THE HORIZONTALLY APPLIED TAPING SYSTEM (HATS)

THE DEVELOPMENT OF ADHESIVE TAPE FOR A TAPE-SEALED PACKAGING SYSTEM

A thesis submitted to the College of Sciences, Institute of Technology and Engineering, Massey University, Palmerston North, New Zealand, in partial fulfilment of the requirements for the degree of

Master of Technology
in
Packaging Technology

Vivien Wai Ying Yeung

2009

ABSTRACT

This project details the work done to develop testing methods for adhesive tapes for a tape-seal packaging system for selection at Graphpak Services Limited in Palmerston North, New Zealand. The company developed and patented a tape-sealing system for corrugated cartons that requires the use of pressure sensitive tape. The system is used for sealing cartons for export for the meat and fisheries industry. The tape is applied horizontally around the case with a circular tape head that deforms to conform to the varying surface layers of a case with an overlapping lid, thus securing the lid to the base.

Existing packaging tapes were tested for minimum strength properties and its effectiveness for use with corrugated board. The storage conditions of export goods require a substantial time spend in cooler temperatures, thus an adhesive tape functional at a large range is favoured. The selection of The Sellotape® brand of freezer grade tape was made as an all-round performer on the experiments conducted.

To export goods representing New Zealand, the Ministry of Agriculture and Forestry logo must be visible on the carton. The tape is intended to replace the seal by incorporating the logo on the tape by the means of print. The compatibility of ink on the adhesive tape was investigated and results show that it was most feasible to print on the tape backing substrate.

To deter unscrupulous operators from reusing the carton for black market resale, the carton must be tamper evident. Tests also investigated the conditions needed for a strong adhesive bond to delaminate the corrugated fibre material upon removal of the tape. It was discovered that the treatment of hot air blown on sealed tape produced a tighter seal as well as more fibre tear.

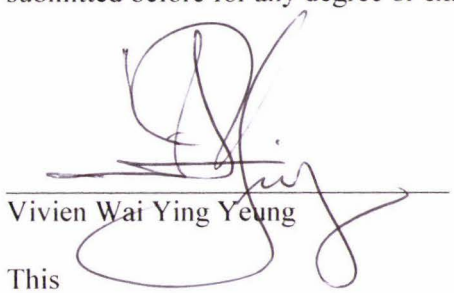
Security features such as bar-coding is highly recommended, and when required the use of microchips implanted in the carton will allow for traceability.

The use of the brand Sellotape for the proposed tape will reduce costs as the tapes are New Zealand made.

The combination of the tape-sealed packaging system and the proposed adhesive tape is an innovative way to incorporate a method of carton closure for waste reduction and a tamper proof international export requirement all in one, a special way to represent the New Zealand export industry.

DECLARATION

I declare that this is my own, independent work. It is being submitted in partial fulfilment of the requirements for the degree of Master of Technology at Massey University. It has not been submitted before for any degree or examination in any other University.



Vivien Wai Ying Yeung

This

First Day of June 2009

ACKNOWLEDGEMENTS

Sincere appreciation to all the people and organisations listed below in aiding the completion of this project.

Thanks to,

- Foundation for Research Science and Technology for funding the Technology for Industry Fellowship (TIF) Program.
- Mr John Bradley, Managing Director of Graphpak Services Limited for the opportunity.
- Mr Rod Collins, fellow masterate from Graphpak Services Limited for your guidance and technical support.
- Mr Tom Robertson, Academic Supervisor for your management, support, patients and friendship.
- Mr Gary Radford, Mr Leo Bolter and Mr Steve Glasgow, technicians from Massey University for your assistance.
- Mr Michael Graves, Production Manager and the team from The Sellotape Company in Auckland for your advice and generosity.
- My family for their support and patients.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 – INTRODUCTION

1.1 GRAPHPACK SERVICES LIMITED

Graphpak Services Limited was established in 1981 in Palmerston North, New Zealand. Its core business is to service and provide engineering to the printing and packaging industry and produce unique machinery for the dairy, fibreboard packaging, print finishing and food processing industries. Own and operated by Mr John D Bradley for over 20 years, the company has undergone new structural and management change. Graphpak has since been bought by Manawatu Precision and John has formed a new company with Bob McIhatton called Lyhatton that focuses further on the development of the Horizontally Applied Taping System (HATS) project; both the tape-sealed packaging unit as well as the adhesive tape. Lyhatton has now relocated to Fielding.

Figure 1-1 Mr John Bradley, Mr Rod Collins and I pictured at Taylor Preston Meat Processing Plant in Wellington February 2002

1.1.1 THE HATS PROJECT

In 1992; John saw a need to provide a solution to replace existing polypropylene strapping in the packaging industry after recognising the reoccurring failure of holding the package together with this method. He patented a design idea of his own that would allow a horizontal taping machine to seal corrugated fibreboard that not only holds the package intact better than strapping but in addition increases the shelf life of the product. John also considered existing security requirements to which Ministry of Agriculture, MAF became interested and so too did the local produce sector.

It was clear that this innovative system had much potential which also required resources from the company that it could not provide on its own, therefore in 2001, technology in industry fellowship funding (TIF) was granted for a masterate student to take this idea to the next level, onto developing a production model. Student Rod Collins undertook this project and developed a tape head roller which makes sealing the tape horizontally possible.

1.2 TAMPER EVIDENCE

The New Zealand meat export industry has often commonly been a target to unscrupulous operators that reuse the New Zealand meat carton and Ministry of Agriculture and Forestry (MAF) seals to sell counterfeit meat products. When these products have reached their required destinations, it may be discovered that the product is counterfeit. This alone will give our products and brand to our overseas market a bad reputation.

Currently, the cardboard boxed meat products are strapped with polypropylene to secure the lid. Official Ministry of Agriculture and Forestry (MAF) seals which are adhesive labels are placed on these straps whereby the lid and base of the cardboard box meets, and usually two labels are required and used. With this type of packaging closure, it is not surprising counterfeiting is common.

Often whole shipments of meat are returned to New Zealand where a few cartons are either found to have evidence of tampering or labels have fallen off due to temperature differences and rough handling. Rough handling is common and with the use of the strapping material as handles to move the cartons and for palletisation. Seals become unstuck, the box will be reshaped due to the strapping material digging to the corners of the carton and lids are not tapered as strapping alone does not make for a uniform package. This therefore makes palletisation untidy and weak. The whole shipment may then be returned to New Zealand at our expense.

1.3 CURRENT SYSTEMS OF CARTON CLOSURE

Adhesive Taping System

- Used on regular slotted cartons (RSC).

Hot Melt Glue

- Applied to lid and side flaps of carton.

Polypropylene Strapping

- Straps are tightened and heat sealed to join.

Table 1-1 Advantages and Disadvantages of Adhesive Taping, Hot Melt Gluing and Polypropylene Strapping

FACTORS	ADHESIVE TAPING	HOT MELT GLUING	POLYPROPYLENE STRAPPING
Ease of use	✓	✓	✓
Easily removed	✓	×	✓
Environmentally friendly	✓	✓	×
Expensive	×	✓	×
Good carton structural integrity	✓	✓	×
High maintenance	×	×	✓
High Strength	×	×	✓
Manual operated	✓	✓	✓
May hinder carton loading	×		
Operational only on flat surface	×	✓	✓
Prevent ingress of foreign matter	✓	×	×
Printed message	✓	×	×
Require separation for recycling	×	✓	✓
Reshapes carton	×	×	✓
Subject to breakages/failure	✓	✓	✓
Time constraints	×	✓	×

✓ = Advantages × = Disadvantages

1.4 PROPOSED TAPE-SEALED PACKAGING UNIT

Currently the New Zealand freezing works and Fisheries industries are looking for more effective methods of carton closure, especially for the export of goods. Their existing method is by mechanised polypropylene strapping and hot melt gluing by which causes non-recyclable waste and requires man power to operate machinery. It has also been a target to reuse and misuse of the goods overseas which spoils New Zealand's brand name. The Ministry of Agriculture and Forestry, have voiced their concern of inadequate carton seal placements which has lead to products being rejected or held pending awaiting corrective action overseas. Both parties have expressed interest for this new taping technology, a method developed by Graphpak Services Limited that seals the carton with packaging tape that can incorporate the required seals while reducing materials and waste. An endorsement from MAF can be viewed in the Appendix A.1.

This new revolutionary technology developed by Mr John D Bradley, managing director of Graphpak Services Limited has been patented and further developed by a masterate project focussing on the development of the tape-sealed packaging unit, that is the tape application

equipment. The initial idea started from only a tape head roller which can be housed by a tape dispenser, figure 1-2.

Figure 1-2 Tape Head Roller (Illustration created by Mr Rod Collins)

This method of sealing boxes whereby the tape can be deformed to conform to the varying surface layers of a case with an overlapping lid. The tape is applied horizontally around the case, thus securing the lid to the base. (Figs 1-2, 1-4). Applications of this packaging system include meat, seafood and potentially other fresh or frozen produce.

Figure 1-3 Photos of a modified taping machine applying tape to a carton with lid. Modified from vertical to horizontal taping, machine supplied by The Sellotape® Company in Auckland.

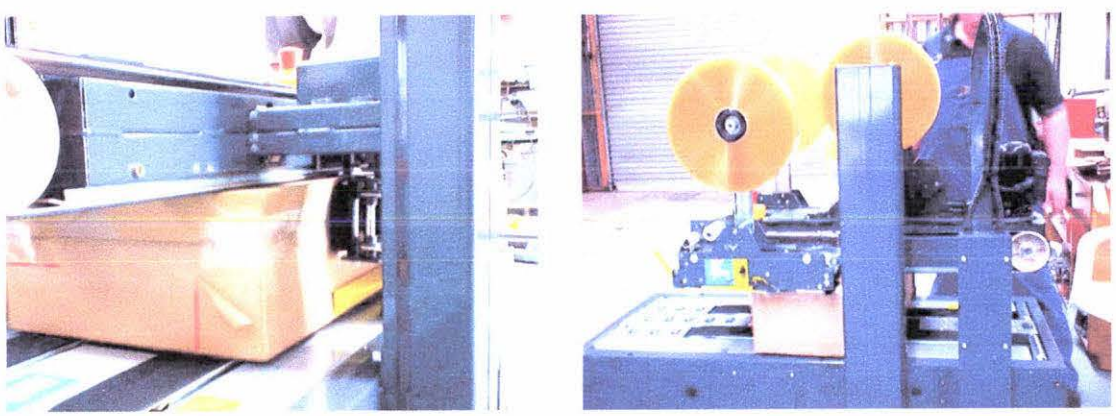
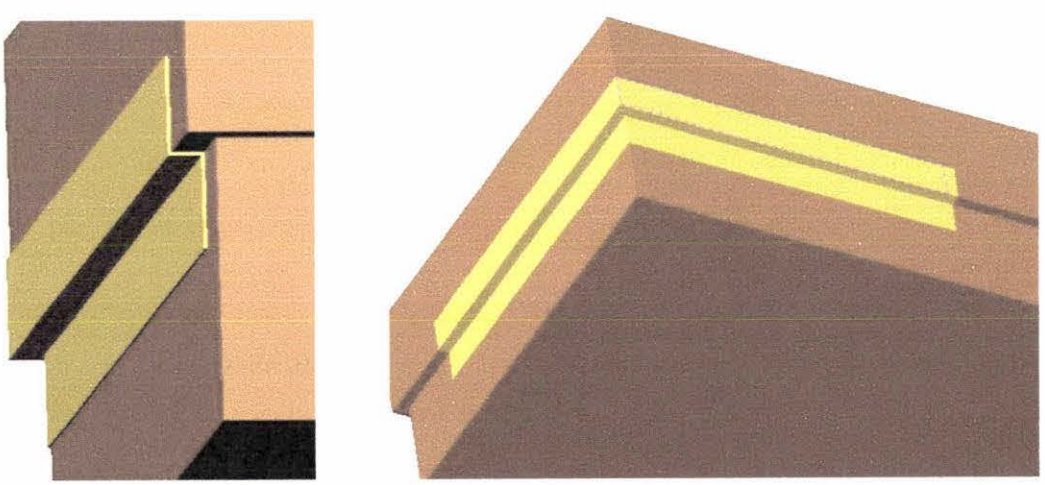


Figure 1-4 Illustrations of the results from the application of the tape-sealed unit to cartons with tape (Illustrations created by Mr Rod Collins)



The advantages of this type of closure of cartons are:

- The package is tamper evident; the carton fibre material will delaminate when the tape is removed.
- A hermetic seal is produced reducing freezer burn and eliminating the need for plastic liners for frozen products. There is no air gap in the fold of the tape to the lid.
- Structural integrity is improved allowing thinner gauge packaging materials, thus reducing packaging material.
- Better constancy of the shape of the packaging improving palletisation with less air gaps between packages, hence improving heat transfer during the freezing process.
- Corresponds to recycling requirements

The potential market and environmental factors that dominate this new method of carton closure has been explored by fellow student Rod Collins in his research of the feasibility of this project while undertaking the development in the construction of the taping system. The potential economic significance for the food packaging industry was also explored and is immense. The savings from material reduction alone will impact the large export trade that exists in New Zealand, [Charles Roderick Collins 2002, Horizontal Application of Tape System (HATS)].

This project will be successful if an adhesive sealing tape can be developed that: imparts minimum strength properties to the packed carton; is tamper evident; incorporates security features to deter fraud and allow traceability; produces an airtight seal; and allow savings in packaging materials.

This work reports on the support of the tape-sealed packaging unit and investigates potential existing packaging tapes that are likely options for use with this system. Existing freezer grade or cold temperature tapes with its vast working temperature range is favoured.

1.5 AIMS

The aims of this research are to

1. Investigate existing packaging tapes with potential for selection for use with the tape-seal packaging system.
2. Develop security measures to protect the tape and system.
3. Develop a package design for use with this tape sealing system.
4. Make recommendations for future development of the tape and system.

1.6 OBJECTIVES

1. Develop appropriate performance specifications and test methods to conduct on selected existing packaging tapes.
2. Investigate tape and adhesive substrates for suitability.
3. Explore methods of security protection of the tape and system.
4. Develop a package design to take advantage of this tape sealing system.

1.7 THESIS STRUCTURE

The literature review follows this section and provides a basic overview of relevant topics and issues that aid in attaining the project's aim. Five experimental chapters follow each including results and discussions, the topics investigated are:

1. Tape Performance Specifications and Testing.
2. Tape Material and Adhesive System.
3. Use of Ionised Air.
4. Development of Security Features.
5. Package Design.

The project then comes together again for an overall conclusion.