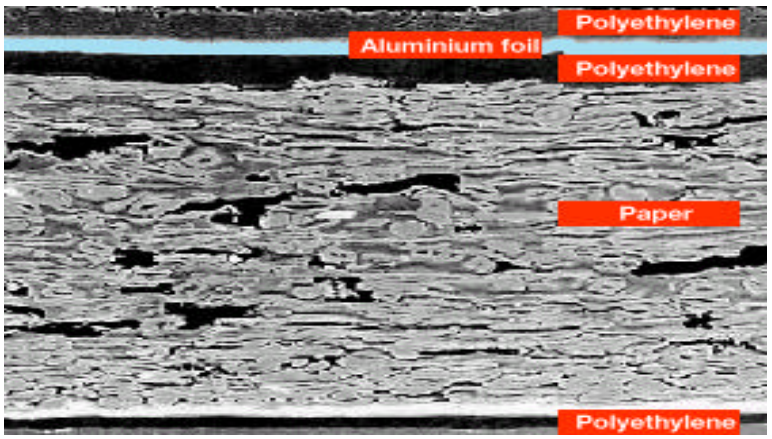
2.0 Tetra Pak

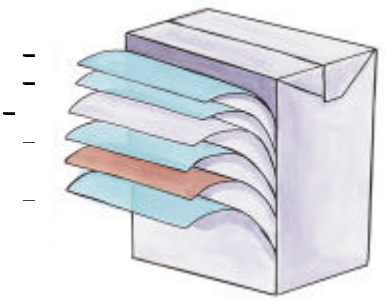
Tetra Pak has the ambition to become and remain the world leader in liquid food processing and packaging. We supply both packaging material and processing machines. The amount of packaging material sold by Tetra Pak in 1999 was equivalent to 86 billion packages, of various sizes. And most of the packages sold were suitable for aseptic packaging. Tetra Pak has 18400 employees around the world, at 66 production plants, 70 service centers, 9 machine assembly factories, 12 R&D centers and 78 marketing companies, serving more than 165 countries. Currently there are approximately 8200 packaging machines in operation.
The packaging material is laminated from paper, low-density polyethylene and aluminum (aseptic packages) and is sold as rolls. Tetra Pak is one of the largest buyers of paper, processing over 1 million tons of paper worldwide per year. All this paper comes from a few suppliers such as Westvaco, Klabin, Potlatch, Stora-Enso and AssiDoman.

Tetra Pak does not buy paper made from (or with) recycled fibers, due to the possibility of food-contact and the high requirements on stiffness. Almost all the board used in North America, Japan, Korea and Australia comes from bleached sulfate pulp. In South America it is mostly unbleached duplex board from sulfate pulp. Europe, Africa and Asia also use unbleached sulfate pulp, but recently the utilization of a three-layered board, with CTMP, has increased due to promoting stiffness and source reduction at the same time.

3.0 Aseptic

Tetra Pak Aseptic cartons are multi-layer polycoated paperboards. The type of paper used depends on the product being packaged, the regional market where it will be sold and the manufacturing conditions. But generally it represents 75% of the total weight of the package. The barriers consist of four or five layers of low-density polyethylene and one very thin layer of aluminum, which accounts for 5% of the total weight.





A one-liter package weights only 28 grams, despite having 6 or 7 layers. Temperature is responsible for gathering all of the layers, which means no glue or hot melt is added. Also, because there is absolutely no contact between the paperboard and the liquid inside the package, no kind of wet-strength is ever used. Therefore pulping this material in any conventional pulper at a paper mill is not a difficult job. As long as the package is opened, perforated or shredded, thus contact between the water and the paper layer is provided, the layers will separate due to the centrifugal forces inside the pulper. All Aseptic packages are identified as such, generally on the bottom flaps.

4.0 At the paper mill

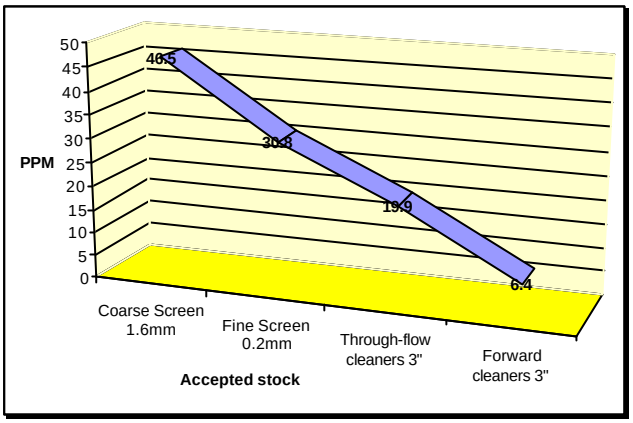
Dealing with a raw material that delivers 25% of residuals is not usual for a paper mill. The drilled plate of a batch pulper will hold substantial amounts of material, after fiber extraction. Therefore the pulper will have to be cleaned after every batch. Running a continuous pulping

may lead to an increase in fiber loss, due to the constant ragging of the rope and constant discharging requirements for the detrasher unit.
Comparisons among low, mid and high consistency pulping showed no significant differences on pulping times. The lower attrition and lower speeds of high consistency rotors tend to separate the layers with a minimum breakage of the non-wood layers, thus avoiding further contamination of the system.
Hence, at the same time paper mills pulping Aseptic packages have a source of high-grade fibers but an operational problem to be solved. Namely, cleaning the pulper. There are two ways to deal with this problem. One is to blend small amounts of cartons to regular waste paper supply, in order to minimise the number of times the pulper will require cleaning. The other is to use a drum washer, generally used to clean pulpers that work continuously, to allow dumping of all the contaminants and wash them out. Doing so, the pulper will be quickly available for the next batch.

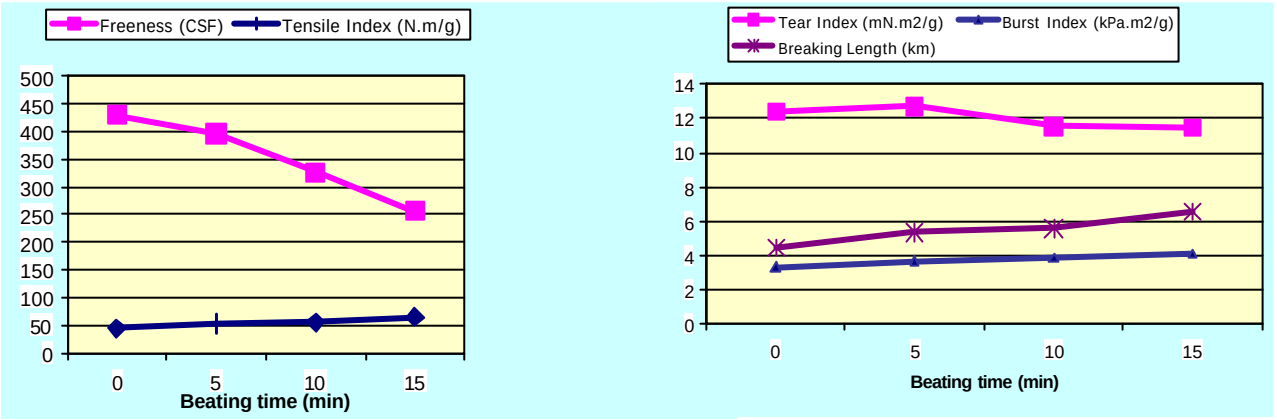
The quality of the fibers present on Tetra Pak cartons, however, is much superior to the average found on the waste paper market.

4.1 Cleaning performance

This chart shows how each cleaning machine affects the final quality of the paper. PPM stands for parts per million and is measured as the number of dirt spots in a sample sheet of paper, according to TAPPI Standards. The numbers shown below are practical figures from a sample of paper that is made 100% from Tetra Pak cartons, coming from South America.
The cleaning equipment should be properly sized according to the final quality and cleanliness of the paper being manufactured.



From the same samples, paper sheets were made from cleaned fibers and sent to Miami University in Oxford, Ohio, which reports are shown on the charts below.



5.0 Brazil

Tetra Pak Ltda, in Brazil, decided to find a way to help the papermakers and at the same time increase the recycling rate of their package in that country. Some batches of shredded and unshredded packages, from both industrial scraps and curbside collection, were run at Thermo Black Clawson ' s pilot plant, in Cincinnati, USA, back in 1996. Best results were achieved using a Hi-Con Hydrapulper, with an extraction plate below the rotor, which is not standard for high consistency pulping. Room temperature water was used for pulping and absolutely no chemicals were added. Through the extraction plate, all fibers were extracted and sent to screening and cleaning devices. The aluminum and plastics strips were kept inside the vat and later on directly discharged through a Selectpurge, in order to recover the white water and fiber free contaminants.

One year later, one of the largest pulp and paper manufacturers in Brazil, Klabin Fabricadora de Papel e Celulose, decided to place an order with TBC`s licensee in Brazil, for a system dedicated to recycle 50 metric tons per day of aseptic packages. This system was installed at their Piracicaba mill, supplying stock for the top ply of their 250 metric tons per day linerboard Voith paper machine.

6.0 Canada

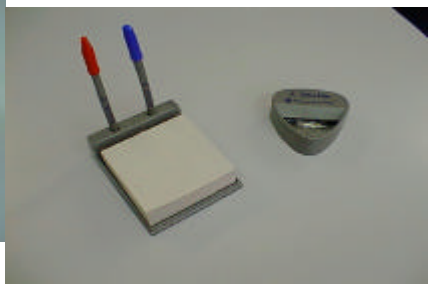
There are two paper mills committed to recycling Tetra Pak aseptic cartons in Canada. Atlantic Packaging, from Scarborough, Ontario, will be the first one and is expected to start doing so in early June, 2000, while Crown Packaging, located in Burnaby, BC, will pulp both aseptic cartons and gable top packages, beggining October 2000. Both paper mills added a drum washer (Selectpurge 5000) to their existing 14ft mid-con pulpers, in order to clean the pulpers and process the aseptic cartons.

7.0 Pulper rejects

Experiments were held in a plastic-recycling mill, with the aid of Unicamp (Universidade de Campinas, Brazil) where all tests of raw materials and final products were held. The reason for the experiments was to recover the low-density polyethylene and the aluminum without their separation.
Extensive work on chemical and mechanical properties was reported by von Zuben and Neves, who concluded that the composite showed higher resistance under traction than virgin low-density polyethylene, delivering more stiffness, due to a higher elastic module. However, the composite achieved lower figures than LDPE for most mechanical properties. Therefore, it is not just an alternative for low-density polyethylene, but may also replace high-density polyethylene in some applications.

The process to recycle the polyethylene and the aluminum altogether consists of washing the wood fibers out, agglutinate both materials (LDPE and aluminum), and extrude them to obtain pellets and further on inject suitable pieces in a mould injection machine.
Currently, this composite is being used in Brazil to produce a large number of products, including hangers, pens, brooms, notepads, clip holders, flower pots etc. Some of the products are made 100% from this composite whereas others are a mixture of the composite and virgin low-density polyethylene.





8.0 Bibliographic references

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Zuben F.v. & Neves, F.L. (1999). Recycling of Aluminum and Polyethylene present in Tetra Pak packages - Sao Paulo, Brazil.