To,
Mr. Pravin Mallick
Environment Director - South Asia Markets
Tetra Pak India Pvt. Ltd;
DLF Cyber Terrace,
Building No 5, Tower C,
16th Floor, Cyber City, DLF Phase III,
Gurgaon-122002

Subject: Report on “Repulpability and Paper Making Potential of Used Tetra Pak Carton (UTPC) in Comparison to Indian & American OCC”.

Dear Sir,

Please find enclosed herewith the project report on “Repulpability and Paper Making Potential of Used Tetra Pak Carton (UTPC) in Comparison to Indian & American OCC”. This is for your perusal please.

Thanking You,

Yours faithfully,

(Rita Tandon)
Scientist-F & Head
Project Leader

Encl: Project report.
REPORT

ON

REPULPABILITY AND PAPER MAKING POTENTIAL OF USED TETRA
PAK CARTON (UTPC) IN COMPARISON TO
INDIAN & AMERICAN OCC

WORK CARRIED OUT BY

CENTRAL PULP & PAPER RESEARCH INSTITUTE
SAHARANPUR (UP), INDIA

SPONSORED BY

TETRA PAK INDIA PVT LTD; GURGAON
EXECUTIVE SUMMARY

1. INTRODUCTION

Tetra Pak is a world leader in providing innovative packaging and processing solutions to the food industry worldwide. Tetra Pak supplies aseptic packaging to various beverage manufacturers; some of them being Parle (Frooti, Appy), Coca Cola (Maaza), Dabur (Real juice), Pepsi (Tropicana), Amul (Milk, milk products), Nestle (milk), KMF (Nandini) etc.

Sustainability is the core of growth strategy for Tetra Pak. The cartons, post use, get collected and sent for recycling everywhere. The challenge is how to increase the recycling rate of a material that very few people recognize as has been any value.

Very few mills in India it is recognize that fibre contained in Tetra Pak cartons is valuable. Through hydropulping fibre is recovered from rest of the material. The polyethylene and aluminum comprising some 25% of the package and traditionally considered out-throws has potential for making value added products like sheets or extrusion based granules for further value addition.

Tetra Pak’s three-pronged approach to actively drive up recycling is to

a) Partner pulp/paper mills that see the benefit of recycling post consumer cartons
b) Help these recyclers identify collection networks capable of sorting and collecting carton waste
c) Invest in educating consumers and others in the waste chain about the recyclability of Tetra Pak cartons and on proper waste management practices in general.

This combination of a short-term (interventions to establish collections and recycling) and long-term approach (education) form the basis of an economic model where the buyer (the recycler) pays an attractive price to the seller (the waste collector) and the
model feeds itself, save for some interventions from Tetra Pak in terms of e.g. communication, promotion and equipment support.

2. BACKGROUND

- Tetra Pak India Pvt. Ltd., Gurgaon entrusted CPPRI a job order for evaluation of Repulpability and Paper making potential of Post Consumer Tetra Pak carton waste in comparison to American OCC and Indian OCC, the grades which are primarily being used as a raw material furnish in the manufacture of packaging grades of paper.

- Tetra Pak is the world's leading food processing and packaging solutions company. Tetra Pak cartons are almost 75% paper based (by weight) and around 25% of the carton is plastic and aluminium. The used Tetra Pak cartons are generated as post consumer waste and are a good source of cellulosic fibrous raw material for recycled fibre based paper industry.

- This raw material is considered to be difficult to recycle because of laminates and are perceived as rejects when found mixed with waste paper.

- To address these challenges a detailed evaluation study was conducted at CPPRI in order to assess and establish the repulpability of used Tetra Pak cartons for its use in paper making. The repulpability studies were conducted at CPPRI on laboratory scale and the pulp obtained was subjected to detailed pulp evaluation.

- In order to establish its suitability for paper making, the pulp obtained from Tetra Pak cartons were subjected to comparison with Indian OCC and American OCC, the two major waste paper grades being used by manufacturers of kraft paper (Liner & Media).
The findings of the study are summarised below:

**UTPC as a Raw Material**

- The moisture content of as such received sample of Tetra Pak carton is 6% and less than IOCC and AOCC. The recovered fibre yield is relatively low compared to IOCC and AOCC.

- The screen rejects are 24% higher in Tetra Pak cartons and are PolyAl rejects with no fibre value. The total rejects in Tetra Pak carton is 26% (PolyAl + Fibre) as against 2% (Fibre only) for Indian OCC and American OCC. Tetra Pak cartons have 32% less available fibre than American OCC and 24% less available fibre than Indian OCC.

- The composition of Tetra Pak carton includes 6% moisture, 59.4% fibre, 5.8% fibre rejects, 20.5% PolyAl rejects and 8% fines.

**Pulp Quality**

- The ash content of Tetra Pak carton pulp is marginally higher compared to Indian OCC and American OCC. The CSF/OSR values of Tetra Pak carton and American OCC are comparable.

- The brightness of Tetra Pak carton pulp is higher (42% ISO) compared to Indian OCC and American OCC. The pulp viscosity of UTPC is falling between American OCC and Indian OCC.

**Fibre Properties**

- The fibre strength in terms of Zero Span Tensile Strength (ZSTS) is 19% higher than American OCC and 49% higher than Indian OCC. In terms of Zero Span Tensile Strength (ZSTS) value it is one below to softwood pulps and better than indigenous virgin pulps. The average fibre length of Tetra Pak carton is 1.1mm. The fibre coarseness value is comparable with American OCC.
- The long fibre fraction (≥ 2.8mm) in Tetra Pak Carton pulp is higher than Indian OCC and lower than American OCC. The middle fibre fraction (<2.8mm - > 0.7 mm) is higher than American OCC and Indian OCC. The short fibre fraction of Tetra Pak carton pulp is 60% lower than Indian OCC pulp. The fibre length distribution index of Tetra Pak carton pulp (4.0) is falling between American OCC and Indian OCC. The fines content is lower than Indian OCC.

**Physical Strength Properties**

- The burst factor of used Tetra Pak carton pulp is 43% higher than American OCC and 50% higher than Indian OCC.

- The breaking length of used Tetra Pak carton is 11% higher than American OCC and 24% higher than Indian OCC.

- The tear factor of Tetra Pak carton pulp is 13%-15% higher than Indian OCC and American OCC.

- The double fold values of Tetra Pak carton is comparable with Indian OCC and American OCC.

- Porosity for used Tetra Pak carton is higher than Indian OCC and Ring crush value of used Tetra Pak carton is 28% higher than Indian OCC and American OCC.
REPORT
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1. STUDIES CONDUCTED AT CPPRI

A. SAMPLING

Sample of Tetra Pak, American OCC & Indian OCC were arranged by Tetra Pak India Pvt. Ltd; Gurgaon for the studies. Upon initial inspection it was found the external contamination in Tetra Pak sample was 5% as against nil for AOCC and IOCC. The contamination was in the form of plastic cap.

<table>
<thead>
<tr>
<th>Sample</th>
<th>External Contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOCC</td>
<td>Nil</td>
</tr>
<tr>
<td>IOCC</td>
<td>Nil</td>
</tr>
<tr>
<td>Tetra Pak</td>
<td>5%</td>
</tr>
</tbody>
</table>

B. REPULING STUDIES

Two approaches were undertaken for repulping based on pulper types used by mills: High consistency repulping and Low consistency repulping. The conditions maintained during evaluation are as follows:
<table>
<thead>
<tr>
<th>Parameters</th>
<th>High consistency repulping</th>
<th>Low consistency repulping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistency, %</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Temp, °C</td>
<td>Ambient</td>
<td>Ambient</td>
</tr>
<tr>
<td>Slushing time, min.</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

The pulp thus obtained was subjected to screening through 0.15 mm slot screen and were tested for –

(a) **Pulp properties**- Yield, Freeness, Ash content, Brightness and Reject content.

(b) **Fibre properties**- Zero Span Tensile Strength (ZSTS), Orientation index (Web consolidation).

(c) **Fibre classification based on**-

   - **Optical method**- Weighted fibre length, fibre, coarseness.

   - **Bauer McNett classification**- Weighted average fibre length based on Long/ Medium/ Short fibre.

(d) **Pulp Viscosity**

(e) **Physical strength properties of handsheets**- Bulk, Burst factor, Breaking length, Tear factor, Double fold, Porosity and Ring Crush Test.

The results are depicted in Tables and Histograms. The value given in Tables represents higher values whereas histogram represents values for duplicate trials.
2. SUMMARY OF THE FINDINGS

A. PULP PROPERTIES

(i) Recovered fibre yield- This value indicates the amount of cellulosic fibre recovered after removal of contaminants (PolyAl) through various unit operations. A maximum recovery of fibre is always desirable, fibre yield unaffected by consistency variation.

The fibre yield obtained with UTPC is 60%. Around 35% less than AOCC and 30% ss than IOCC.

(ii) Freeness of pulp- Freeness is a measure of the drainage resistance of pulp slurry and is measured as CSF (Canadian Standard Freeness) or oSR (Schopper-Riegler Freeness). High CSF/ Low oSR value increases the scope for refining.

The CSF/oSR value of UTPC and AOCC are comparable and gives a scope for refining.
(iii) **Ash content in pulp**- This value reflects on residual ash retained with the pulp and which contribute to opacity and porosity of paper. Consistency variation has no impact on Ash content of pulp.

The ash content in UTPC pulp is 4.2% compared to 3.6% for IOCC and 1.3% for AOCC.

![Bar chart showing ash content comparison]

(iv) **ISO Brightness of pulp**- ISO brightness is an intrinsic reflectance factor determined with brightness meter whose sensitivity to light corresponds to a wavelength of 457 nm. ISO brightness is ideal for monitoring the effects of bleaching on the brightness of pulp.

The brightness of UTPC is 42% ISO compared to 22% ISO for IOCC and 16% ISO for AOCC. The brightness value is higher due to presence of white liner in the UTPC samples.

![Bar chart showing ISO brightness comparison]
(v) **Total Screened Reject Content**- It is a direct measure of quantifiable contaminants present in raw material which is collected as rejects on 0.15 mm vibratory slot screen. The screens rejects are around 24% higher in UTPC. These are PolyAI rejects and have no fibre value. Value addition to reject recycling may compensate the loss on fibre yield.

![Screened reject graph](image)

**B. FIBER PROPERTIES**

(i) **Zero Span Tensile Strength (Fibre Strength)**- The Zero Span Tensile Strength (ZSTS) value is reported in km. This test measures the intrinsic strength of individual fibre and provides a possibility to measure the fibre strength separated from other effects. It is a good indicator of the average strength of individual fibre.

UTPC is 19% higher than AOCC and 49% higher than IOCC.

![Zero Span Tensile Strength graph](image)
(ii) **Orientation Index (Web Consolidation)** - The test indicates orientation of fibres to form web. Web consolidation is largely influenced by the amount of fines present and is indicative of good formation.

The orientation index value of UTPC is comparable with AOCC. Orientation index improves upon refining.

![Bar chart showing orientation index values for IOCC, UTPC, and AOCC](chart1)

(iii) **Fibre length by optical method** - The average fibre length by optical method shows the fibre length of UTPC is falling between IOCC and AOCC.

It is an important property of virgin fibres which are native in nature.

![Bar chart showing fibre length values for IOCC, UTPC, and AOCC](chart2)
(iv) **Fibre coarseness by Optical method**- This is a measure of the average weight of fibre per unit length, often reported in units of mg/m. More conformable than fine fibre and do not bond readily. Coarser fibre result in fewer fibre per mass having significant impact on sheet formation and light scattering potential.

The fibre coarseness value of UTPC is comparable with AOCC and slightly lower than IOCC. Recycled fibre are more coarse than virgin fibre and collapse more easily.

C. **Fibre Classification Through Bauer McNett Classifier**

(i) **Long fibre fraction= >2.8 mm (+16 fraction)**- Fractionation measure the average fibre length and length distribution by weight directly. Long fibre is desirable for better machine runnability. Upon refining the long fibre fraction decreases and short fibre fraction increases due to fibrillation.

The long fibre fraction in UTPC is 23% higher than IOCC and around 24% lower than AOCC.
(ii) **Middle fibre fraction** = <2.8 mm - >0.7 mm - The middle fraction remains unchanged during refining.

The middle fibre fraction of UTPC is 23% higher than AOCC and 28% higher IOCC.

![Middle fibre fraction graph]

(iii) **Short fibre fraction** ≤<0.7 mm (-100 fraction) - The short fibre fraction determines the fibre length distribution index. Presence of high amount affects the fibre length distribution index. The values obtained are:

UTPC has 60% lower short fibre fraction than IOCC.

![Short fibre fraction graph]
(iv) **Fibre length distribution index**- The value indicates the ratio of long fibre (>2.8 mm) and shortest fibre (<0.7 mm). Higher values indicate better fibre distribution.

Fibre length distribution index of UTPC (4.0) is falling between AOCC and IOCC (8.1 and 1.3).

(v) **Fines content**- These are the pulp particles measuring less than 0.2 mm length and are called debris. Fines impacts on filtration and drainage operations and air permeability. The values obtained are:

The fines content of UTPC is 6.2% which is around 2.2% higher than AOCC and 2.4% lower than IOCC.
D. PHYSICAL STRENGTH PROPERTIES

(i) **Burst factor/ Bursting strength** - It is an important property for packaging grades of paper and paperboard and is an indicator of sheet bonding. Bursting strength is the maximum pressure that paper can resist without breaking when force is applied perpendicular to the plane. Increase fibre length gives higher bursting strength but is more affected by fibre bonding. It is predominantly an internal sheet property.

The burst factor of UTPC is 43% higher than AOCC and 50% higher than IOCC.

(ii) **Tensile strength/ Breaking length (km)** - Tensile strength is the maximum force per unit width that a paper strip can resist before breaking when applied longitudinally. It depends on fibre strength but primarily on the degree of bonding between areas.

The breaking length of UTPC is 11% higher than AOCC and 24% higher than IOCC.
(iii) **Tear factor/ Tearing strength (T.S)**- Tear strength is the mean force required to continue the tearing of paper from an initial cut. Highly dependent on fibre orientation of sheet and affects runnability. Longer and stronger fibre provide high tearing strength.

Tear factor of UTPC is 13%-15% higher than IOCC and AOCC.

(iv) **Double fold**- Folding strength is the ability of a strip of paper to resist breaking when folded under certain load. It is the measure of strength and flexibility of paper. Low value results from lack of fibre length, inadequate fibre bonding and brittleness. Higher tensile and elongation of paper equate to higher folding strength. Folding strength indicates the effect of aging.
(v) **Porosity** - Sheet porosity is the measure of air flow through a known area and is an indicator of potential absorbency of paper particularly for coated grade.

The values of porosity for UTPC is relatively low than AOCC.

![Porosity Chart]

(vi) **Ring Crush Test** - Ring crush test is considered to be an important property for paperboards. It measures the resistance of paperboard to edgewise compression.

The ring crush value for UTPC is 28% higher than IOCC and AOCC.

![Ring Crush Test Chart]
3. **CONCLUSION**

The studies conducted to establish the feasibility of repulping and papermaking potential of waste Tetra Pak cartons has revealed that the raw material is suitable for recycling and is a good source of recycled fibre. The recovered fibre yield is around 60% as against >80% for AOCC and IOCC which is mainly due to presence of plastic and aluminum lamination. Despite of its low yield, the fibre quality is better than IOCC and at par with AOCC.

There is a potential to use this raw material in blended raw material furnish to manufacture packaging grades of paper and boards. The fibre in its present form is well suited to manufacture media kraft, liner kraft and liner boards.

To disseminate the findings of the study carried out on “Repulpability and Paper Making potential of Used Tetra Pak Carton (UTPC) in comparison to Indian and American OCC” an interaction meet was organized by Tetra Pak India Pvt. Ltd; Gurgaon on 20th December 2014 at Hotel Taj Surya, Coimbatore in which CPPRI participated as Technical Partner and South India Kraft Mill Association participated as supporting partner.