final report

Project code: A.MPT.0054

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Date submitted: June 2012

PUBLISHED BY
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Locked Bag 991
NORTH SYDNEY NSW 2059

SmartShape Auto Bagging System (Stage 1)

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government and contributions from the Australian Meat Processor Corporation to support the research and development detailed in this publication.

Executive summary

This project for the SmartShape Auto Bagging system is the first stage in automating the packaging (bagging) process for SmartShape. The successful development of the bench trial auto bagging model and developments to the bag holding system have shown that the full automation of SmartShape's bagging system is feasible.

The next stage work to follow will now be focused on refinement of the above developments, then integration into the current SmartShape commercial machine followed by testing in a production environment.

However, the auto-bagging and bag holding system can also be applied to other SmartShape machine configurations and designs, including those currently being trialed within Australia.

Further and separate development will required for automatic loading and un-loading. When these elements are integrated with auto-bagging, it will mean that SmartShape will be a fully automated process, providing many benefits to the meat industry.

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1 Background

This project was to develop stage 1of a novel bag holder and automatic bagging system for current and future SmartShape machines. The intent was to assist the SmartShape technology to achieve the cycle times required by industry as per their feedback. In doing this it was to also reduce labour inputs and address one of the requirements for full automation (auto load, auto bag and auto unload) of SmartShape.

Processors have indicated that, if this design is successful, then they would seek to have this retrofitted to existing and future Smart Shape machines.

2 Project objectives

This project is the preliminary project in the process for developing the automation add-ons for the current evolution of SmartShape machine. The project has the objective to determine acceptable methods of auto bagging, and this has two key areas; preparation of the packaging film, and further development of the bag holder.

- Bench trial model of the bag holder and auto bagging system.

- Trial of the new bag holder and auto bagging system as integrated into the next SmartShape demonstration machine currently under construction.

An experimental auto bagging system was developed, called the bench trial model. This is an experimental module which is designed to attach to the existing SmartShape machine, and to demonstrate the requirements of the auto bagging system.

3 General Methods

3.1 Auto bagging system

The auto bagging system comprises of multiple components, notably;

- packaging film delivery;
- packaging film alignment;
- packaging film opening; and
- packaging film placement on the bag holder.

For this bench trial model, the aspects of packaging film delivery and alignment are omitted as this requires significant further development, yet is more straight-forward and can be addressed at the time when the auto bagging system is fully integrated into the SmartShape machine.

3.2 Packaging film opening

The packaging film used for SmartShape is lay-flat polymer film, in the form of collapsed cylindrical tubing. The film is sized specifically for the size of product processed, therefore variable in width. The packaging is supplied in reeled form, many meters of film process wound onto a hollow spindle.

To open the packaging film requires that the presented two sides of the flattened tube can be grasped by mechanical means then the retaining devices can be separated from each other to open out the tube.

The method used was a custom developed vacuum pad. The vacuum pad followed several evolutions in the design to improve its functionality to a reliable level.

3.3 Packaging film placement on the bag holder

Once the packaging film is successfully retained in its open state, then it needs to be placed on the bag holder. The method to do this was to design an additional module that is able to fit to the existing bag holding mast on the SmartShape machine. Contained in the module is a mechanical geared system of interconnected arms that manipulate the vacuum pads that open the packaging film down onto the bag holder itself.

Through the development it is seen that the movements can in fact be combined through arc movements to provide opening then placement in one movement.

The developed mechanism for the Bench trial model contains the estimated movements required for the complete auto bagging system, minus the actuation and integration into the machine cycle of the SmartShape machine. For this preliminary development, manual movement of the mechanism was used to simulate the motion.

3.4 Bag holder

The current bag holder design used is not well suited to automation of the bag application. The reason for this is that currently the packaging film is threaded through the bag holding ring then back over itself on the outside of the bag holding ring. This is physically a complex movement.

The proposed new method to be used in-conjunction with the auto bagging system is that where the packaging film is applied to the exterior of the new design bag holder only.

Different geometry was trialed, and the most suitable was a *finger-type bag holder*, with sprung loaded fingers that sit naturally at a smaller size than the packaging film for the film to be loaded, and then under meat ejection cycle retain the packaging film in-place.

In addition to the development of the new method of holding the bag, another existing problem exists where the meat is not completely ejected into the packaging film. Different strategies were experimented with to combat this, with the most successful being to lower the packaging film’s position into bag holder, so that the packaging film is further over the ejected meat.

4 Results and discussion

4.1 Auto bagging system

Following the design of the initial experimental equipment, numerous tests of the Bench trial model auto bagging system was carried out throughout its development. The key area of development was the:

- Geometry, materials and design of the vacuum pads

4.2 Vacuum Pads

To grasp the packaging film using vacuum pads posed difficulties and required several iterations of the vacuum pad design to attain satisfactory results. Some of the designs used are shown in the Appendix (figure 6.1).

The result shown here below is the current level of development, where the packaging film is reliably opened to the required aperture.

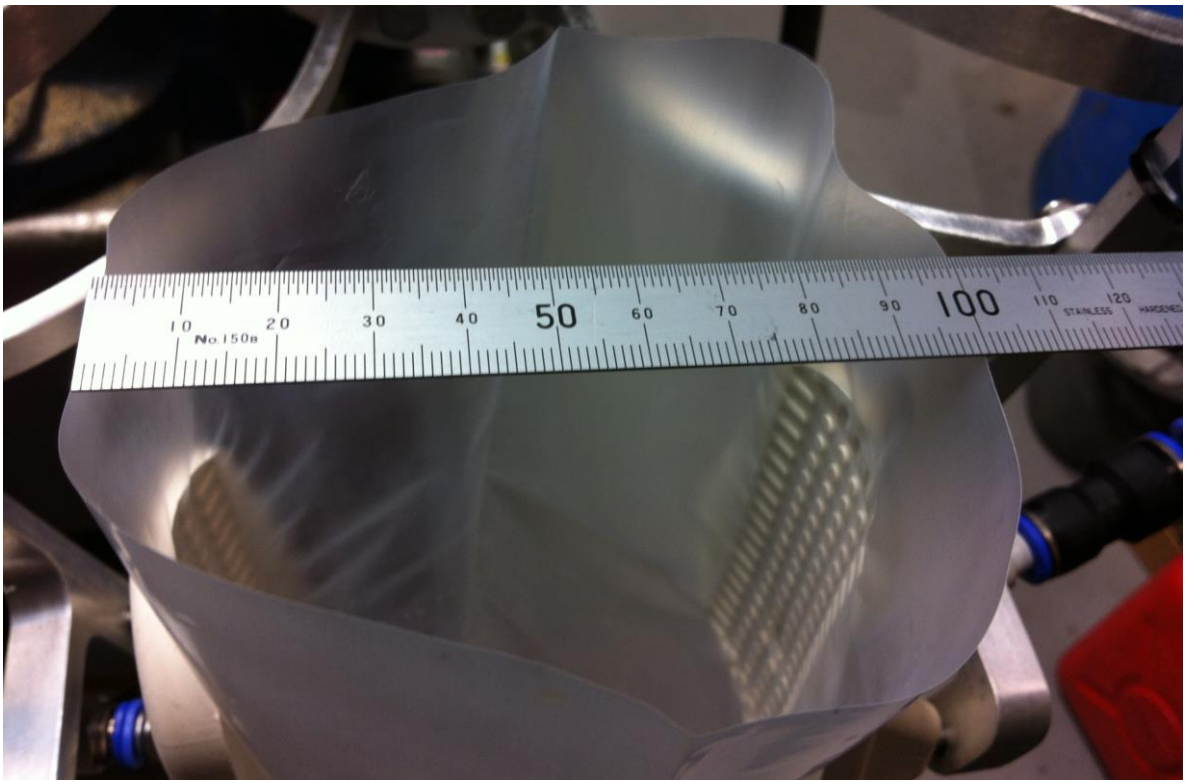

Figure 4.1 Vacuum pads grasping packaging film to desired aperture

4.3 Bag holder

The new *finger-type bag holder* was created in a few different variations and tested for its ability to both apply the packaging film readily to the exterior of the bag holder and its retention during the meat ejection cycle.

The finger design worked exceptionally well providing an excellent target for the packaging film to be applied, and the film easily slides into position.

Figure 4.2 Example of finger-type bag holder holding meat and packaging film at conclusion of ejection cycle.

Retention during the ejection cycle was tested under normal operation in the modified *MLA test jig* (a minimalistic replica of the SmartShape machine chamber, used for testing of the rubbers for the SmartShape machine). Results showed that the fingers retain the packaging film under ejection load, and during this period did not cause the packaging film to fail at the points of contact.

4.4 Increasing meat insertion into packaging

The strategy employed to increase the meat insertion distance was to increase the distance that the packaging film is inserted into the bag holder. A modified version of the finger-type bag holder was manufactured with the facility for the packaging to be inserted a further 40 mm.

Currently, on average meat insertion will leave 40 mm exterior.

Experimental testing of the modified finger-type bag holder reduced this distance to 25 mm.

5 Conclusions and recommendations

This preliminary project has shown that the auto bagging system is now ready for integration into the SmartShape machine, providing that several issues relating to performance can be addressed.

These include:

- Ensuring that the packaging is placed low enough on the bag holder so that all the meat is retained within the bag.

- Ensuring that the meat is ejected far enough through the finger bag holder for easy removal.

The auto bagging system operates in the bench trial model in a manual mode, demonstrating the movements and functions that will be implemented in the final integrated auto bagging system.

The finger-type bag holder functions as designed (pending addressing of the above issues), and hence improves the ease of application for packaging film.

This finger type bag holder is potentially a replacement for the existing bag holder approach, and could be used even without an auto-bagging system.

Work to improve the insertion distance of meat into the packaging film has shown significant improvement in this area. However, it should be noted that further investigation into this area should be undertaken.

Following on from this project now needs to be the further step of transferring the bench trial model into a completely functioning experimental auto bagging system, showing also its integration into a SmartShape machine cycle.

It is proposed that this could physically take place firstly onto the previous demo machine, first making modifications allowing it to simulate the physical dimensions of current SmartShape evolution.

6 Appendices

Figure 6.1 Examples of Vacuum pad evolution.