



SAMPLE B

Diploma Programme subject in which this extended essay is registered: DESIGN AND TECHNOLOGY

(For an extended essay in the area of languages, state the language and whether it is group 1 or group 2.)

Title of the extended essay: THE EFFICIENCY IMPROVEMENT OF "THAI KIDS RECYCLE" RECYCLING
PROCESS UNDER THE NEW STRUCTURAL DEVELOPMENT OF UHT MILK BOX

Candidate's declaration

If this declaration is not signed by the candidate the extended essay will not be assessed.

The extended essay I am submitting is my own work (apart from guidance allowed by the International Baccalaureate).

I have acknowledged each use of the words, graphics or ideas of another person, whether written, oral or visual.

I am aware that the word limit for all extended essays is 4000 words and that examiners are not required to read beyond this limit.

This is the final version of my extended essay.

Candidate's signature: _____ Date: 13-01-09

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A: 44389

B:

Supervisor's report

The supervisor must complete the report below and then give the final version of the extended essay, with this cover attached, to the Diploma Programme coordinator. The supervisor must sign this report; otherwise the extended essay will not be assessed and may be returned to the school.

Name of supervisor (CAPITAL letters) _____

Comments

Please comment, as appropriate, on the candidate's performance, the context in which the candidate undertook the research for the extended essay, any difficulties encountered and how these were overcome (see page 13 of the extended essay guide). The concluding interview (viva voce) may provide useful information. These comments can help the examiner award a level for criterion K (holistic judgment). Do not comment on any adverse personal circumstances that may have affected the candidate. If the amount of time spent with the candidate was zero, you must explain this, in particular how it was then possible to authenticate the essay as the candidate's own work. You may attach an additional sheet if there is insufficient space here.

_____ feels passionate about the "Thai Kids Recycle"; consequently she chose to base her study on the development of new techniques to help make the recycling process easier. Although _____ did not study Design Technology she adapted very well and this study demonstrates a thorough understanding of the process involved in product design and development.

Her introduction was clear and she established a range of effective and achievable primary and secondary investigations using a variety of techniques to inform her decision making into the design solution.

_____ has shown a mature and independent approach to this task and has been extremely well organised throughout. She listened with intent and interest to the advice that was offered to her and acted upon it positively and with enthusiasm. I found the essay interesting and informative, well written with a very good technological content.

I have read the final version of the extended essay that will be submitted to the examiner.

To the best of my knowledge, the extended essay is the authentic work of the candidate.

I spent hours with the candidate discussing the progress of the extended essay.

Supervisor's signature: _____

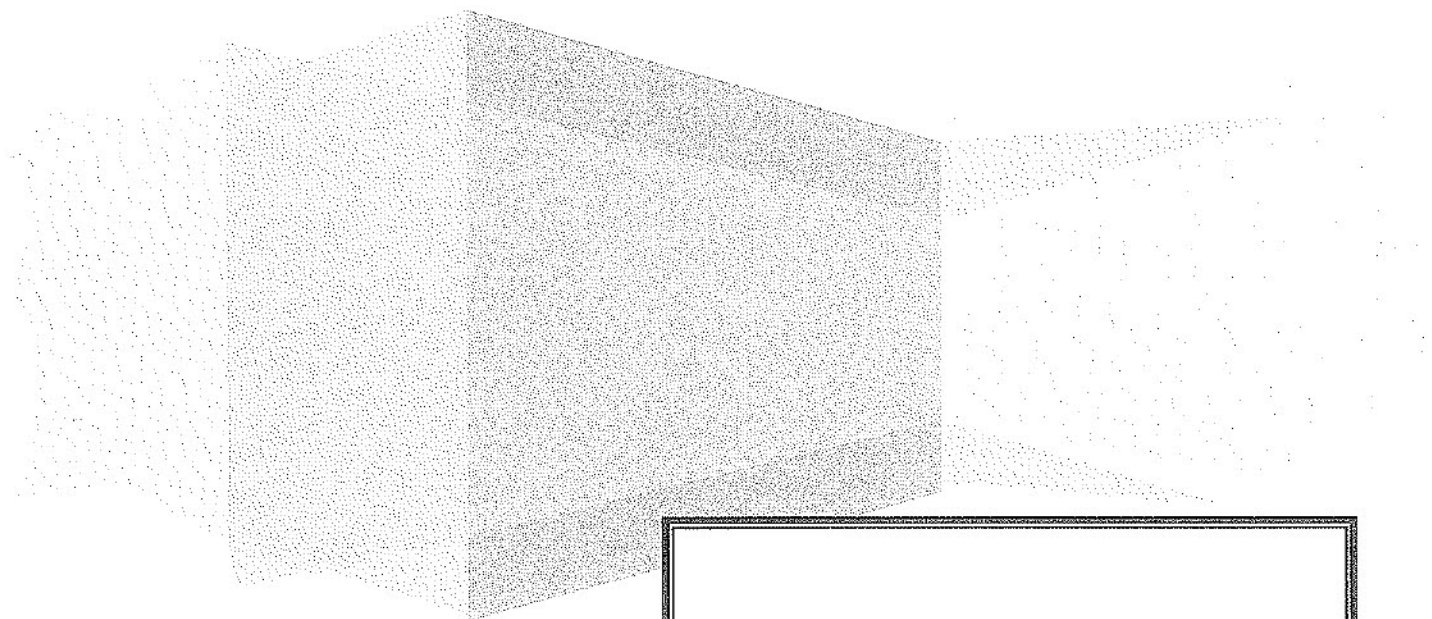
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The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

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Extended Essay (2009) – Design Technology



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|-----------------------|
| Center number: |
| Candidate number: --- |
| Supervisor: |

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

Acknowledgement

I would like to use this chance to thanks my supervisor _____ and my brother for allowing this essay to happen. As well as the help from the interviewers who were involved in this project.

Abstract

This essay focuses on the development of new UHT milk box geometrical design to facilitate and minimize the use of water with respect to "Thai Kids Recycle" milk box's national recycling campaign.

The preliminary approach was to find alternative materials of milk box to ease separation process of its compositions. However, the interview with packaging company *Tetra Pak* showed that current material was considered being the best. Thus, the final idea was to design a new structure geometrically, reserving its existed materials and order of layers, so that they can perform best their functions.

The experiment investigated the various shapes in term of efficiency improvement, i.e. decomposition, packaging, environmental impact, convenience, and product diversification in business point of view. The cuboids scored the highest performance among such criteria.

Nevertheless, compared to the current packaging, the resultant design held limitations as it was based on prototype and assumptions. The further analysis, such as creation using actual materials, or nutritional value testing through aseptic technology, should be carried out to prove the efficiency.

RQ
Investigation
Conclusion } not all clearly
stated

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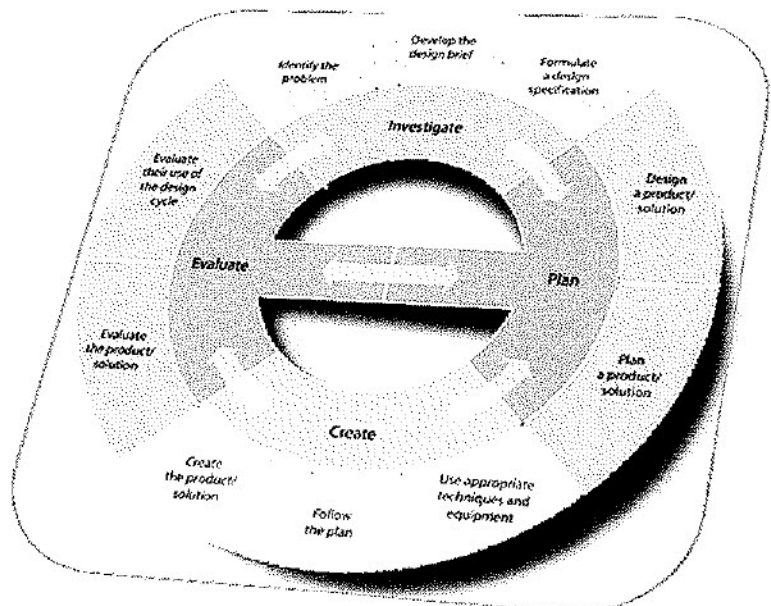
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Introduction



Introduction

Aim

To develop new UHT milk box in term of geometrical structure, in order to facilitate recycling process with respect to national "Thai Kids Recycle"¹ Campaign. The idea inspired by Japanese biscuit packaging call 'Pocky' where there is container for content and packaging to protect this container. Ultimate goal aimed to encourage recycling process, which will be reducing the use of new natural resource and energy that contributed to global warming.

Recycle?

Constantly the term 'Global Warming' raised the awareness among people about the world's current situation. Many campaigns were found to encourage people to stop actions that contributed to this issue, and change their habit to become more environmental friendly. One type of natural resource, namely "sustainable resource", caught everyone's attention because of their minimal impact toward the issue, and as a promising resolution under appropriate management.

Recycle!

Technology provides convenience for human. Thanks to the innovation of 'aseptic packaging' (see appendix B.2.1) which extended the shelf life of beverage contents and no need to store in the refrigerator. *UHT* (stand for Ultra High Temperature) milk box introduce such convenience, in which milk can be consumed and distributed widely and for anyone, resulting in the global increase of milk consumption.

Conversely, parallel with proportional depletion of natural resource, if recycling remain undertaken.

"Thai Kids Recycle" promoted as a national campaign, encourages students to wash their consumed milk box before sending to the actual recycling process at paper mill. The arising question is; Has it been effective enough to compensate water wasting? The involvement of such limited resource made the recycling method became more complex. My belief is that as the campaign is for children, process should be relatively accessible for them. Recycle, its purpose is to save the resource, but this process itself at the same time wastes another resource. Would it be better if there is a compromising solution for this issue?

I aimed to restructure the packaging as a container domain comprise within another: Milk container and packaging that contain milk container (analogously to the yolk within the white egg, all inside the eggshell). The structure of this project will be based on 'Design Cycle' of International Baccalaureate Program. Research, through both primary and secondary research, will involve facts, figures, and opinions from campaigners, non-campaigners, and organizer of campaign. The creation will be accompanied by visualized computer graphic and prototype in which variable factors are to be considered.

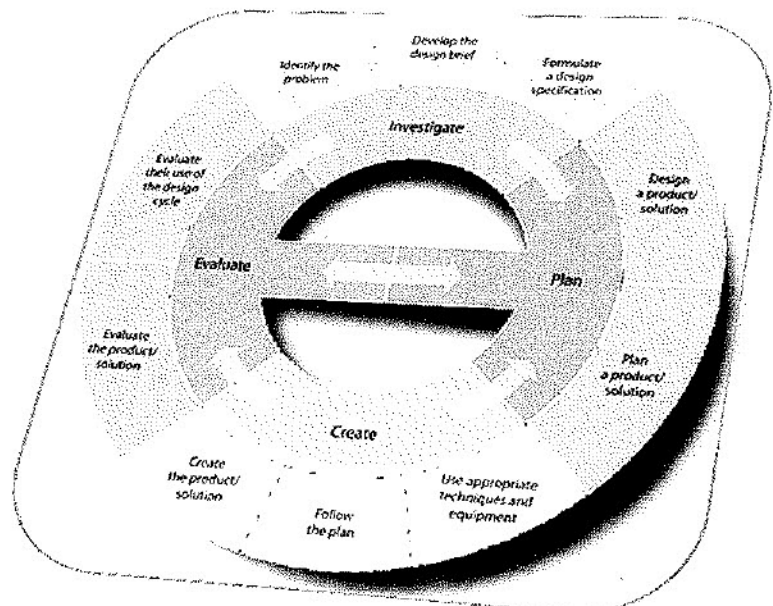
RQ stated but not sharply focussed

¹ Social responsibility campaign of Tetra Pak Thailand. Known as "โครงการเด็กไทยหัวใจรีไซเคิล" in Thai

(Note that the word 'milk box' present further in this context only refers to 'UHT milk box' or 'UHT milk carton')

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

Investigation



1. Investigation

Over 21 billion cartons (including milk box) are recycled each year². The increase in approach for sustainable resource can, example, reduce carbon dioxide emission as there is no need for additional fossil fuel to be burned. Less electricity generation, direct heat, and limited refrigerant emission, can reduce carbon footprint. So why shall not we recycle?

1.1 UHT milk box

General knowledge about UHT milk box is necessary to know before the further action.

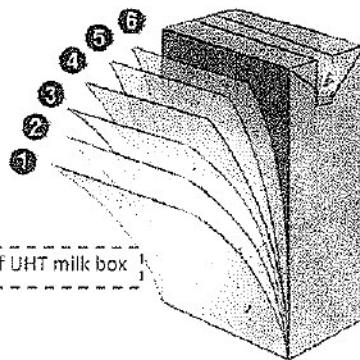


Figure 1 : 6 different layers of UHT milk box

Milk box made of 6 layers of 3 different materials. Each of them has specific role as below

- | | |
|-----------------|--|
| 1. Polyethylene | : Prevent external moisture |
| 2. Paper | : Strengthen the structure |
| 3. Polyethylene | : Adhesion layer |
| 4. Aluminium | : Prevent external effects such as light, oxygen |
| 5. Polyethylene | : Adhesion layer |
| 6. Polyethylene | : Seal-in the liquid |

From interview with Mr.Sinchai Thiensiri³, he stated that current milk box composition as above is currently the best. Firstly, because paper is renewable and is the easiest one that can be recycled. Secondly, polyethylene is the safest plastic material which releases no emission. Lastly, thickness of aluminum layer is the thinnest which can perform its best function and provide least effect on the environment. Using same materials to create new milk box would ensure nutritional value of beverage content and safety to a certain level.

1.2 Nutrition

What determines beverage content's quality is partly the structure of container and materials, but most importantly, is the aseptic packaging technology. Taste of product, nutritional value, and health safety depends on this. As stated before, structure of milk box can also alter these factors if it unable to safely seal the packaging from light and moisture.

² Tetra Pak. "Highlight". Environmental and Social Report 2007. See Appendix B.1.1

³ Technical Environmental Manager of Tetra Pak South East Asia. See Appendix A.1.1

1.3 Shape and Dimension of packaging

Milk box packaging have different shapes. Which is best for nutrition value? Are they different? No, not in term of nutrition value (assumed that all milk box are all well sealed) Shapes and dimension affect by the external factor rather than what it contains inside.

Milk box package was introduced by Dr. Ruben Rausing⁴ in tetrahedron-shaped. Assembling process is easy: Seal the top 180° bottom 90°. However, it can't be seen as the best choice. Due to the space between two packaging, unnecessary space would be transported. Consequently increase in transportation price and higher risk of product damage. Logistic and business aspects should be concerned the most. For this reason, we often see milk box in rectangular shape rather than octagon or smooth-edged shape. Even though these unusual shape provide better grip, to assemble is difficult and inefficient for logistic. Packing involves only heat to melt polyethylene to act as glue. Folding facilitated by provided folding line on the packaging sheet.



Figure 2: Tetrahedron-shaped invented by Dr. Ruben Rausing

1.4 Fiber Recovery

In old days, milk boxes were recycled naturally by underground decomposition. Nevertheless, increased rate of consumption surpass; rate of decomposition. Since it takes many years to decompose, these dumped area then become even more insufficient. As technology performance improves, beverage carton (milk box included) can now be recycled through process called "Fiber Recovery" which now can be done at paper mill.

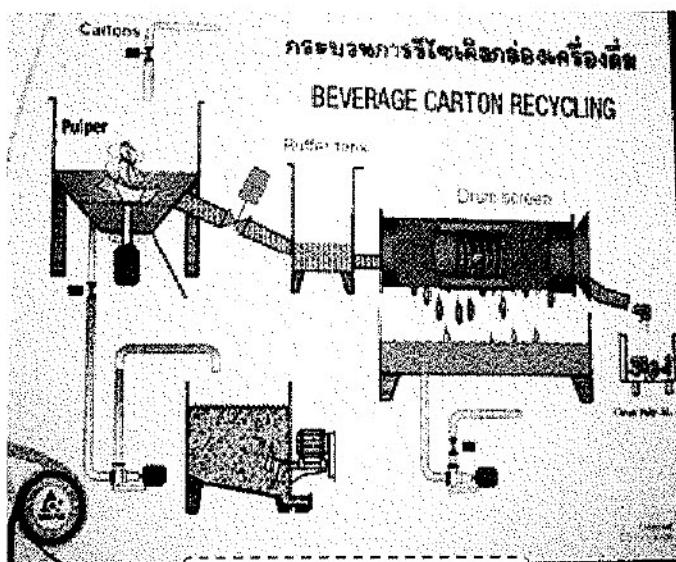


Figure 3: Fiber Recovery Process

Milk boxes are put into the 'Pulper' (See Appendix B.3.1) which contains water. No chemical or specific machine involves, these milk boxes will be spun for 20-30 minutes, cause paper layer to separate from polyethylene and aluminum. Paper sinks faster, and will change its form to pulp, and will pass through tube at the bottom to continue with further paper recycling.

Similarly for polyethylene and aluminum, they will pass through tube on the right to get into 'Drum Stream' for further recycling process. This recycling technology is cheap comparing to its inputs and outputs. 1 ton of cantons can be extracted to about 600kg of pulp⁵ There is no need to change or refill water in the machine as they are evaporated, thanks to, ironically, global warming.

⁴ Stated by Mr.Sinchai Thiensiri Technical Environmental Manager of Tetra Pak South East Asia.

⁵ Fact from: Tetra Pak. "Beverage Carton Recycling". Facts about Beverage Cartons, Environmentally Friendly Packages. See Appendix B.3.1

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

1.5 Thai Kids Recycle Campaign

"Thai Kids Recycle" one of existing recycling campaigns in Thailand, targeted at kindergarten to primary students, aimed to persuade these students to recycle milk box as their milk consumption rate is on average, daily. The recycling preparation (considered to be part of recycling process) advertised around school and nearby community which campaigners have to strictly follow

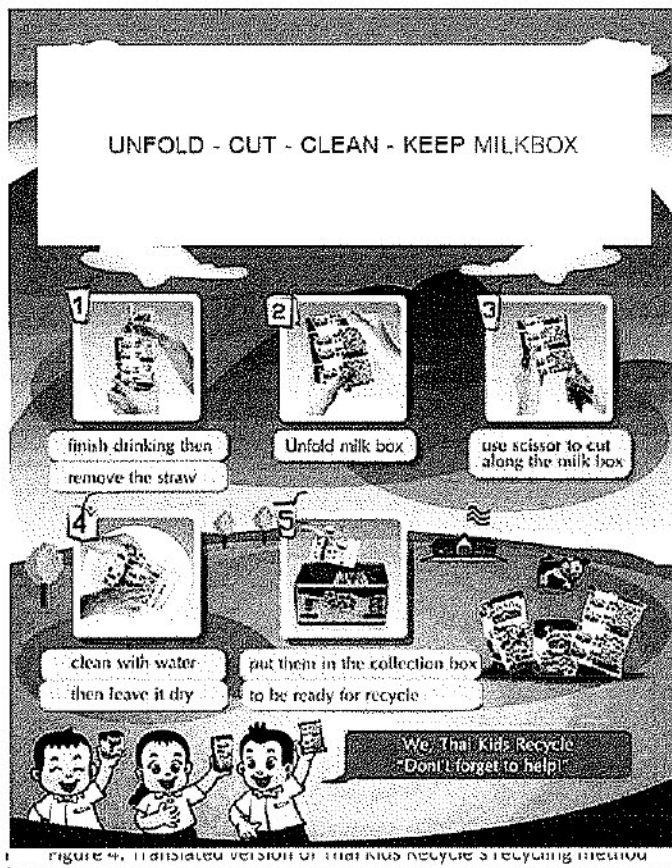


Figure 4. Translated version of Thai Kids Recycle's recycling instruction

Before, milk box can be recycled by throwing them into the collection bin, but process has to be extended due to several reasons

1. To clean milk box: Over times, it will eventually cause undesirable smell. This affects environment in the area, and may progress to development of bacteria or disease.
2. To facilitate transportation: folding save space and more milk box can be recycled at a time.
3. To keep milk box longer: especially in the area where milk box collection service cannot be accessed.

⁶ "ภาพ-ล้าง-เก็บ-กล่องนม" <http://www.thaikids-recycle.com/th/ccc_for_recycling.php>. 25 July 2008

See appendix B.1.3 for original version

1.6 Problem with recycling method

It is necessary to clean milk box and follow the method. Nevertheless, after critically analyzed, recycling needs some improvements in order to be more effective

1. Unpack and fold: faster if process can be reduced to fold.
2. Cutting: must rely on sharp-edged equipment such as scissors which is dangerous for children (It's still too hard to rip by hands)
3. Cleaning: some water was definitely wasted if there is no control. After all, the water usage in this stage depends on the habit of people.

1.7 Different perspectives

Preliminary research was to interview students from schools that join this campaign. Unfortunately these places are far from Bangkok. Further investigation was carried out. 'Roong Aroon' school is one of the few participants in Bangkok where I can obtain different perspective towards recycling. (See Appendix A.2.1 for the original questionnaires)

Below are summaries from interview and questionnaires.

| Process | Problems |
|---------------|---|
| Cut | <ul style="list-style-type: none"> • Require sharp-edged material • Too dangerous for little kids |
| Clean | <ul style="list-style-type: none"> • Inevitable to waste water |
| Whole process | <ul style="list-style-type: none"> • Complicated and long for teenagers; would be more willing to help if the process is facilitated |

According to the interview with Mrs.Pranee Wadpia⁷, cleaning is a psychological issue. Students believed everything that has been thrown away is dirty, especially if it is not theirs. Therefore, cleaning a milk box is yet an appealing task for them.

The factors which prevent people not to contribute to recycle identified though questionnaires at Siam Square, and Jatujak Market

(See Appendix A.2.1 for the original questionnaires)

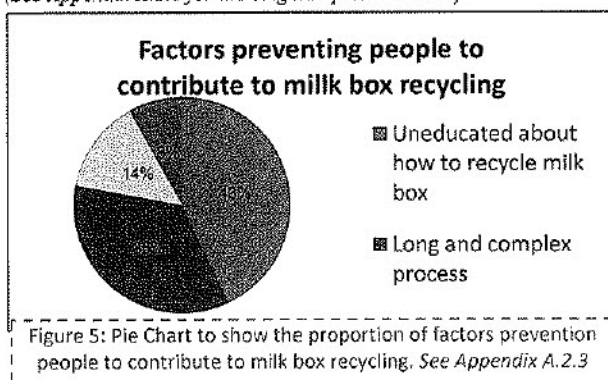


Figure 5 shows that most of the populations are still uneducated about milk box recycle. Some that are educated do not contribute to the process due to the fact that they are too long and complex. Other factors such as lifestyle, different environmental concern, and inconvenience as there is no collection box available

⁷ The collections separation manager of Roong Aroon School. See Appendix A.1.2

1.8 Design Specification

This project essentially aims to solve one of these factors which is "long and complex process" in a belief that easier process would increase recycling number. To facilitate the process with less water being used I decided to create new milk box packaging; Design specifications are as below;

1. Should facilitate recycling process of "Thai Kids Recycle" meaning that
 - a) No special equipments involved for cutting
 - b) Easy to unpack
2. Protect nutrition value or at least should have the same quality as original design
3. Light weight, therefore, easy and convenient for logistic
4. Use minimal natural resource, especially water

1.9 Japanese Biscuit Packaging "Pocky"

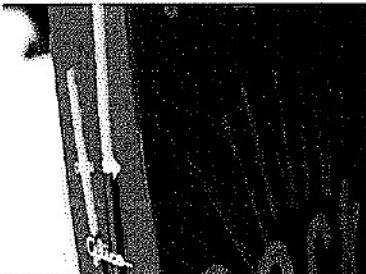


Figure 7 Perforation line on the Pocky Packaging



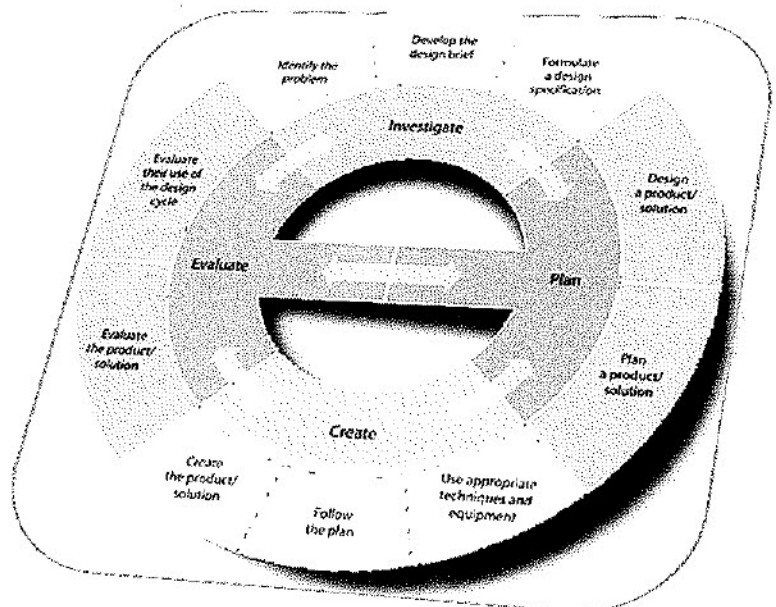
Figure 6 How to remove perforation line. Notice the inner set inside the packaging

The idea inspired by Pocky Packaging in which their features can be seen as below

- Perforation line for separation
- two containers in one packaging
- Reasonably strong packaging to protect content inside

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

Planning



2. Planning

2.1 Initial idea

Design solution based on design specification (see section 1.8) Initial idea was to replace some layers of milk box structure with other materials so that they can be separated by hands. For instance, layer 3-6 can be easily removed from layer 1-2. However, this approach has to be changed after experimenting with the current milk box design, which showed that

1. Combinations of first two layers are difficult to pull apart unless they are spun in the same way as in paper mill.
2. Alternative materials cannot be used as each components have a specific role, otherwise, safety and nutrition value cannot be guaranteed

2.2 Final idea

Ultimate idea based on existing milk box's order of layers and components and "Pocky" (see Appendix 1.9), new design of milk box packaging will consist of two main sets allowing the dirty and clean part to be permanently separated. Specific role of each component is used to allow each set to perform at their best functions. Even if outer set break down, from moisture and light got in, content would still be protected by polyethylene and aluminum layer.

1. Outer set: layer 1-2. Functions
 - a. Strengthen the milk box structure through the hardness of paper
 - b. Prevent moisture from getting into the packaging through the role of polyethylene
2. Inner set: layer 3-6. Functions
 - a. Act as a milk container
 - b. Conserve nutrition value with the application of aluminum and polyethylene

If the outer set contains layer 1-3, inner set contains layer 4-6. The moisture can pass through aluminum layer into content if there is a hole since there is no direct moisture protection. Similarly, if outer set contains layer 1-4, inner set contains layer 5-6, aluminum layer doesn't directly protect milk content, light can get damage nutrition value. (Note that the word 'outer set' present further in this context only refers to 'layer 1-2' where the 'Inner set' refers to 'layer 3-6')

I apply feature of biscuit packaging (see Appendix 1.9) which has **perforation line** on the outer set to facilitate the separation between two set as below

1. Remove perforation line on the outer set
2. Throw outer set into the normal bin, the inner set into well-insulated bin allowing no spreading of bad smell and bacteria.
3. Collections are sent to the paper mill for further recycle

Improvements through the application of new milk box packaging can be seen as below;

1. Reduction in water usage to clean milk box since two sets are permanently separated
2. Ease recycling process as there is no cleaning, or cutting

2.3 Exploring Variables

Three different designs will be experimented. Variable factors are defined as below

Independent variables:

- Volume: of milk content varies depending on the dimension of packaging
- Shape: Varies in shape but under restricted dimension where height is 12.00cm and width is 7.00cm

Controlled variables:

- Packaging material: Paper, polyethylene, aluminum
- Packaging process: use heated polyethylene as a glue
- Removing process: Separate through perforation line in the outer set
- Structure of packaging: outer set contains inner set

Dependent variables:

- Consideration in term of application such as
 - Consumers convenient; gripping
 - Logistic; effectiveness of packing
 - Resources wasted; area of paper used to produce one packaging

2.4 Assumptions

Creation will be done as simplified prototype rather than real packaging, because the actual materials and procedure are not available. The prototype based on the assumption that

1. Outer set fully perform its function which can hold the structure of the milk box and prevent moisture and light from getting into inner set.
2. Outer set can strongly hold whole structure, implies no logistics and distribution problem.
3. Same order of layers are used as original milk box packaging, content quality is then guaranteed as their roles remain the same (aluminum protect light, polyethylene prevent moisture).
4. Collection bin can be well-insulated, such that area would not be smelled and protect spreading of bacteria from animals and insects.

2.5 Materials for prototype:

- 1.00 mm thick of papers to construct outer set
- Small Plastic bags as inner set
- Water as milk content
- UHU water glue as melted polyethylene layer for joining layers
- Cutter to make perforation line
- Ruler (± 0.5 mm)
- Scissors
- Three straws

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

2.6 Layers of Outer Set

Diagram to show the layer structure of the Outer Set: From Inside to Outside
(Note that this apply to all the shapes of the Outer Set for prototype)

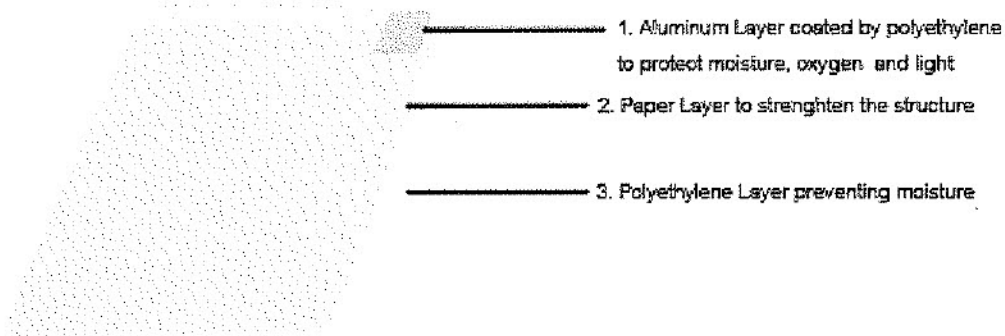
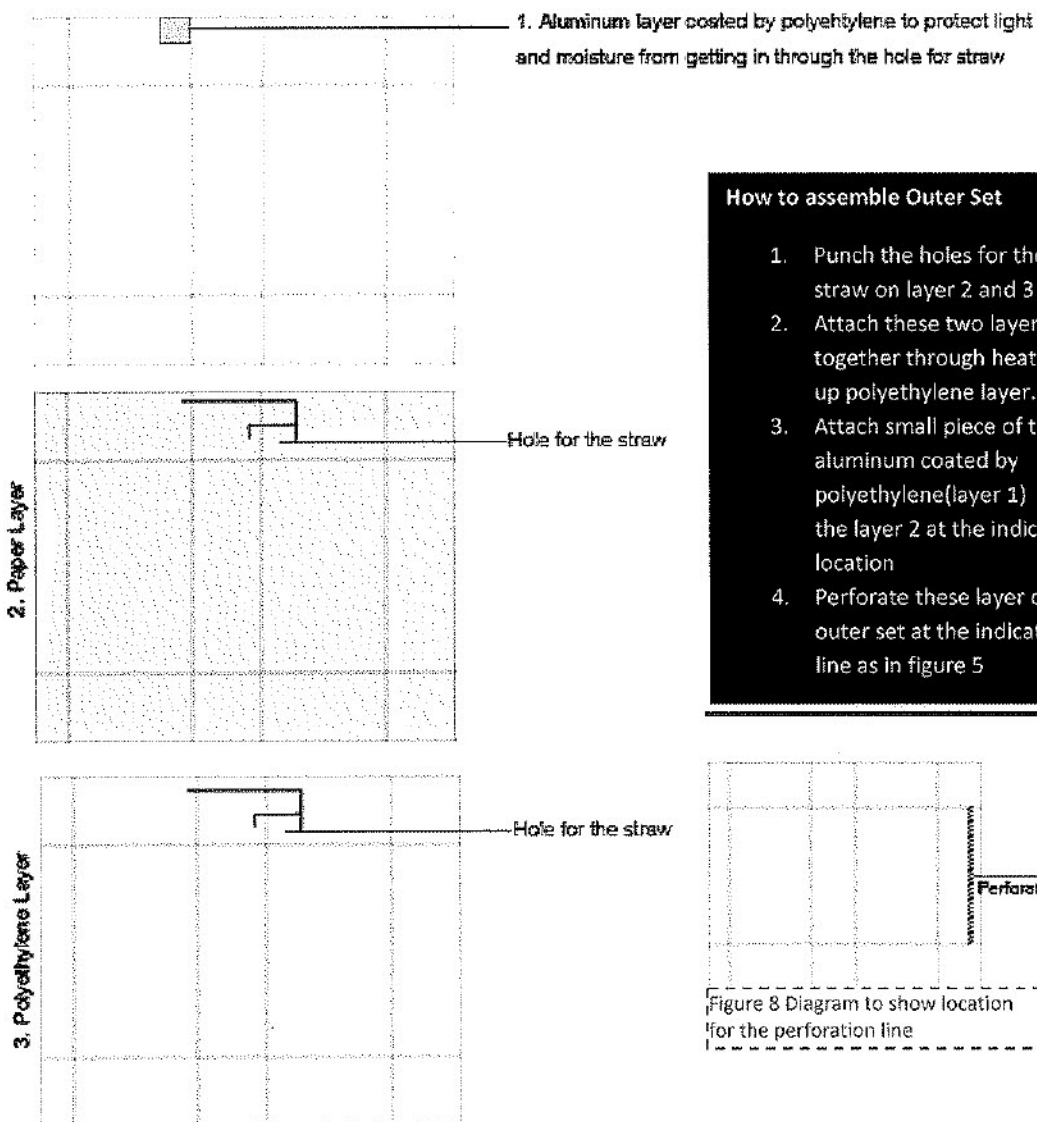


Diagram to show how should each layer of the Outer Set looks like before assemble
(Note that this apply to all the shapes of the Outer Set for prototype)



How to assemble Outer Set

1. Punch the holes for the straw on layer 2 and 3
2. Attach these two layers together through heating up polyethylene layer.
3. Attach small piece of the aluminum coated by polyethylene(layer 1) on the layer 2 at the indicated location
4. Perforate these layer of outer set at the indicated line as in figure 5

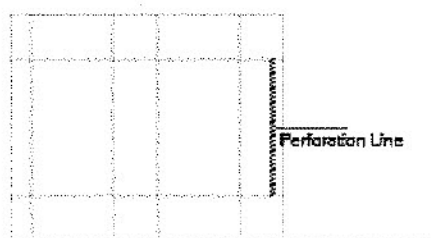


Figure 8 Diagram to show location for the perforation line

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

2.7 Layers of the Inner Set

Diagram to show the layer structure of the Inner Set: From Inside to Outside
 (Note that this apply to all the shapes of the Inner Set for prototype)

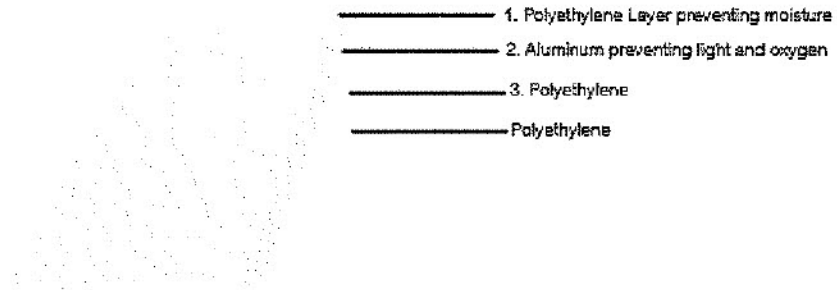
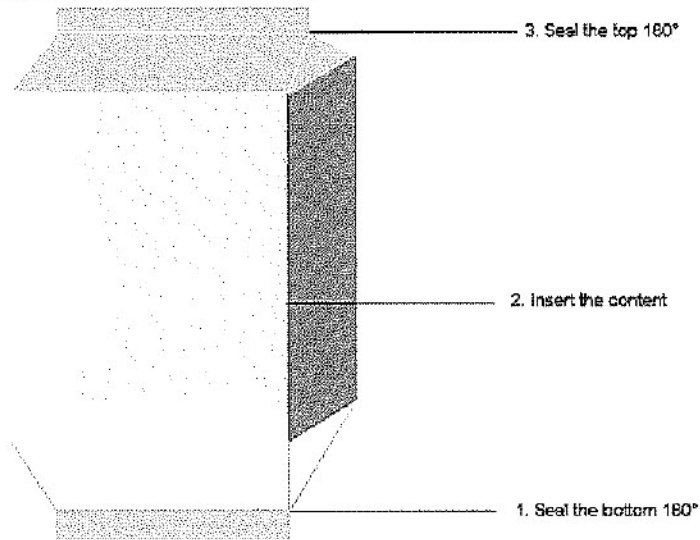
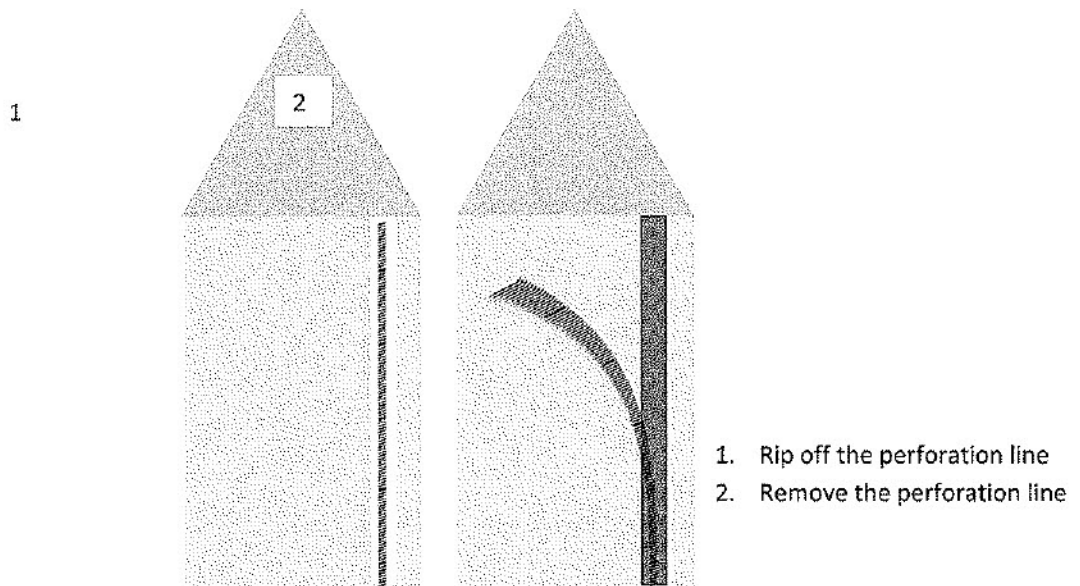


Diagram to show how to assemble the inner set



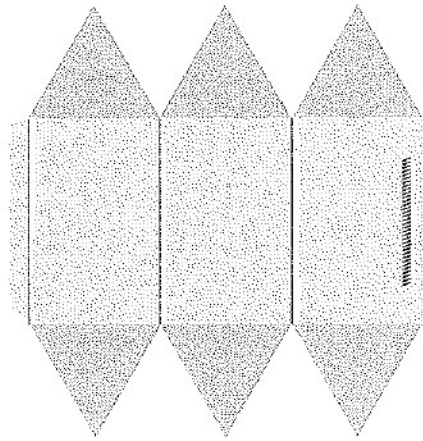
2.8 Unfold Method



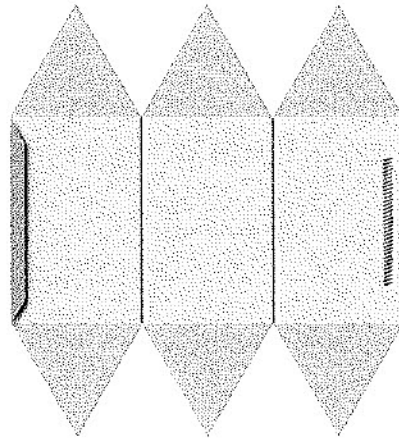
The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

2.9 Packing Method

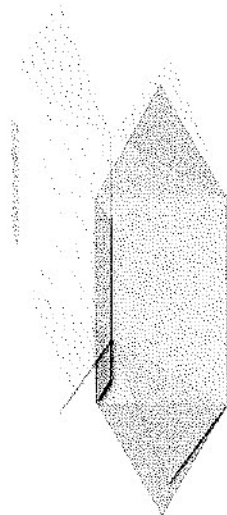
All 3 proposed designs will have the same packing process as below



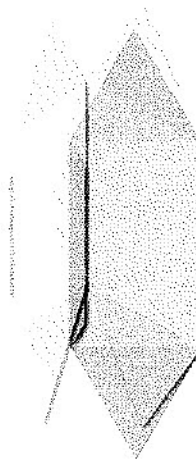
Unfolded UHT Milk Box



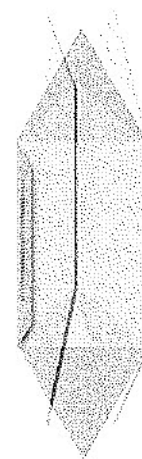
1. Follow folding guide to fold up 'c'



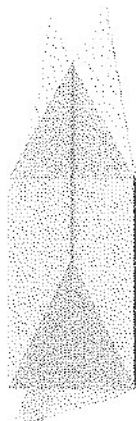
2. Follow folding guide to fold up 'a2'



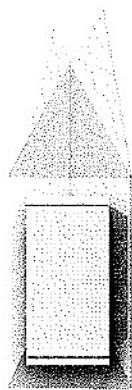
3. Follow folding guide to fold up 'a3'



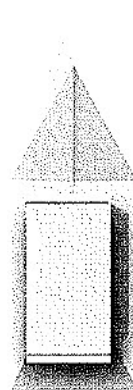
4. Attach the end of 'a3' with the glue on 'c'



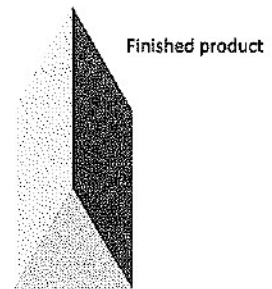
5. Fold the bottom of the box



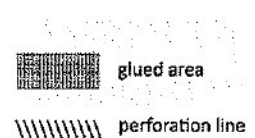
6. Insert inner set



7. Fold the top



Finished product



The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

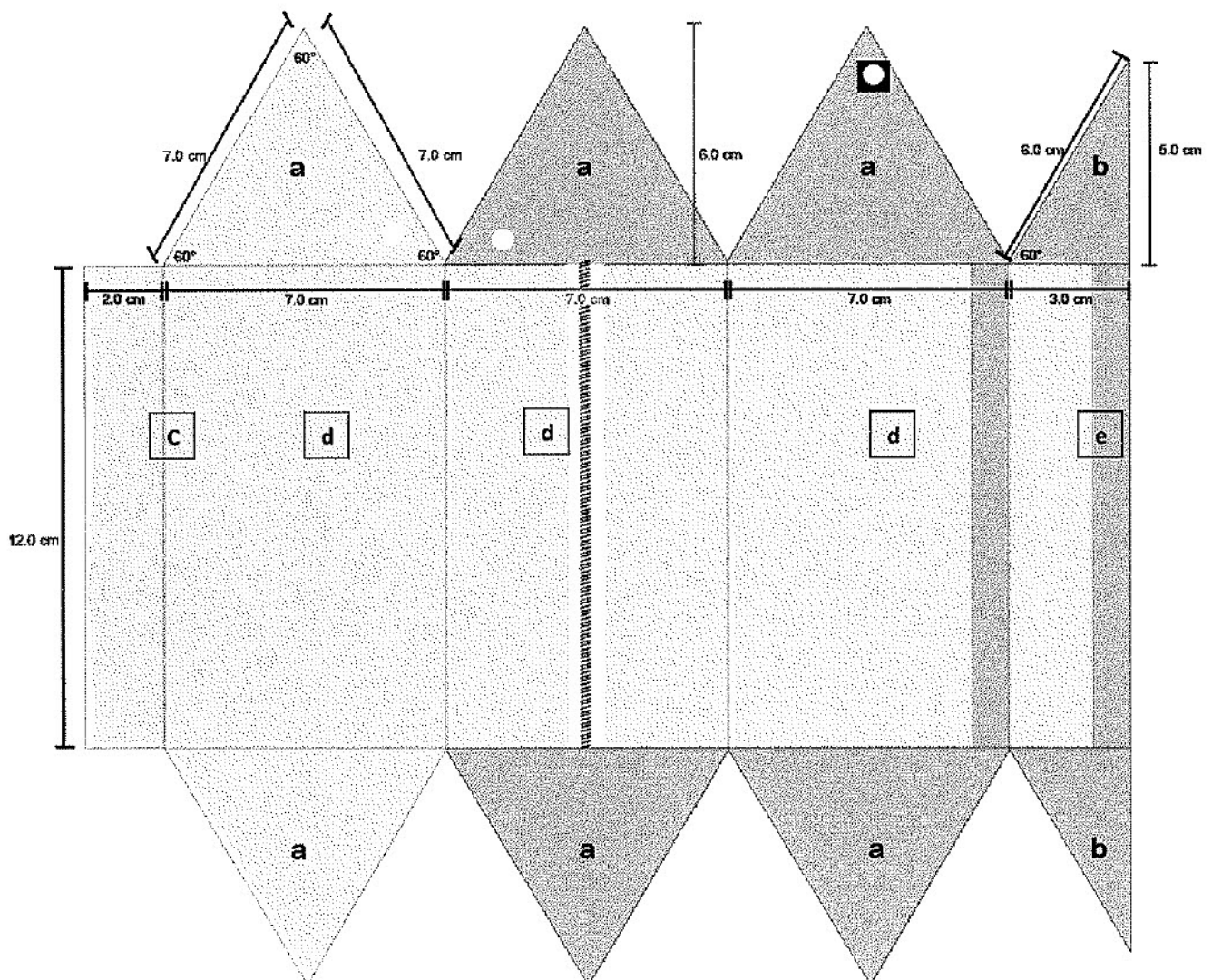
2.10 Plan of prototype

Thyree different prototypes will be experimented and constructed according to their plan

2.10.1 Design1 (D1)

Inspired by TOBERLONE© of their unique shape. The palm's sized packaging should be able to provide better gripping especially for children.

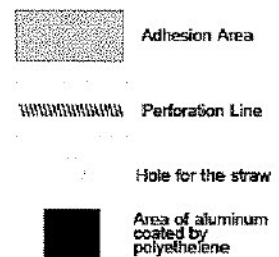
Shape: Triangular prism



Dimension: 7.00 x 6.00 x 12.00 cm

Surface Area: ⁸453 cm²

Approximate volume: 504 cm³



Scale 1:2.5

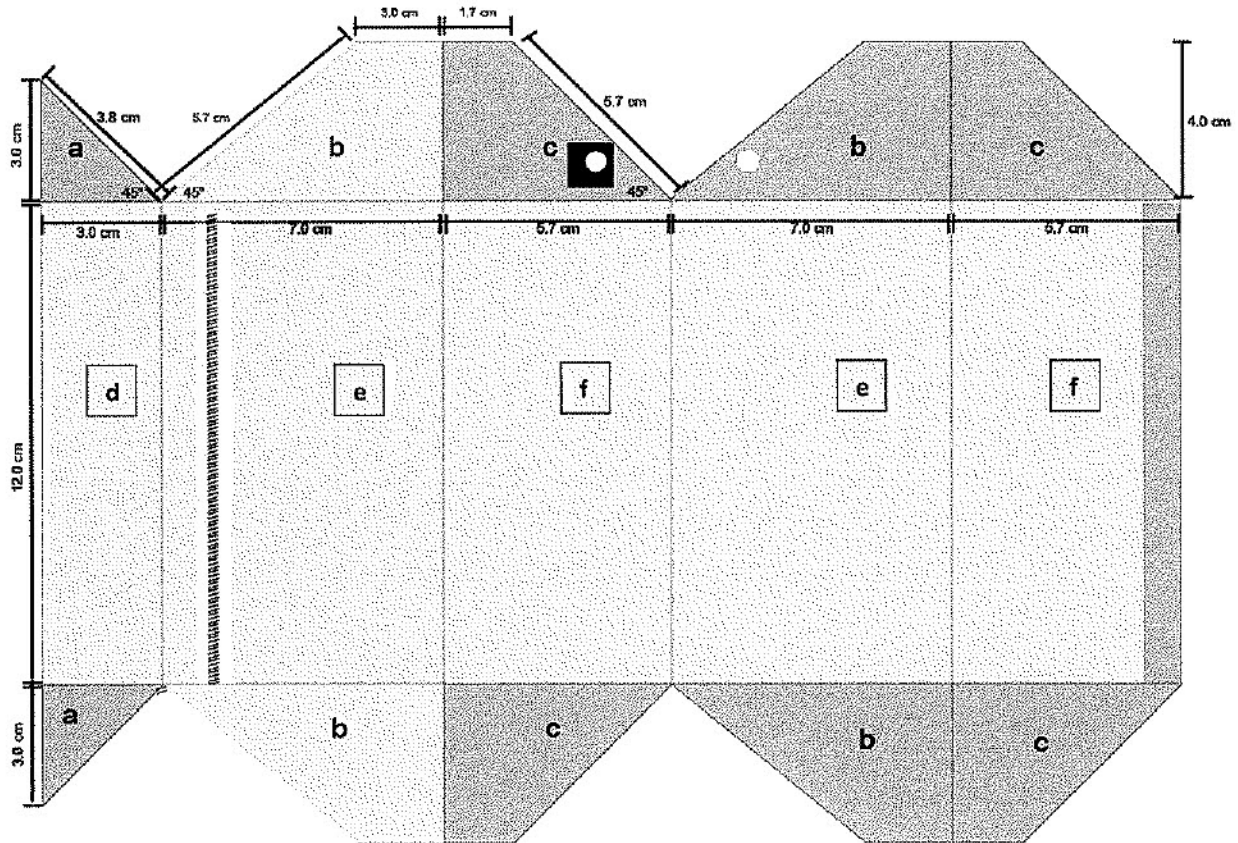
⁸ See Appendix C.1.1 for full calculation

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

2.10.2 Design 2 (D2)

Inspired by manipulation of current milk box shape. Can shape make the difference?

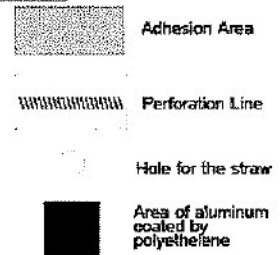
Shape: Parallelepiped



Dimension: 7.00 x 5.70 x 12.00 cm

Surface Area:⁹ 424.6 cm²

Approximate volume: 478.8 cm³



Scale 1:2.5

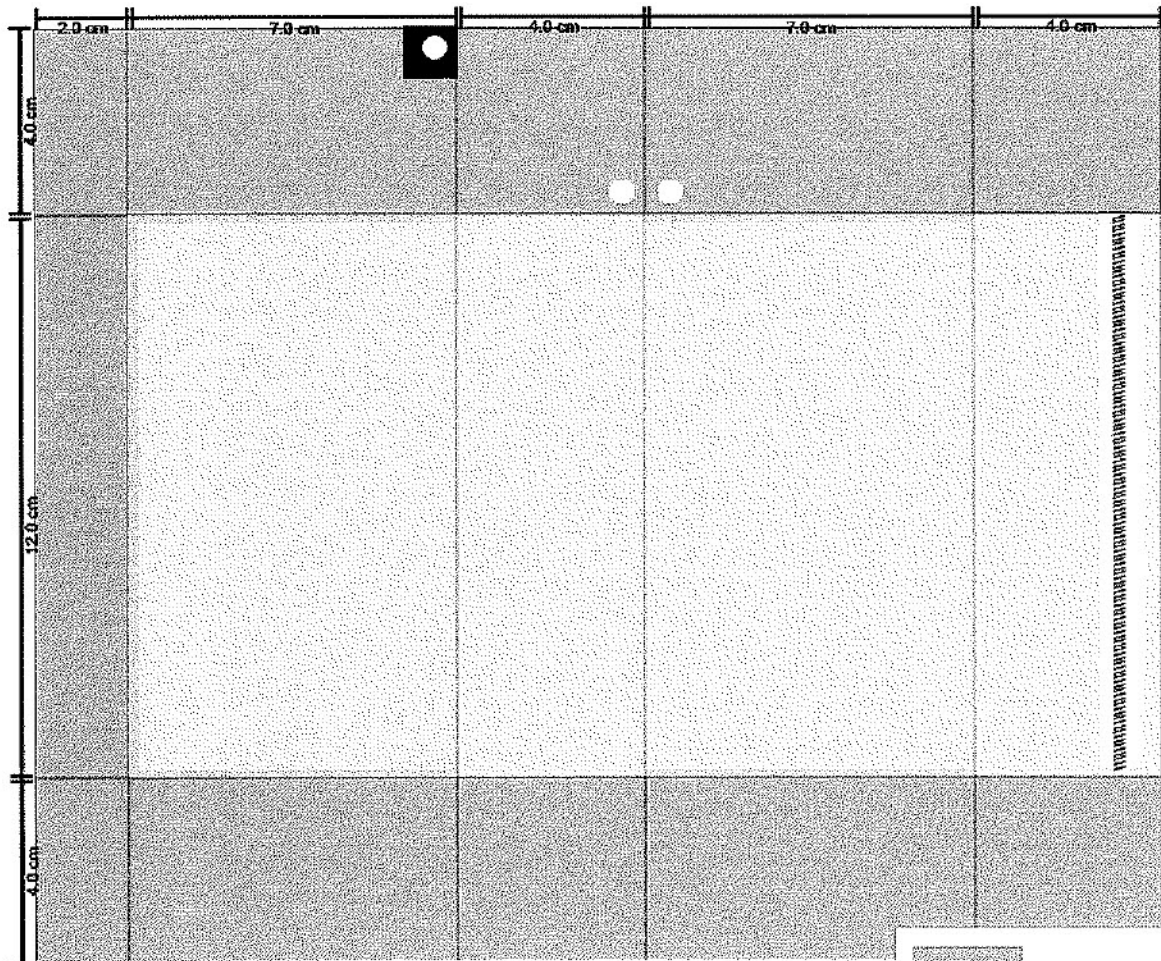
⁹ See Appendix C.1.2 for full calculation

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

2.8.3 Design 3 (D3)

Intended to compare effectiveness of this structure with current structure


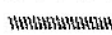


Shape: cuboids



Dimension: 7.00 x 4.0 x 12.00 cm

Surface Area: 10480 cm^2

Approximate volume: 336 cm^3

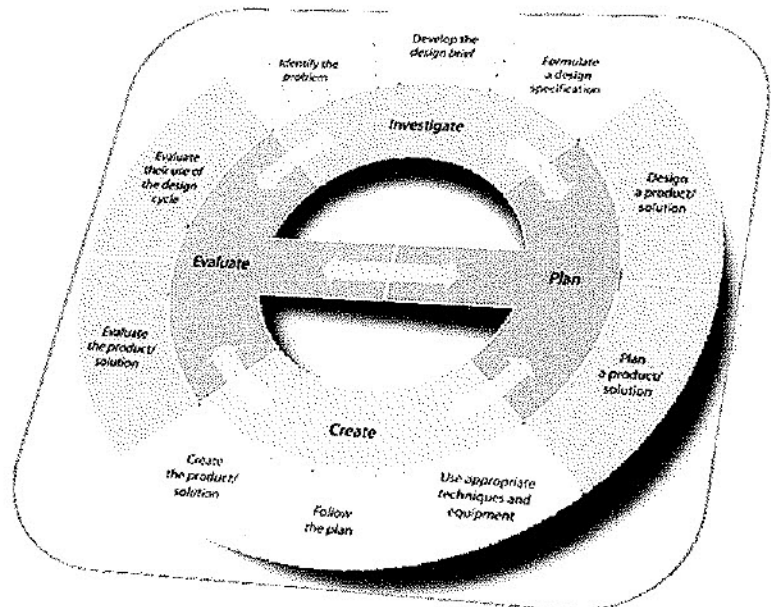
-  Adhesion Area
-  Perforation Line
-  Hole for the straw
-  Area of aluminum coated by polyethylene

Scale 1:2.5

¹⁰ See Appendix C.1.3 for full calculation

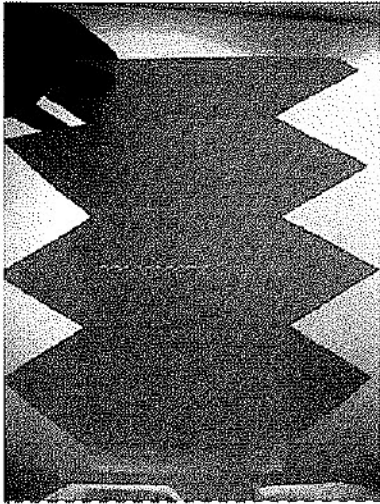
The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

Creation

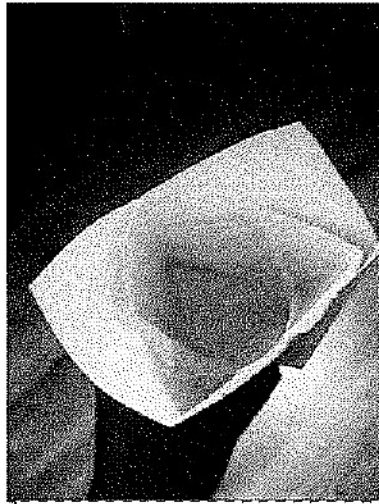


The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

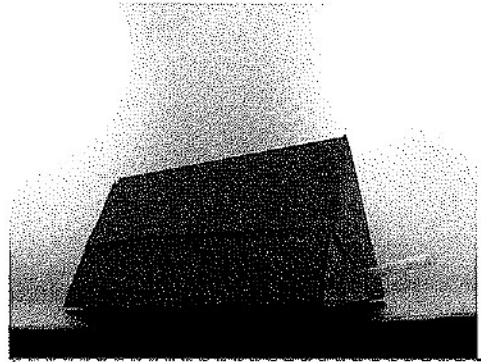
3.1 Model D1



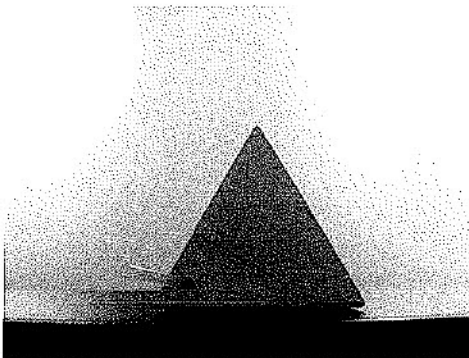
Model D1 1: unfolded packaging



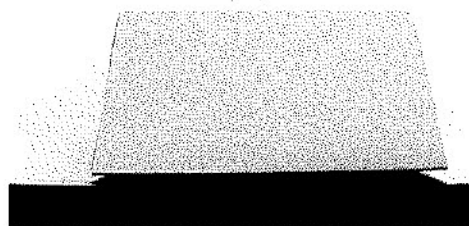
Model D1 1: Inner set (content) inserted



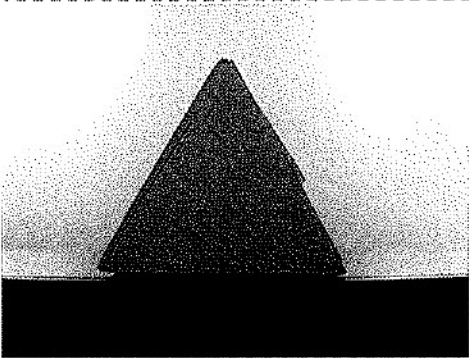
Model D1 3: Isometric View of folded packaging



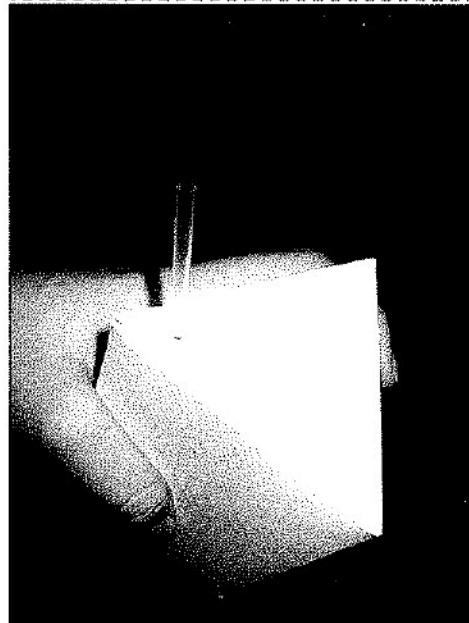
Model D1 4: Front View



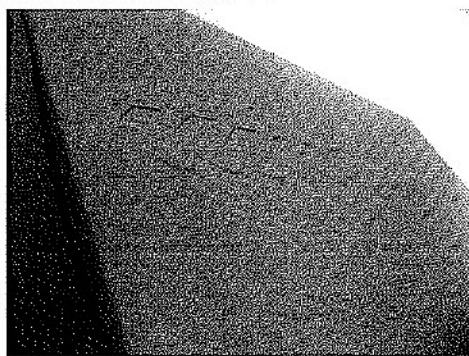
Model D1 5: Side View



Model D1 6: Back view



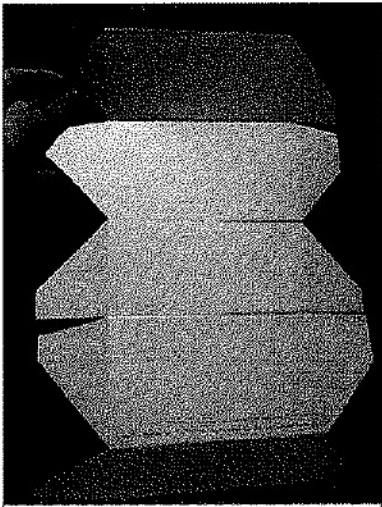
Model D1 8: Gripping



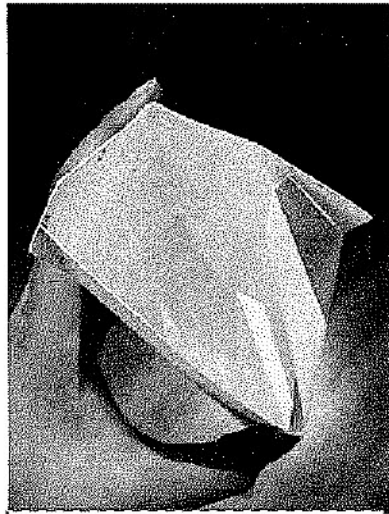
Model D1 7: Perforation line on the packaging

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

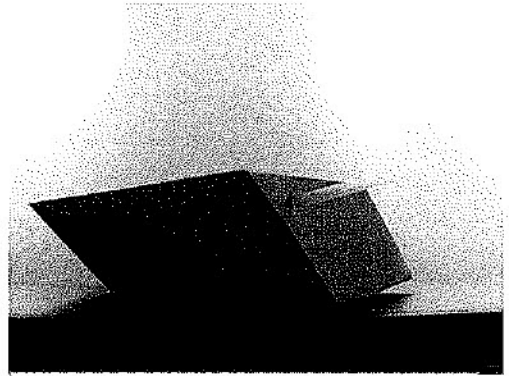
3.1 Model D2



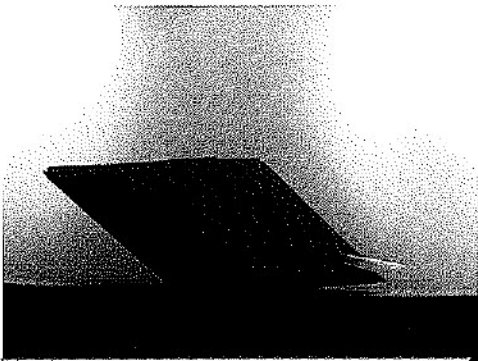
Model D2 2: unfolded packaging



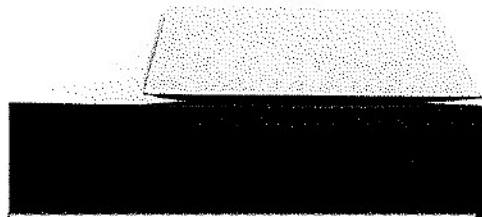
Model D2 2: Inner set (content) inserted



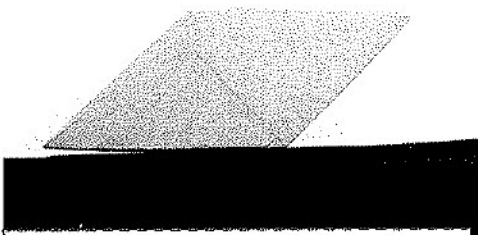
Model D2 3: Isometric View of folded packaging



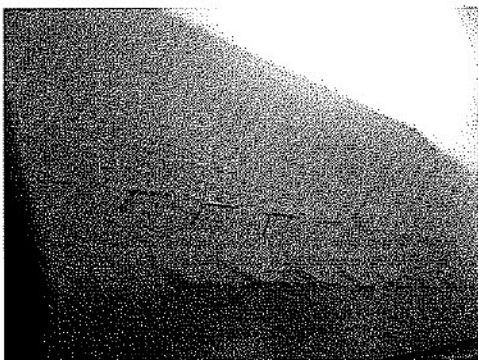
Model D2 4: Front View



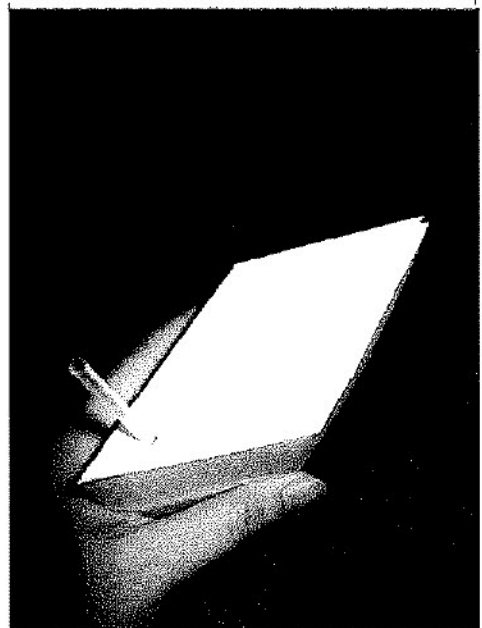
Model D2 5: Side View



Model D2 6: Back view



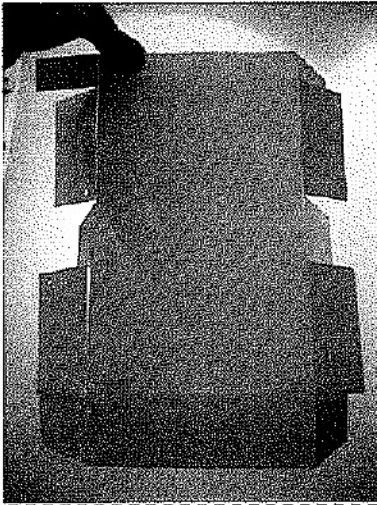
Model D2 7: Perforation line on the packaging



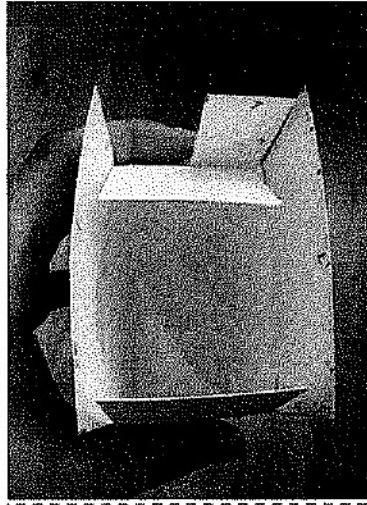
Model D2 8: Gripping

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

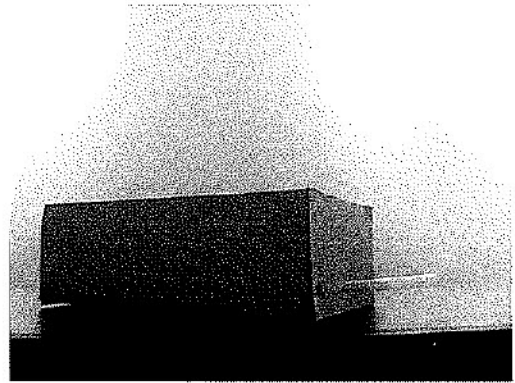
3.3 Model D3



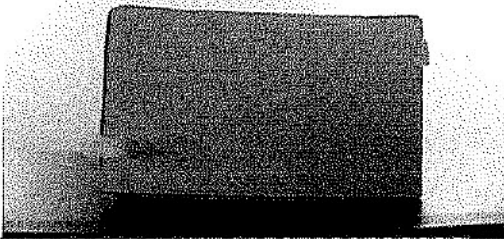
Model D3 1: unfolded packaging



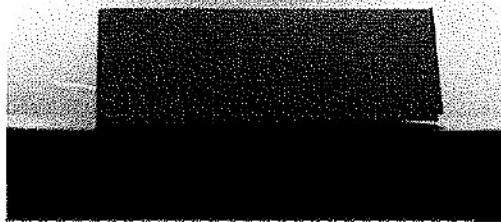
Model D3 3: Inner set (content) inserted



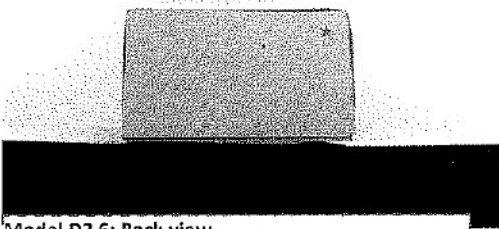
Model D1 3: Isometric View of folded packaging



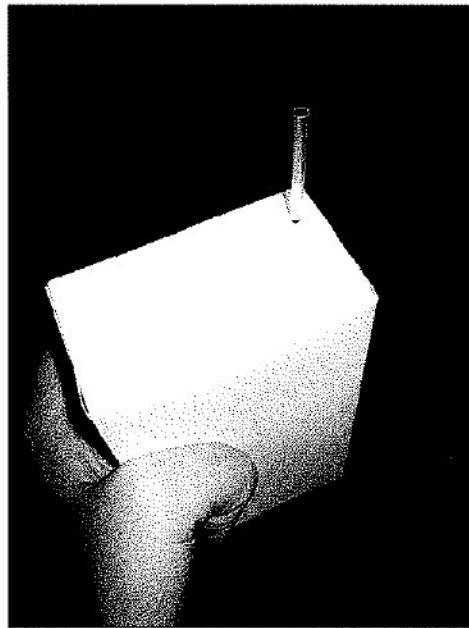
Model D3 4: Front View



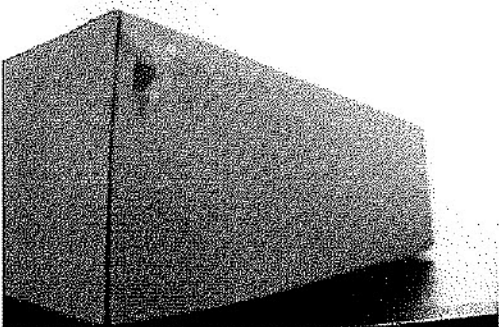
Model D3 5: Side View



Model D3 6: Back view



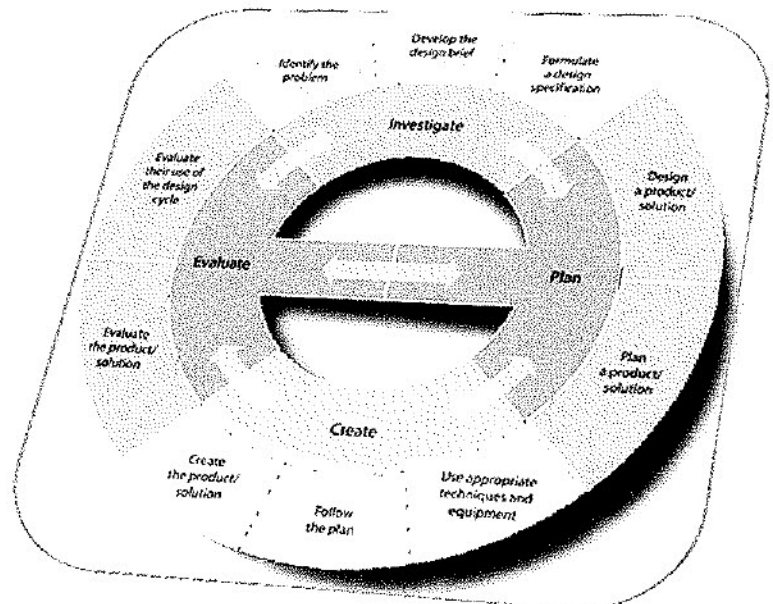
Model D3 8: Gripping



Model D3 7: Perforation line on the packaging

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

Evaluation

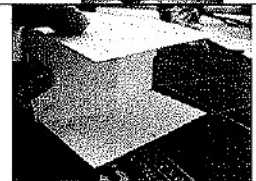
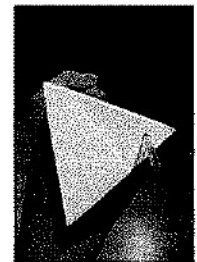
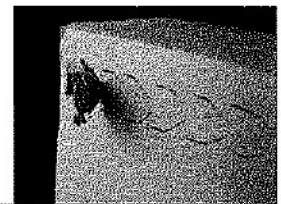


4. Evaluation

4.1 Product against Design Specification

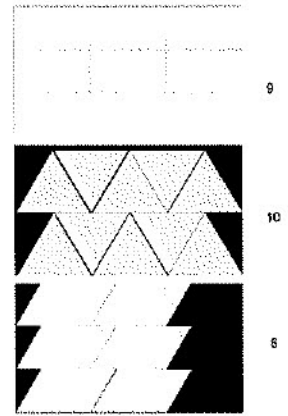
Products evaluation against design specification based on prototype which accompanied by assumptions (see 2.4). Table below contains design specifications. Each design would be assessed against each point. Mark (0-5) indicates how much they are closed to design requirements.

| Requirements | Design | Score (Out of 5) | Notes |
|--|--------|------------------|--|
| No special equipment involve for cutting | D1 | 5 | Each design contains perforation line on outer set, which intended to facilitate exclusion of the content through removing this line, and rip off whole packaging. No sharp-edged required |
| | D2 | 5 | |
| | D3 | 5 | |
| Easy to pack | D1 | 4 | Easy to pack because their shapes can easily fit into palm. Furthermore, equilateral triangle has same sides lengths and angle, which make the shape easier to fold |
| | D2 | 3 | Due to the complex shape, angle, side length, and position must be accurate in order to fold |
| | D3 | 5 | straight forward packing. Right angle (90°) allow shape to be more stable than previous two designs |
| Waste least water before recycling | D1 | 5 | No water involved during preparation. These packaging only have to be thrown into specific bin |
| | D2 | | |
| | D3 | | |
| Protect nutrition value | D1 | 4 | Same milk box components as original one were used, assuming that nutrition quality would remain the same. Precise packing is required to prevent external factors. However, Since D3 is easier to fold; the potential of preserving nutrition value is then higher. |
| | D2 | 4 | |
| | D3 | 5 | |
| Light weight | D1 | 4 | Surface area of the paper used to produce these packaging directly proportional to their weights. |
| | | | |



The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

| | | | |
|---|-----------|--------------|--|
| | D2 | 5 | D2, D1, D3 from lowest to highest respectively |
| | D3 | 3 | |
| Easy and convenient for distribution and logistic | D1 | 3 | <p>Small experiment carried out to test for logistic factor. Same size of box was used to estimate which design suit best for logistic. D3,D1,D2(from greatest to smallest quantity respectively)</p> <p>Even if triangular prism could fit one more unit than Cuboids, but Cuboids is more worth to use as there is no space between packaging.</p> |
| | D2 | 2 | |
| | D3 | 5 | |
| Waste the least natural resource | D1 | 3 | <p>Only referring to surface area that each packaging requires is not enough to conclude. Notice that D1 and D2 loss more paper on top and bottom compared to D3. Calculating overall paper used can see that D3 save the natural resource the most (See Appendix C.2 for full calculation)</p> |
| | D2 | 4 | |
| | D3 | 5 | |
| Total | D1 | 28/35 | |
| | D2 | 28/35 | |
| | D3 | 33/35 | |



Geometric shape of D3 convenes design specification the most. Nevertheless, each shape has their specific advantage. D1 can differentiate product from existing market, D2 provide comfortable grip benefit younger kids. D3 world widely used and has been developed for many years consequently almost all aspects are investigated.

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

4.2 Former Packaging vs. New Packaging:

Evaluation of D3 within the same criteria prove its best performance. Are they better than former packaging?

Assessment is shown below in a table

(noted that grey box indicate preferred. This evaluation also based on the assumptions for the new packaging)

| Aspects | Arguments | | Preferred | |
|--|---|--|-----------|--------|
| | New Packaging | Former Packaging | New | Former |
| No special equipment involve | can be removed through elimination of perforation line | Require sharp edged material for cutting | | |
| Easy to pack | Longer process, two packaging to be packed and assembled separately | All layers sealed together which could be packed in one step | | |
| Waste least water before recycling | No water wasted as dirty part can be easily separated from clean part and put in well-insulated bin. These collections are cleaned at the same time they are recycled | Water needed to clean packaging to preserve clean environment. | | |
| Nutrition value | Orders of layers and components are done the same as original. However, it allow chance of external factors getting in; all layers are not attached together | Recognized for their conserved nutrition value. | | |
| Light weight | Layers are not attached into one sheet. Thicker paper on the outer set required to strengthen whole structure | All layers tightly sealed preventing space between layers which could filled with air increasing weight. | | |
| Easy and convenient for logistics and distribution | Able to resist to the force if structure is strengthen enough | Strong, and guaranteed for transportation | | |
| Waste the least natural resource as possible | New packaging requires higher resource than original. However, it is believed that easier process would persuade more people to join campaign. Consequently, reduce further human impact (i.e. deforestation) | | | |
| Product Diversification | Alternative design for business to enhance customers' awareness that they are environmental friendly. Customers can easily distinguish their products from competitors, increasing company's existence. | 'Standardized' design; no competitive advantage. | | |
| Most Preferred | | | | |

4.3 Evaluation of Aim

Based on assumptions is the weakness, many factors aren't fully tested or investigated such as, performance of to preserve nutrition value and how effective could well-insulated bin be. Regardless these weaknesses, I'm confident that project has developed in accordance to its objective. Referring to the aim, new design provides very convenient approach of recycle; reduced into a very few step. First, remove perforation line. Second, separate inner set and outer set. Last, throw them into the provided bin. Evidently, there's no water usage within this preparation. Water usage can now control in terms of recycle under responsibility of paper mill, if process followed.

Similarly in term of natural resources preservation, new packaging might require more papers for structure. Conversely, has more chance of getting recycled, it is worthy to use. Additionally, more chance of getting pure paper to be recycled as outer set contains only paper and polyethylene, unlike current packaging'; all layers are attached together and difficult to separate.

4.4 Evaluation of Investigation

4.4.1 Primary research

Tetra Pak: Many facts and figures obtained from Tetra Pak. This globally operated company usually educates people in the area for the importance of recycle as part of their social responsibility campaign. It is then importance for them to have evidences to support, these acknowledged through booklets, and magazine. Fortunately I had a chance to interview Mr. Sinchai Thiensiri which I was given apparent information which used in this essay. I then believe that data obtained from this source is highly reliable.

Roong Aroon School: Explored different opinions about recycle from 'campaigners' It is believed that data obtained are relevant because they are based on people opinions.

Questionnaires at Siam Center and Jatujak Market: wide ranges of opinions are obtained which I mainly focus on non-campaigners. Their attitude towards recycle that I explored are very contrast to the Roon Aroon community. Nevertheless, I believe that this raw data is essential to my essay as it direct me which aspect should I focus.

4.4.2 Secondary research

Leaflets, Magazines : highly reliable as this information has to be distributed to customers by Tetra Pak internationally.

Website: 'Thai Kids Recycle' provided by Tetra Pak. However, it has not been updated since 2007 but needed information is still relevant.

4.5 Evaluation of Software

Adobe Photoshop CS3: is used to create graphic which is more suitable for graphic arts. It is then therefore, more appropriate to use specialized program such as AutoCAD, or CAD/CAM to provide more accurate numerical calculations, light and shadow of objects, as well as Adobe Illustrator from their vectors application. Nevertheless I believe that graphic produced by Adobe Photoshop CS3 in this essay is comprehensible.

Conclusion

Through research and development of new packaging, it has shown that recycle process of "Thai Kids Recycle" can now be facilitated by reconstructing milk box structure. One packaging would contain smaller packaging inside. This made sure the part needed to be cleaned is separated from part that doesn't. Inner set, that contains milk, would be put into provided well-insulated bin, which aims to preserve clean environment and prevent spread of smells and bacteria. Follow assessment of each geometric shape, current cuboids is preferred the most. By comparing new packaging with current one, there are weaknesses about new packaging because they are prototype and based on assumptions. Further investigation is needed to be done such as nutrition value testing, strength in term of logistics, and as well as calculation for production cost. This product would be more trustful if there is more evidences to back up.

Paying more for packaging doesn't mean that people would recycle more. People have different lifestyle and opinions about global issue, supported by my primary research. Therefore, improving its process and packaging is not enough. It is important to persuade these people in many ways to change their attitudes, which could be done through medias.

This project has exposed me to explore different perspectives about current global issues. I had viewed the little children concerned about friendly environment and recycle without hesitations or difficulties. I then believed that older people like us *could*, or in fact, *should*, do the same thing. With this facilitated process and regardless their flaws, I hoped it could increase the rate of recycle and raise awareness about environmental concern. This is because my ultimate goal is to reduce rate of factors that contribute to global warming by making people become more environmental friendly. I believe this packaging could be applied to any other recycling campaign as the recycling method is universal, in a hope that this could at least reduce the rate global warming,

As we are still sharing this very same world together...

Word Counts: 3992

Formal presentation good

Holistic Judgement - contains some practical activity
2/4 To achieve higher mark for this criterion candidate would have needed to demonstrate greater creativity leading to a wider range of innovative solutions

Bibliography

Interview

- ❖ Tetra Pak Thailand–
 - Mr. Sinchai Thiensiri - Technical Environmental Manager
- ❖ Roong Aroon School –
 - Mrs. Pranee Wadpia -
 - Primary – Secondary Students

Questionnaire

- ❖ Jatujak Market
- ❖ Siam Square-Center
- ❖ Roong Aroon School

Leaflet

- ❖ ตาวิเศษ. สมาคมสร้างสรรค์ไทย “อ๊ะ! อ๊ะ! กล่องเครื่องดื่มมีค่านะจ๊ะ”.
- ❖ Tetra Pak “Tetra Pak in figures 2008”.
- ❖ Tetra Pak “GOOD FOR YOU GOOD FOR THE EARTH”

Fact Sheet

- ❖ Tetra Pak. “Beverage Carton Recycling”.Facts about Beverage Cartons, Environmentally Friendly Packages.

Book

- ❖ Tetra Pak. “Highlight”. Environmental and Social Report 2007

Website

- ❖ เกษ-ล้าง-เก็บ กล่องนม”<http://www.thaikids-recycle.com/th/ccc_for_recycling.php>. 25 July 2008

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

Appendix A: Primary Research (Interview)

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

A.1 Tetra Pak



Name:

- ❖ Sinchai Thiensiri

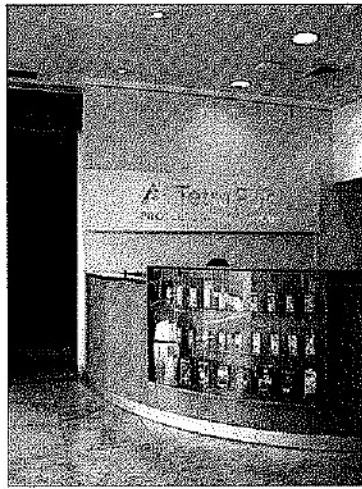
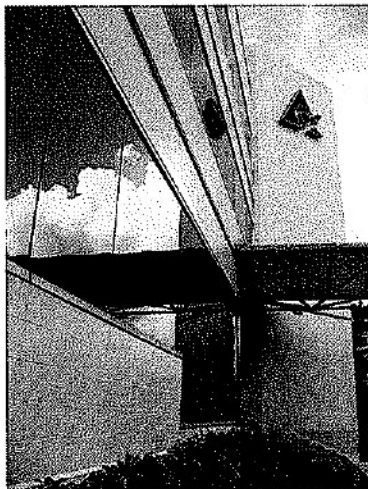
Location:

- ❖ Tetra Pak Thai Ltd

1042 Soi Poonsin, Sukhumvit Road 66/1, Prakanong 10260 Bangkok, Thailand

Phone:

- ❖ +66 2 361 2801



Interview Dialogs

1. About the UHT milk box, what are they consisted of?
"75% of paper, 20% of polyethylene, and 5% of aluminum"

2. How do they structure in the milk box? And why do they arrange in that order? Do they have any specific roles?

"yes, they do they specific roles, this is why they are arranged in different layers. The first layer, from the outside, is polyethylene which used to protect the moist from getting in, second layer is paper, which mostly used to hold the structure of the milk box. Third layer is polyethylene again to help with the sealing. Follow with aluminium which prevents the external factors such as light which can create bacteria. The last 2 layers, fifth and sixth are both polyethylene which are for adhesion and prevent leakage"

3. In the UHT milk box assembling process, what kind of material do they use?

"as the first layer and last layer of UHT milk box are made of polyethylene, the heat is used to melt these layer, then they will act as a glue which join each sides together"

4. Is there any alternative materials which can use to make UHT milk box packaging?

"To be honest the research has been done over years and these materials are the best one that we can use. We as a developer tried to find the best materials in term of price, health, and environmental effects. For examples, the paper that we used are recycled paper with no chemical process involved. We use the least amount of aluminum in each UHT milk box as they are one of the hardest materials that can be recycled. However, we still need to use it as they have the best role for this function. For polyethylene, they are the best plastic material which create the least emission, as therefore, less harm to the environment"

5. Would you say that the current milk box materials are the best?

"as far as we have developed, they are the best, and have been use throughout the world"

6. Is this UHT milk box packaging healthy enough to use?

"The milk goes through the aseptic process which kills the bacteria before packaging is sealed. Milk box is healthy enough in term of material used but if they are not well packed, the nutrition value can be deduct"

7. Is there any other way to recycle milk box? Is this the universal procedure?

"yes, there is only one procedure to recycle milk box They go through the fiber recovery process at the paper mill but

before, it is necessary to clean the milk box for the environmental reason"

8. Is Tetra Pak the only one who produce the aseptic milk box in Thailand?

"No, there is another one which is called 'Combi' who produce the packaging for 'Lacta Soy'"

9. In term of packaging production, who is leading in the market?

"I would say Tetra Pak because we have recycled 17 billion cartons, however, it is just 10% of all the waste"

10. About the Thai Kids Recycle Campaign, what is the reason for setting up this campaign?

"Firstly, is it to encourage people to know that they can be recycled, and follow by how to recycled and how to be responsible for society"

11. Do you have the same campaign in other countries?

"Tetra Pak in every country have the same motto towards recycling but which kind of campaign depends on the country"

13. What about campaign in Thailand, how do you encourage people?

"People in each country have different lifestyle, therefore, we firstly need to identify the habit of Thai people, starting from their culture. There are 3 ways that we have tried

1. By increasing the price: as the oil price increase, the price for polyethylene also increase, so people would consider before they buy"
2. By using scavenger: about 20-30 tons of milk box can be found because Thai people tend to throw them away, so we use scavenger to help us collect them
3. By donation: as you might have heard of several campaign such as "แม่บ้านรักโลก (maid love the world), and Thai Kids Recycle. People contribute most by this method. So once we identified the market, we focus and approach them"

14. For people who contribute to the campaign, what do they have to do?

"It was nice that they participate in this campaign, but we encourage them to clean these milk boxes before we collect them because they could be smelly in couple days and this would damage the environment in the area"

15. After you have collected them, what do you with it?

"We sent these UHT milk box to the paper mill so that they can carry out the fiber recovery process"

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

A.2 Roong Aroon School (โรงเรียนรุ่งอรุณ)



Name:

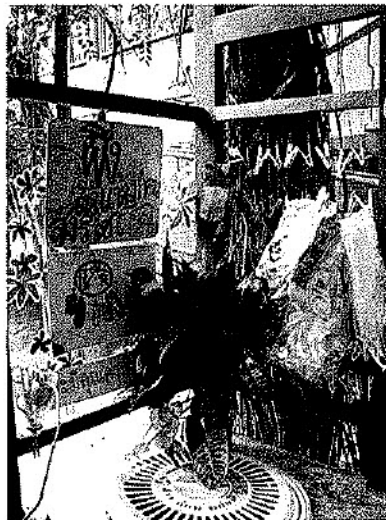
- ❖ Pranee Wadpia
- ❖ Students

Location:

- ❖ Roong Aroon School
9/9 m.5 Rama 2 road soi 33
Thakarm, Bangkhuntien, 10150 Bangkok, Thailand

Phone:

- ❖ +662 870 7512-3



A.2.1 Original Questionnaire

Questionnaire for those who didn't contributed

Original Version

เหตุใดที่ทำให้คุณไม่รีไซเคิลกล่องนม UHT? (เลือกได้มากกว่า 1 ข้อ)

- ไม่รู้วิธีรีไซเคิลยังไง วิธีการรีไซเคิลมันยุ่งยากและยาวเกินไป
- ไม่รู้วิธีรีไซเคิลแล้วจะเกิดอะไรขึ้น ไม่สนใจ

Translated Version

What factors prevent you to contribute to UHT? (choose more than 1)

- Don't know how to recycle Recycling process is too long/complex
- Don't know the difference Other Factors

Questionnaire those who contributed

Original Version

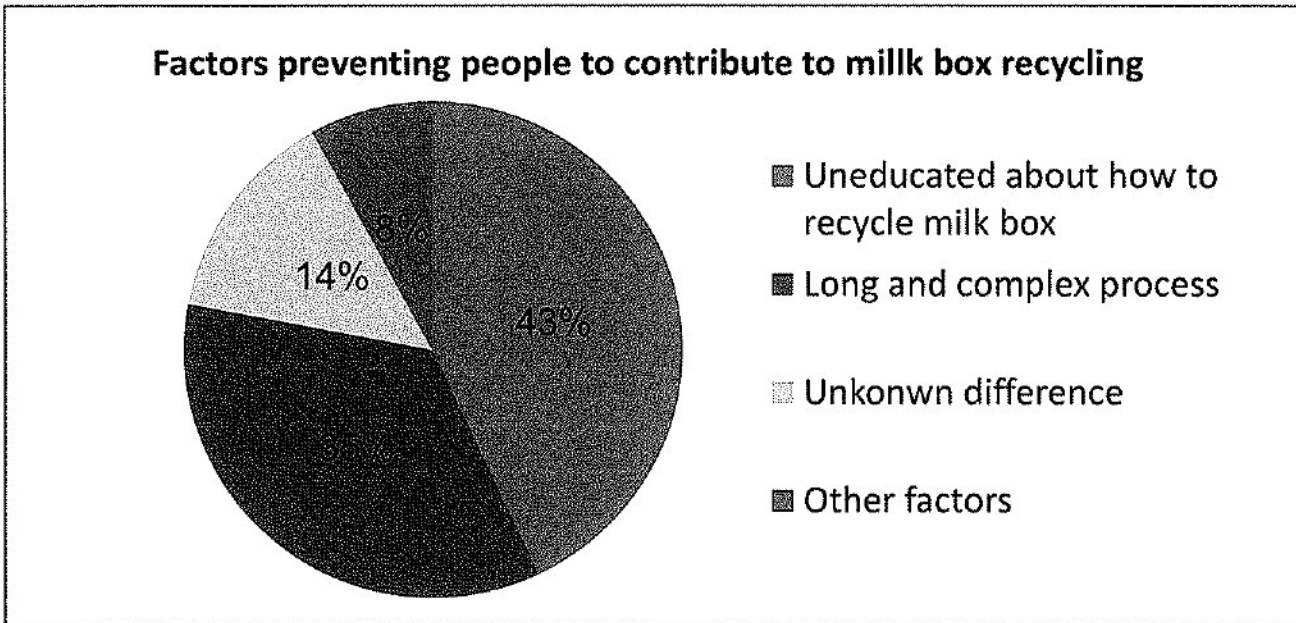
1. คุณได้ทำตามกระบวนการรีไซเคิลกล่องนมยูเอชทีของ "โครงการเด็กไทยหัวใจรีไซเคิล" (แกะ ล้าง เก็บ กล่องนม) หรือไม่?
 ได้ ไม่ได้
2. อันไหนบ้างในขบวนการนี้ที่คุณคิดว่ามีปัญหาหรือไม่สะดวก? (เลือกได้มากกว่าหนึ่งข้อ)
 การตัดกล่องนม การที่ต้องตากกล่องนมให้แห้ง ขบวนการที่ต้องใช้เวลานาน
 การที่ต้องเสียน้ำเพื่อทำความสะอาดกล่อง การที่ต้องแบกกล่องนมไปมา
3. คุณได้ตระหนักหรือไม่ว่าคุณได้เสียน้ำไปเยอะมากเพื่อที่จะรีไซเคิลกล่องนมพวกนี้?
 ได้ตระหนัก ไม่ได้ตระหนัก คิดไม่ถึง

Translated Version

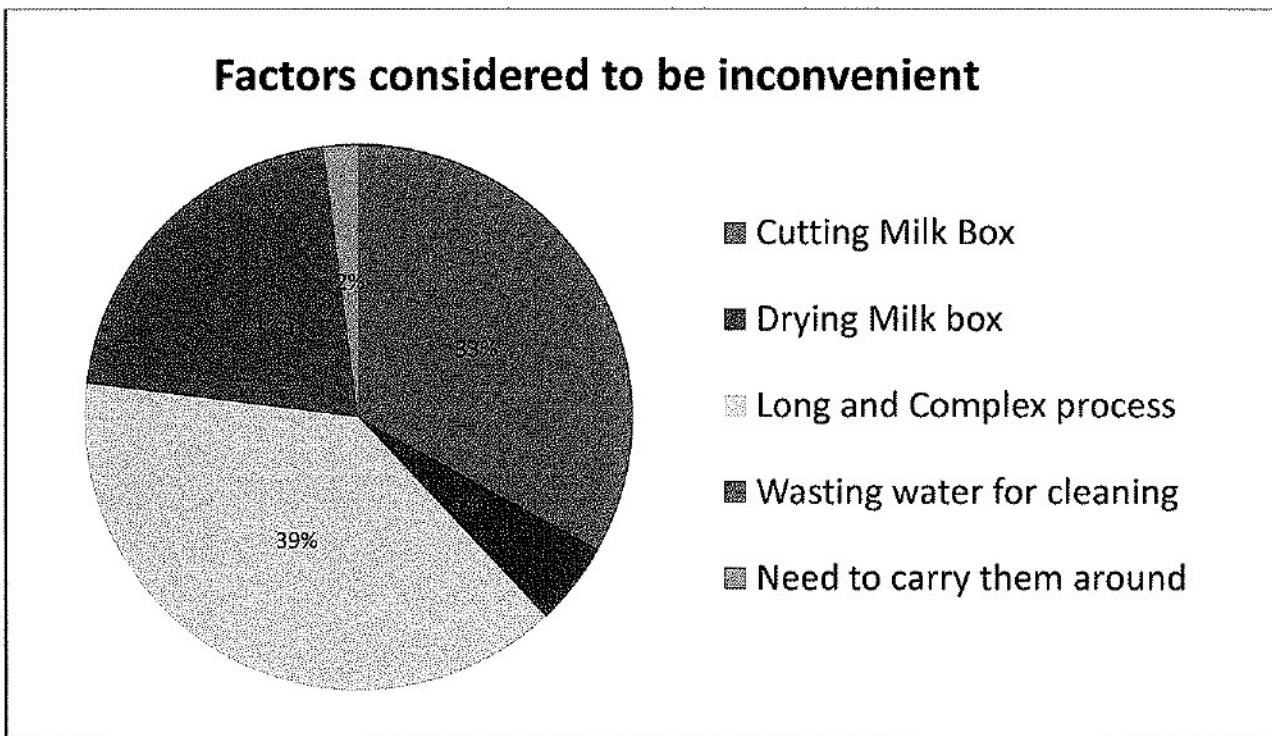
1. Have you followed the UHT milk box recycling process of "Thai Kids Recycle" (unfold clean keep UHT milk box)?
 yes no
2. Which of the following factors that you consider inconvenient (choose more than 1)
 cutting milk box drying milk box long process
 long process box wing factor need to carrying them around
3. Were you aware of the loss of water throughout the process,
 yes no didn't aware

A.2.3 Analysis from Questionnaire

Questionnaire for those who didn't contributed



Questionnaire those who contributed



The efficiency improvement of "Thal Kids Recycle" recycling process under the new structural development of UHT milk box.

Appendix B: Secondary Research

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

B.1 Book

B.1.1 Tetra Pak. "Highlight". Environmental and Social Report 2007

- 4% REDUCTION IN CO₂**
 3 facilities started to use green power
 A 0.6% improvement in energy efficiency (measured per standard package produced)
 Energy use in 2006 is now at a 2004 level (due to 2002, due to a production output of packages produced by 20%)
- 100% KNOWN AND ACCEPTABLE SOURCES FOR OUR PAPER**
 76% Certified Chain of Custody from forest stands in our own forest or material
 30% FSC or PEFC certified sources for our paper
 Membership in Global Forest Trade Network
- 76% INCREASE IN RECYCLING SINCE 2001**
 25 billion cartons recycled in 2006
 80% increase in facilities that recycle cartons since 2001
- 4.1 OUR OVERALL EMPLOYEE SATISFACTION SCORE, OUT OF A POSSIBLE 5**
 One of 200 employees surveyed in our Employee Engagement Survey
 81% of managers are satisfied
- 40 MILLION CHILDREN IN MORE THAN 45 COUNTRIES RECEIVED SCHOOL FEEDING IN 2006**
 Global Alliance World Business Award

CLIMATE GOAL

Tetra Pak has a goal to reduce CO₂ emissions by 10% in 2010 as compared to 2005, in absolute terms. The goal covers Tetra Pak sites globally, and includes direct emissions from burning fuels, indirect emissions from the generation of electricity and district heating that we use, and to a limited extent, emissions of refrigerants. The goal will be achieved through continued improvement in energy efficiency and the use of green power from renewable energy sources. With its climate programme Tetra Pak qualified for the WWF Climate Savers initiative.

FORESTRY

Our ultimate goal is to have all the paper in our packaging certified to the highest standard - currently FSC (Forest Stewardship Council). In order to achieve this, not only must all the forests that our suppliers source from be certified, but so too must all the systems and facilities that deliver it, from forest to pulpstock to board manufacturer and thence to our converting plants and to our customers. In cooperation with our suppliers, and with guidance from NGOs such as WWF, and auditing organisations like ProForest, we are yearly increasing the amount of certified material in our cartons.

RECYCLING

In 2001 twelve billion Tetra Pak cartons were recycled. Today, we are recycling over 21 billion a year - a 76% increase! The recycling rate for the markets that had recycling programmes in place in 2001 is currently 23.3% - well on the way to our goal of recycling at least a quarter of our packaging. Our overall recycling rate is 16.3% - evidence that it takes time and a critical mass of cartons to generate sustainable recycling systems. And - that once the supply is there, demand for the long clean fibres is strong.

PEOPLE

In the yearly employee satisfaction surveys for 2006 over 16,500 employees answered, which represents an 85% capture rate, and scored their overall satisfaction with the company at 4.1.

To guarantee a good balance within the company we have set ourselves ambition levels for gender proportion and diversity of nationality. Regarding health and safety our goal is to eliminate all workplace related injuries and illnesses and to ensure the long-term well-being of our employees. Our overall rate of workplace accidents in 2006 continues a clear downward trend. We suffered 151 serious injuries, a substantial decline from 2005's 190 (the majority of these injuries were cutting injuries).

COMMUNITY

Tetra Pak was awarded the World Business Award in 2006, for its support of the United Nations Millennium Development Goals. The award recognises the significant role business can play in implementing UN targets for reducing poverty.

The Global Alliance for Improved Nutrition (GAIN) signed a letter of intent to work together with Tetra Pak in the fight against malnutrition. Tetra Pak also joined the GAIN Business Alliance for Food Fortification. This is a strategic partnership to support private sector initiatives in food fortification targeted to the poor.

Environmental and Social Report 2007



SUSTAINABLE BY NATURE

▲ Tetra Pak

Environmental and Social Report 2007 - 9

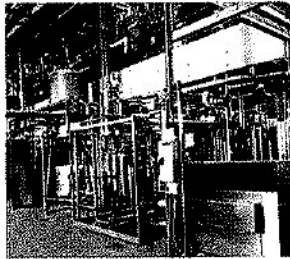
The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

B.2 Leaflets

B.2.1 Tetra Pak "Tetra Pak in figures 2008".

Processing Solutions

We provide processing solutions within five food categories: dairy, cheese, ice cream, beverage and prepared food. We deliver plants with guaranteed performance and offer support over the lifetime of the plant. This includes integrated plant automation systems to protect food safety.



Packaging Solutions

We provide integrated processing, packaging, and distribution solutions for food manufacturing and offer packaging machines for the eleven different packaging alternatives presented in the picture on next page. From our network of production facilities, we also supply packaging material to the 9,143 packaging machines in all parts of the world.



Tetra Brik

The Tetra Brik package was introduced in 1963. It is rectangular or square in shape and available with a large number of different openings. The Tetra Brik Aseptic carton, which was introduced in 1969, is the most frequently used package for long-life products.

Tetra Recart

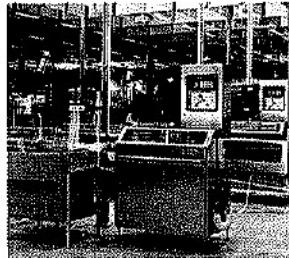
Tetra Recart is a carton packaging system with revolutionary possibilities. This is an alternative packaging solution for a variety of food products that have traditionally been packed in cans or glass jars. These are products such as fruits, vegetables and pet food.



Tetra Pak packages, from left: Tetra Rex, Tetra Top, Tetra Fino (in front), Tetra Gemma, Tetra Recart (in front), Tetra Wedge (in front), Tetra Prisma, Tetra Brik and Tetra Classic (in front).

Distribution equipment

We can offer our customers a large number of different types of distribution equipment, such as conveyors, tray packers, film wrappers, crates and roll containers, which are developed, produced and marketed by Tetra Pak.



Aseptic packaging

Our aseptic packaging systems have fundamentally changed the handling of sensitive liquid foods. Distribution and storage no longer require refrigeration, with the result that the shelf life of the package contents is considerably extended. The need for aseptic packaging is rapidly increasing and the system has proved to be invaluable in the distribution of milk and other products.

Today, two thirds of Tetra Pak packages are aseptic. Our aseptic packaging systems have played a vital role in providing children all over the world with essential nourishment.



Tetra Classic

Tetra Classic is the name of our tetrahedral package. It was the first package launched by Tetra Pak in 1952. An aseptic variant was released in 1961.

Tetra Fino

Tetra Fino Aseptic is a carton-based pillow-shaped package, which was introduced in 1997. This roll-fed packaging system offers good economy for producers as well as for consumers.

Tetra Gemma

Tetra Gemma Aseptic is the world's first roll-fed gable-top shaped package with full aseptic performance for juice and liquid dairy products. This packaging system, which was introduced in 2007, is based on the reliable Tetra Brik Aseptic concept.

Tetra Prisma

Tetra Prisma Aseptic is an octagonal package made in accordance with the principle of the Tetra Brik Aseptic system. The package was launched in 1997. The package has excellent grip and

pouring performance and is available with resealable StreamCap for added convenience.

Tetra Rex

The Tetra Rex package is rectangular with a gable-shaped top. The first Tetra Rex packaging machine was installed at a customer's site in Sweden in 1966. The package is used throughout the world for pasteurised products.

Tetra Top

The Tetra Top package was launched in 1986. It is a reclosable, square package with rounded corners and has a polyethylene lid, which is injection moulded and sealed to the package in a single process. The opening device makes it easy to open, pour from and reclose.

Tetra Wedge

The Tetra Wedge Aseptic package was introduced in 1997. Its innovative shape enables products to be easily distinguished on shop shelves and keeps packaging material consumption to a minimum.

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

B.2.2 Tetra Pak "GOOD FOR YOU GOOD FOR THE EARTH"

GOOD FOR THE EARTH

Good for the Earth is becoming a global concern, focusing through at supply chain.

- Using renewable resources as raw material. Tetra Pak packages are primarily made of recycled (75%) which comes from professionally managed forests planted and certified by independent organizations as World Wildlife Fund for Nature (WWF) and Forestry Stewardship Council (FSC). In these certified and well-managed forests, more trees are grown than harvested.
- Saving energy in production and transportation or using green power (renewable wind). Energy use in factories worldwide in 2007 was the same as in 2002, though production up 29%. Our CO₂ emissions reduction target is by 20% in absolute terms by 2010.
- Being transported in bulk to mills, resulting fewer trips than the forested packaging. Less than one truck is needed to transport 225 for one million milk packages, which is used for recycling reaching 30 tons.
- Being easy to separate, thus minimizing energy costs in paper.
- Being recycled. Each ton of used beverage cartons recycled saves 300 k kilograms of carbon dioxide in the air. In 2007 over 22 billion of our cartons were recycled.

Help solve global warming by sending spent cartons for recycling.

Remember! Please flatten the package from the top and bottom and drop it into the recycling bin.

Beverage carton recycling process

When your old paper-based packaging is done, you are doing good for the earth.

Thank you for taking care of our planet!

Tetra Pak

GOOD FOR YOU GOOD FOR THE EARTH

ดีต่อใจ ดีต่อใจ ดีต่อใจ ดีต่อใจ

Tetra Pak

GOOD FOR YOU

Aseptic carton

- Safe and hygienic
- Preserves nutrition and taste
- Convenient
- No preservatives
- No refrigeration

Tetra Pak aseptic cartons are good for you because with our aseptic technology, they help deliver safe and nutritious food. They have unique benefits with a six-layer laminate made of paper (75%), polyethylene (20%), and aluminum foil (5%). Paper gives the package strength, polyethylene makes it liquid tight, and the micro-thin foil protects milk and beverage contents from light, oxygen, and bacteria, thus giving the products a longer shelf life without using artificial preservatives.

- Taking out what's best while retaining goodness with the UHT process (aseptic technology).
- Locking in what's good with six protective layers.
- Keeping drinks good and safe for months without the need for preservatives or refrigeration.
- Providing convenience to enjoy nutritional goodness whenever and wherever you are.
- Saving energy and ensuring hygiene and nutrition work hand-in-hand.

Drink it after opening. If cannot finish, keep refrigerated and consume within 24 days. Even at room temperature, after opened can cause food deterioration.

Food safety and aseptic technology

In every step of Tetra Pak aseptic processing and packaging systems, safety in food and beverages is top priority.

UHT-treated product is piped to the packaging machine in a closed system then packed in sterilized packaging material. The process of form-fill-seal is automatically done in Tetra Pak's packaging machine in a safe and free of bacteria environment.

Protects food and beverages, keep fresh without refrigeration and no preservatives.

Tetra Pak PROTECTS WHAT'S GOOD!

Tetra Pak carton helps protect food and beverages inside from light, oxygen, and bacteria. It keeps the contents fresh without refrigeration and requires no preservatives.

- Polyethylene: protects against external moisture
- Paper: for stability and strength
- Polyethylene: adhesion layer
- Aluminum foil: oxygen, moisture and light barrier
- Polyethylene: adhesion layer
- Polyethylene: seals in the liquid

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

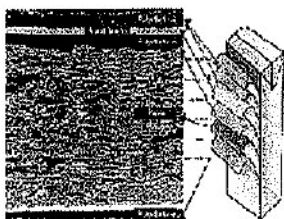
B.3 Facts Sheets

B.3.1 Facts about Beverage Cartons, Environmentally Friendly Packages

Facts about Beverage Cartons, Environmentally Friendly Packages

Facts about Beverage Cartons, Environmentally Friendly Packages

What is a Beverage Carton?



- A beverage carton is an efficient package for liquid foods, made largely from paper - a renewable resource. It is a popular package for juice, milk and other liquid foods around the world.
- It protects sensitive products against the effects of air, microorganisms and light. Aseptic beverage cartons can keep the contents fresh at room temperature for 6 months or more.
- A 1-liter beverage carton weighs only 26 grams or about 3% of the total weight of the filled carton.

Environmental Impact of Beverage Cartons

Life Cycle Analysis (LCA) involves evaluating the environmental impacts of a product system throughout all stages of its life-cycle, i.e. from extraction of raw materials to final disposal. The results of many independent LCAs on beverage containers concluded that beverage cartons have among the lowest impacts of all beverage containers. One-way beverage cartons and refillable glass bottles in Germany were found to have similar environmental impacts throughout their life cycles.

What Make Beverage Cartons a Preferred Choice for Packaging?

- ✓ Liquid foods in aseptic cartons require no refrigeration → saving energy.
- ✓ The rectangular shape of the carton takes up less space during distribution → lower emissions & savings in energy
- ✓ Empty cartons are transported in flattened form, requiring fewer trucks → lower emissions & savings in energy
- ✓ Cartons are 75% paper, a natural and renewable resource.
- ✓ Beverage cartons are recyclable; approximately 250,000 tons were recycled in Europe in 2001.

Beverage Carton Recycling

Although technically there are many options for recycling of beverage cartons, two main options (fiber recovery and chipboard manufacture) are widely used and have been operated commercially for many years in many countries:

Fiber Recovery

Used cartons can be used as raw material in any conventional paper mill operating in a local market. With typical equipments in the mills, called "pulpers", the virgin fibers in the paperboard fraction are separated from beverage cartons; approximately 600 kg of pulp can be extracted from 1 tonne of cartons. The process needs no chemical or special equipment to recycle beverage cartons.

Because these fibers are virgin, comprising long fiber and CTMP, the reclaimed fibers from used cartons are stronger than those of old corrugated carton boxes (OCC), which are widely used as the prime raw material in the recycled paper industry. They are ideal for making strong paperboard or corrugating medium paper.

The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

B.4 Website

B.4.1 Thai Kids Recycle Official Website

- ❖ “แกะ-ล้าง-เก็บ” <http://www.thaikids-recycle.com/th/ccc_for_recycling.php>. 25 July 2008



The efficiency improvement of "Thai Kids Recycle" recycling process under the new structural development of UHT milk box.

Appendix C: Mathematical Analysis

C.1 Calculation of surfaces area in Prototype Design

C.1.1 D1 'Triangular prism'

$$\begin{aligned}
 \text{Total surface area} &= (6 \times \text{area of 'a'}) + (2 \times \text{area of 'b'}) + (\text{area of 'c'}) + (3 \times \text{area of 'd'}) + (\text{area of 'e'}) \\
 &= 6\left(\frac{6 \times 7}{2}\right) + 2\left(\frac{5 \times 32}{2}\right) + (12 \times 2) + 3(7 \times 12) + (3 \times 12) \\
 &= 126 + 15 + 24 + 252 + 36 \\
 &= 453 \text{ cm}^2
 \end{aligned}$$

C.1.2 D2 'Parallelepiped'

$$\begin{aligned}
 \text{Total surface area} &= \text{area of '2a'} + \text{area of '4b'} + \text{area of '4c'} + \text{area of 'd'} + \text{area of '2e'} + \text{area of '2f'} \\
 &= 2\left(\frac{3 \times 3}{2}\right) + \{4\left(\frac{4 \times 4}{2}\right) + (3 \times 4)\} + \{4\left(\frac{3 \times 4}{2}\right) + (1.7 \times 4)\} + (3 \times 12) + 2(7 \times 12) + 2(5.7 \times 12) \\
 &= 9 + (32 + 12) + (24 + 6.8) + 36 + 168 + 136.8 \\
 &= 424.6 \text{ cm}^2
 \end{aligned}$$

C.1.3 D 3 'Cuboids'

$$\begin{aligned}
 \text{Total surface area} &= \text{width} \times \text{length} \\
 &= 24 \times 20 \text{ cm} \\
 &= 480 \text{ cm}^2
 \end{aligned}$$

C.2 Calculation of paper consumption area in Prototype Design

C.2.1 D1 'Triangular prism'

$$\begin{aligned}
 \text{Consumption area} &= \text{width} \times \text{length} \\
 &= (7+7+7+3+2) \times (6+12+6) \\
 &= 26 \times 24 \\
 &= 624 \text{ cm}^2
 \end{aligned}$$

C.2.2 D2 'Parallelepiped'

$$\begin{aligned}
 \text{Consumption area} &= \text{width} \times \text{length} \\
 &= (3+7+5.7+7+5.7) \times (4+12+4) \\
 &= 28.4 \times 20 \\
 &= 568 \text{ cm}^2
 \end{aligned}$$

C.2.3 D 3 'Cuboids'

$$\begin{aligned}
 \text{Consumption area} &= \text{width} \times \text{length} \\
 &= 24 \times 20 \\
 &= 480 \text{ cm}^2
 \end{aligned}$$

Assessment form (for examiner use only)

| | | | |
|--------------------------|---|---|--|
| Candidate session number | 0 | 0 | |
|--------------------------|---|---|--|

| Assessment criteria | | Achievement level | | |
|---------------------|-----------------------------|-------------------|---------|--------------------------|
| | | First examiner | maximum | Second examiner |
| A | research question | 1 | 2 | <input type="checkbox"/> |
| B | introduction | 1 | 2 | <input type="checkbox"/> |
| C | investigation | 2 | 4 | <input type="checkbox"/> |
| D | knowledge and understanding | 2 | 4 | <input type="checkbox"/> |
| E | reasoned argument | 2 | 4 | <input type="checkbox"/> |
| F | analysis and evaluation | 2 | 4 | <input type="checkbox"/> |
| G | use of subject language | 1 | 4 | <input type="checkbox"/> |
| H | conclusion | 1 | 2 | <input type="checkbox"/> |
| I | formal presentation | 3 | 4 | <input type="checkbox"/> |
| J | abstract | 1 | 2 | <input type="checkbox"/> |
| K | holistic judgment | 2 | 4 | <input type="checkbox"/> |
| Total out of 36 | | 18 | | <input type="checkbox"/> |

Name of first examiner: _____
(CAPITAL letters)

Examiner number: 3886

Name of second examiner: _____
(CAPITAL letters)

Examiner number: _____