Used beverage carton recycling – an introduction to recycling technologies for fibres in used beverage cartons

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Abstract

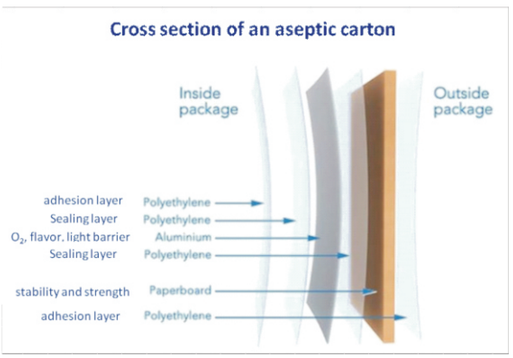
This paper describes & discusses the innovations in UBC recycling technologies & new systems being developed for separation of fibres & polyAl (polyethylene + Aluminium) by different reputed equipment suppliers. The final pulp recovered has potential to be either used separately or can be blended with different furnish to manufacture packaging grades of paper (media Kraft, Liner Kraft & Liner boards) & boards. The polyAl separated is recovered as a bi-product from paper mills and is used as a raw material for plastic industries for making different polyAl end products either by using it 100% or can be mixed with other grades of plastics. Following topics are covered under recycling of used beverage cartons.

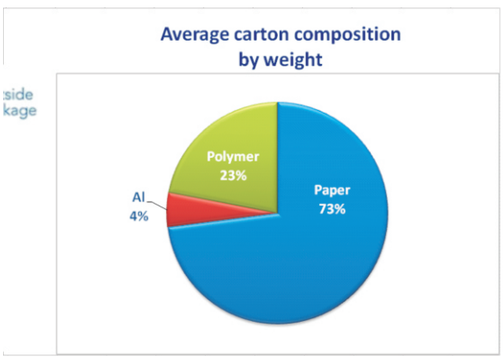
- Beverage carton recycling overview
- Why used cartons often go to paper mills?
- Turning used cartons into an asset
- Equipment suppliers
- UBC pulping & polyAl technology
- Summary

Key words : Used beverage cartons (UBC), Used Tetra Pak cartons (UTPC), polyAl (polyethylene + Aluminium), Gable Top (GT), Central Pulp & Paper Research Institute (CPPRI), American OCC (AOCC), Aluminium composite panel (ACP), Tetra Fino Aseptic (TFA)

Introduction

Our used Tetra Pak cartons are composed of 73% fibres, 23% polymer & 4% Aluminium.





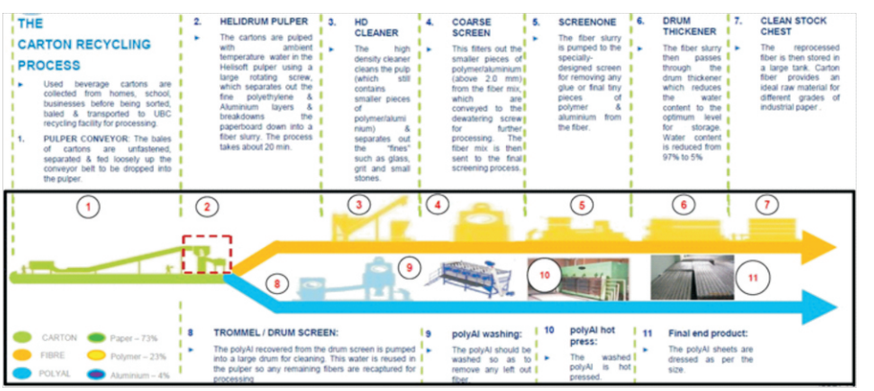
We use only high quality virgin fibres in our packs. These packs can easily be recycled either alone or together with other types of raw material in the same pulper & down the line equipments with some modifications in the pulper. Since the polyAl content is ~27%, equipment suppliers are developing/

developed systems suitable to handle & recover the polyAl without much damage to the aluminium part. The highly efficient technologies developed separate pulp from polyAl. Study done by CPPRI shows that the pulp qualities of used Tetra Pak cartons are at par with AOCC hence is processed at paper mills for replacing AOCC (20 – 100%) & can be recycled many times. Pulp properties for brown cellulose from recycled beverage cartons match the requirements for corrugated paper.

PolyAl recovered as a bi-product from the hydra pulper has a consistent quality & hence is used as a commodity by the plastic industries either mixed together with other grades of plastic or can be used separately for making different valuable end products. Agglomeration, Chemical separation, hot press, WPC and granulation by extrusion are some of the common technologies being adopted by different plastic end product manufacturers.

The carton recycling process

The process flow below is self explanatory to describe the compact system for separation of high quality fibre & polyAl as a bi-product from the hydra pulper.



The existing hydra pulper (no.: 2 in the figure above) can either be modified or replaced with the new design for smooth operation & efficient extraction of high quality fibre & the bi-product polyAl. The pulp separated from the polyAl is pumped into dump chest/ dump tower to be processed down the line, with the system available in the secondary fibre treatment plant.

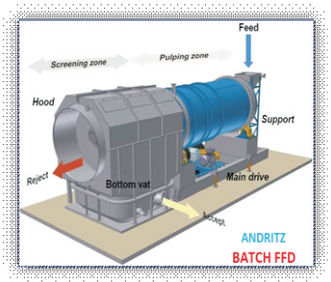
The polyAl which a composite of polyethylene & Aluminium is then dewatered, baled & sold as a raw material to the plastic industries. The polyAl is further treated either in the wet washing line or in a dry cleaning system which reduces the residual fibre content in the polyAl to ≤ 1.5 to 2.0% making it suitable for making high end valuable polyAl products such as polyAl pellets (B2B products) or polyAl roof sheets…ACP (B2C products).

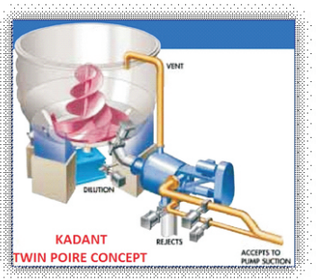
Equipment suppliers

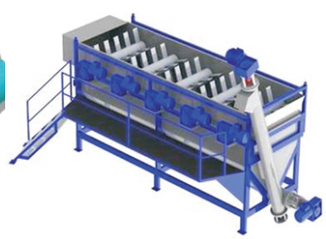
Every reputed equipment suppliers like Kadant (Twin Poire & Helidrum concept), Andritz (Batch fibre flow drum concept) & Voith Meri (WPSD concept) are working towards innovations & developing efficient UBC recycling technologies. These new technologies developed through R&D are able to efficiently handle the high polyAl content in comparision to the existing equipments & systems available with different paper mills without any Aluminium fragmentation.

We also have worked together with Parason, a local equipment supplier for the delivery of a pulping system in the cluster.

We are also working with numerous equipment suppliers for the development of technologies which can efficiently pre-treat polyAl thereby reducing the residual fibre content in the polyAl & the moisture content is reduced to the minimum thus making polyAl ready for use in different polymer end products i.e. can be either used 100% or can be mixed in different ratios with different polymers.

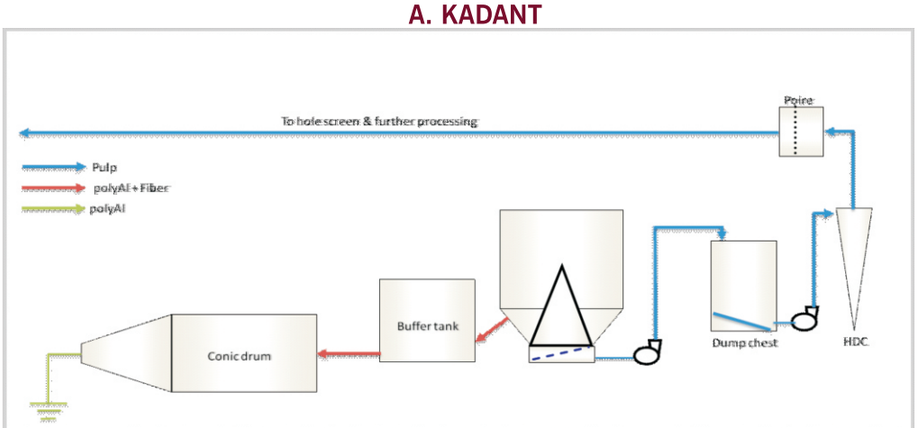






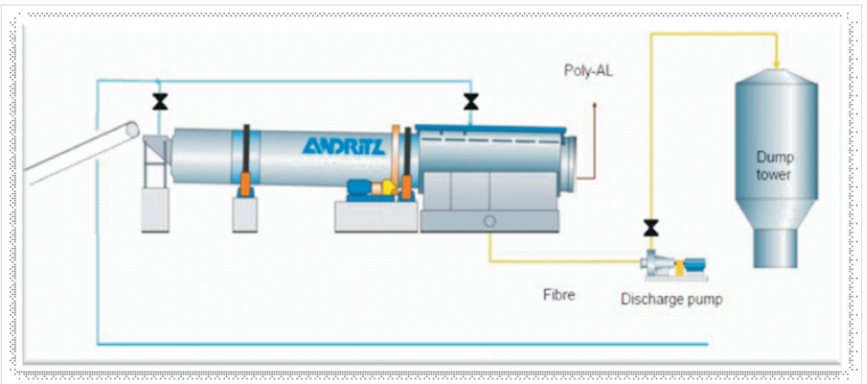
UBC pulping & polyAl technology

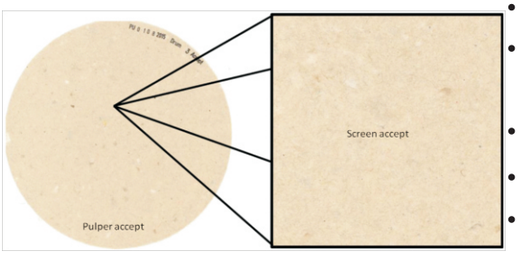
A. KADANT



- Twin Poire concept (not necessarily 2 Poires for lesser capacities) can handle max upto 50TPD infeed in HC pulper.
- Beyond 50TPD infeed, HELIDRUM concept is a possible solution.
- The concept of Twin Poire is to have a bigger volume Poire equal to at least half of the pulper useful volume
- HELISOFT rotor is used for pulping
- No extraction screen plate in HC pulper in case of Twin Poire concept
- Pulping consistency can be maintained at ~18 – 25%
- Fibre to fibre yield is ≥98%
- Fibrous material in polyAl is ≤1.5%
- TFA slushing is better with HC pulper
- Bacteria killing can be used to eliminate residual smell

B.ANDRITZ





- Batch FFD can be used upto 70TPD infeed. For capacity more then 70TPD, continuous fibre flow drum is recommended
- Operating consistency: ~18 – 25%
- Single line solution for Pulping/washing/ screening & reject separation.
- Fibre to fibre yield is ≥98%
- Fibrous material in polyAl is ≤2.0%
- No significant rotating parts inside the drum hence no wear & tear
- PolyAl is discharged after washing cycle at the rear end of the drum
- Easy operation & less human resource demand.

C. PolyAl technologies

1. **Agglomeration:** PolyAl pieces are fused together by friction or heat. Process can be both batch or continuous.
2. **Chemical delamination:** Polymer & aluminium layers are separated and can be used instead of virgin materials.
3. **Hot press:** The operation is defined as the production process of boards & roof tiles consists in the melting of the material under pressure and its subsequent cooling.
4. **WPC:** whole post consumer beverage cartons are used in products without separating the raw materials (fibre, polymer and aluminium). Sheets or profiles and hollow structures of carton composite material are produced.
5. **Granulation:** PolyAl in its original form usually have a low bulk density and a high moisture content. Pelleting increases the bulk density.

D. Evaluation of fibre quality by CPPRI

Study of Different Pulp Properties - Post Pulping

SL. NO.	PROPERTIES	RAW MATERIAL		
		AOCC	IOCC	UTPC
1	Recovered fibre yield	93%	85%	60%
2	Ash content	1.30%	3.60%	4.20%
3	Freeness/ ^{o}SR	683/ 16	540/ 23	650/ 17.5
4	ISO brightness	16	22	42
5	Viscosity - cm^2/gm	921	446	736
6	Fibre strength - ZSTS - Km	104	8.3	12.4
7	Orientation index	1.4	2.3	1.6
8	Fibre length - optical method - mm	1.0	1.2	1.1
9	Fibre length - Bauer Macnnet method - mm			
A	> 2.8 mm (long fibre fraction)	57.40%	35.50%	43.70%
B	< 2.8 mm (middle fibre fraction)	36.90%	35.50%	45.30%
C	< 0.7 mm (short fibre)	7.10%	27.60%	11%

Study of Different Pulp Properties - Post Pulping

10	Fibre length distribution index	8.1	1.3	4.00
11	Fines content - not useful for paper making	4.0	8.6	6.2
12	Burst factor	19.7	13.9	33.4
13	Tensile strength - Km	1.9	1.7	2.1
14	Tear factor	78	76	92
15	Double fold	15	17	18
16	Porosity - ml/min	2789	2283	2400
17	Ring crush - RCT - N/m	700	700	900

PARAMETER	AOCC	IOCC	UTPC
Moisture, %	6.0	9.0	6.0
Fiber, %	87.4	78.3	59.4
Reject (Fiber), %	1.9	1.8	5.8
PolyAL, %	NIL	NIL	20.8
Other Losses (Fines), %	4.7	10.9	8
TOTAL, %	100	100	100

Conclusion

We can conclude from the developments that the system developed by the reputed suppliers is simpler than the traditional one. As this system avoids high residual fibres in the polyAl, improved yield, the operation of the system is simpler & easier with better system yield & less fragmentation of Aluminium particles.

- The raw material is can be easily slushed and is a good source of recycled fibre.
- There is a potential to use this raw material in blended material furnish to manufacture packaging grades of paper and boards.
- The fibre in is well suited to manufacture media Kraft, liner Kraft and liner boards.
- 40 – 80% UTPC fibre content in the blend:
- UTPC: IOCC => remarkable improvement in the physical strength properties.• UTPC: AOCC => better improvement in strength properties observed in comparision to 100% AOCC

REFERENCES :

1. *R&D work done by Kadant, Andritz, Voith Meri & Parason*
2. *Internal documents from Tetra Pak*