Final Report

Magnetic planar conveyors

Magnetic Planar Conveyors - Stage 1 – Environmental Testing

Project Code
2021-1225

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Date Submitted
08/02/24

Published by
AMPC

Date Published
09/02/2024

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1.0 Executive Summary

Project Description

New technologies are developed outside of the meat industry continuously, that could have benefits and applicability to the red meat industry. Only by looking out for new technologies and their applications into other industries can other technologies be leveraged for beneficial use in the meat industry processing environment. One such technology is magnetic planar conveying. Based on possible benefits, it behoves the industry to trial the use of such a conveyor in a washdown environment, to understand the lifetime of the technology within Australian meat plants.

Project Content

The project aimed to investigate:

1) The current robustness of magnetic conveying solutions when operating in an Australian red meat boning room environment

2) Any platform R&D / further development required to ensure the solution is robust in the identified environment

3) Identification of use cases and business propositions

The project undertook to monitor the performance of the Planar Motor unit over a period of 6 months while experiencing regular washdown conditions to understand the technology's ability to withstand the harsh red meat industry processing environment.

The steps undertaken were,

1) Confirm concept design for the trial unit

2) Design housing and electrical enclosure

3) Purchase components

4) Assemble and factory test

5) Successful demonstration to AMPC staff

6) Relocate to site and start 6-month site trial

7) Monitor with site the progress of the trial

8) Report on the 6-month findings.

Project Outcome

The planar motor has performed without any issues over the 6 months it spent on site being washed down. No major issues have arisen over the 6 months. This demonstrates that the technology has the potential to work well in the red meat industry.

Benefit for Industry

There are a range of benefits behind the use of this technology within the red meat industry, that fit within AMPC's 2020-2025 strategic plan. These include:

1) Industry 5.0, via individual part tracking and mass customization

2) Carcase Primal Profitability Optimisation, via accurate processing (Advanced Manufacturing)

3) Digitisation, via acquiring product information and leveraging data insights (Advanced Manufacturing),

4) Retention, via staff able to work at different paces to each other (People & Culture),

5) Traceability, via unique part tracking in a boning room

6) Food Safety, via less lubrication fall-out from existing solutions

In addition to the benefits identified by AMPC, there are other benefits including:

- Potentially easily cleanable surfaces
- More hygienic designed conveyors (less crevices for bacteria growth)
- Enabler of sorting solutions and other technologies due to asynchronous movements

Useful resources

https://www.youtube.com/watch?v=bsZlW6UIcAk

2.0 Introduction

New technologies are developed outside of the meat industry continuously, that could have benefits and applicability to the red meat industry. Only by looking out for new technologies and their applications into other industries can other technologies be leveraged for beneficial use in meat. One such technologies, is magnetic planar conveyors.

Figure 1- Conveyor Concept (Left) and Wet Conveyor (Right)

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1) Industry 5.0, via individual part tracking and mass customization
2) Carcase Primal Profitability Optimisation, via accurate processing (Adv. Mft.)
3) Digitisation, via acquiring product information and leveraging data insights (Adv. Mft.),
4) Retention, via staff able to work at different paces to each other (People & Culture),
5) Traceability, via unique part tracking in a boning room
6) Food Safety, via less lubrication fall-out from existing solutions

In addition to the benefits identified by AMPC, there are other benefits including:

- Potentially easily cleanable surfaces
- More hygienic designed conveyors (less crevices for bacteria growth)
- Enabler of sorting solutions and other technologies due to asynchronous movements

2.1 Project objectives

Based on all of these benefits, it behoves the industry to trial the use of such a conveyor in a washdown environment, to understand the lifetime of the technology within Australian meat plants. The project outputs are projected to be:

1) The current robustness of magnetic conveying solutions when operating in an Australian red meat boning room environment
2) Any platform R&D / further development required to ensure the solution is robust in the identified environment
3) Identification of use cases and business propositions

2.2 Project methodology

The project methodology is as follows:

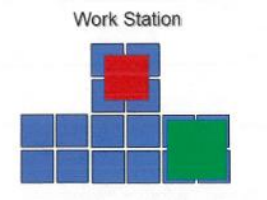


Figure 2- Magnetic Conveyor Trial Layout Design

1) Confirm concept design for the trial unit
2) Design housing and electrical enclosure
3) Purchase components
4) Assemble and factory test
5) Successful demonstration to AMPC staff
6) Relocate to site and start 6-month site trial
7) Monitor with site the progress of the trial
8) Report on the 6-month findings.

3.0 Methodology

3.1 Design and Manufacture Challenges

Intelligent Robotics worked with the supplier on the design associated with making a washdown version of their planar motor system. The challenge was to manufacture a watertight system made out of stainless steel while adhering to the metal thicknesses required for the planar motor movers and stator.

Due to the thin stainless steel and the requirement to wet wash at high temperature, we were concerned in regard to fatigue cracking of the stainless during the hot wash process. A test rig was built to dunk test the movers in and out of hot water 10,000 times. This trial was performed successfully, with no issues encountered with the movers.

The whole system was then assembled and tested.

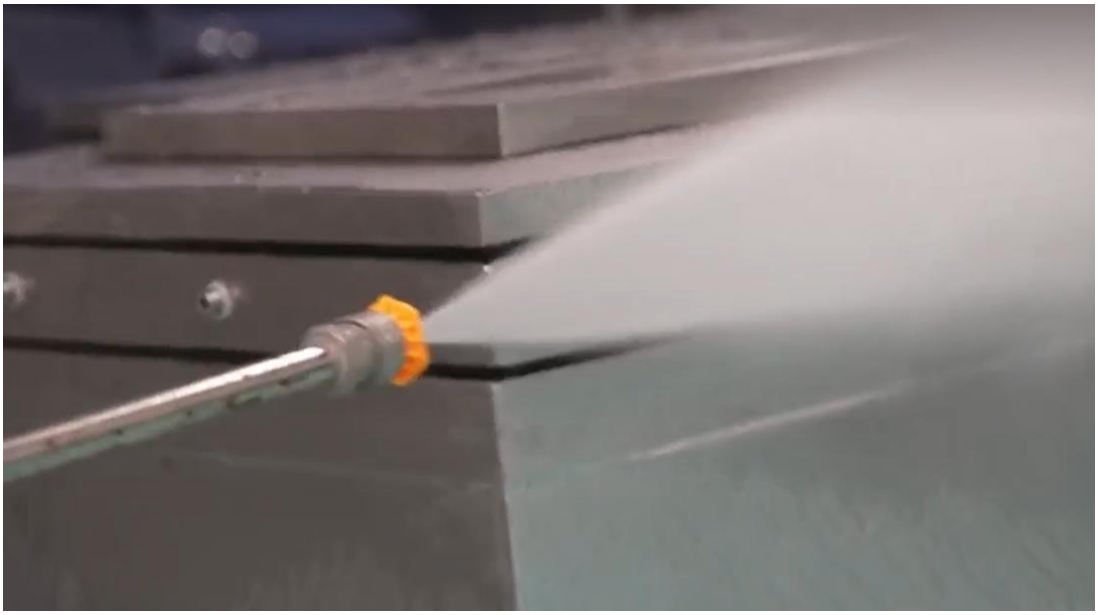
The system performed well with no scratching of the tabletop.

The plastic trays were trialled along with the ability of the system to weigh.

The last stage was to perform the water ingress test on the enclosure. The water cleaning tests on the enclosure were carried out on the 16/01/2023. They sprayed for a total of ~5mins on all sides of the system to better than IP69 test standards.

Results:

- No leaks or water at all could be found inside main compartment after removing one of the bottom panels.
- System held the movers in position during cleaning without issue (maintained control throughout).
- Restarted and ran system after testing, no change the system worked well.



3.2 Processor Installation

Once the unit arrived on site it was unpacked and put in position.

It was decided after the initial setup trial to upgrade the vacuum pump to an oil free unit and to put the equipment into a plastic tub.

3.3 Six-month performance testing period.

Once the unit was positioned and tested it went through the typical room washdown for the area. An Intelligent Robotics service engineer tested the planar motor each month to check that it was still performing correctly and to look for any potential issues.

The tests included:

- checking the table vacuum system and that the system is able to hold vacuum;
- that the chiller is supplying chilled water correctly;
- that the system powers up correctly and can run the operating program to move the movers on the table; and
- that there were no issues from the chemical washdown.

Initial Setup 2023-06-06

System tested and running correctly.

2023-07-31

The system was tested and found to be running correctly. No water ingress was found after cleaning.

2023-08-03

System tested and no issues found.

2023-09-05

System tested and no issues found.

2023-10-06

System tested and no issues found.

The lower covers were removed to check for any water ingress into the system. No water was found in the internal system.

2023-11-03

System tested and no issues found.

2023-12-04

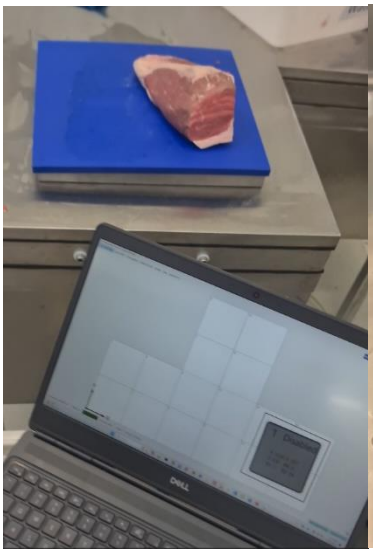
System tested and no issues found.

2024-01-09

The system was tested to demonstrate the weighing capability of the movers.

The system was first tested with two calibration weights to find the scaling factor for the individual mover.

A primal was placed on top of the mover and weighed, it was then trimmed and the new weight found.



4.0 Project Outcomes

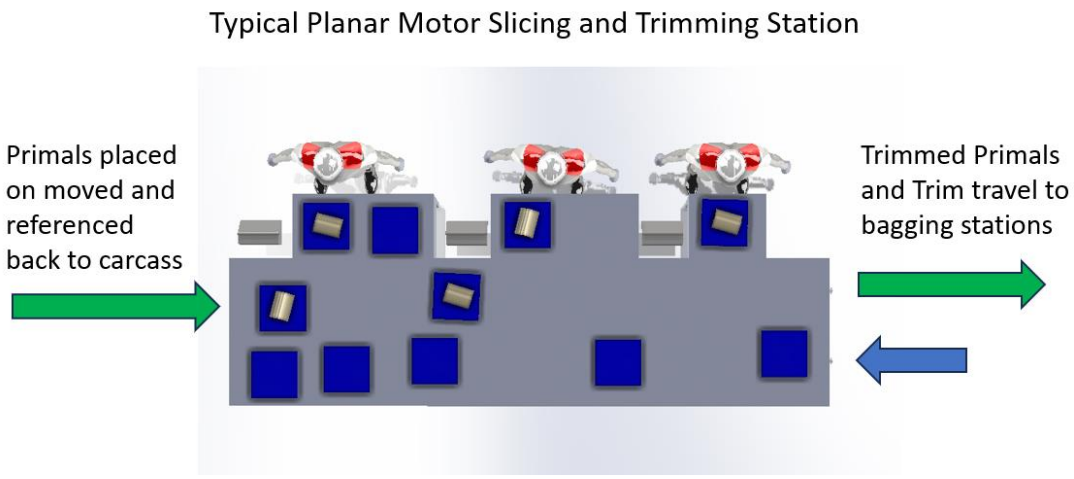
4.1 The current robustness of magnetic conveying solutions when operating in an Australian red meat boning room environment.

The system performed very well and there were no effects on the system from the chemical washdown. There were a number of challenges experienced in manufacturing the final, stainless-steel solution for the processing site. Intelligent Robotics worked closely with Planar Motor through the design and manufacture issues to achieve the final system.

4.2 Any platform R&D / further development required to ensure the solution is robust in the identified environment.

- Trialling the planar motor unit as an operating slicing trimming station.
- Replacing manual loading and unloading of the movers with an automatic system.
- Development of a boning room digital simulation of a large system to ensure that the expected benefits can be achieved from the system. This should also identify the equipment cost so that the required price point for the equipment can be shared with all stakeholders.

4.3 Identification of use cases and business propositions



Once the technology becomes more cost effective, it can possibly be used to fully automate the boning of the primals.

A primal can be placed on a mover and tracked from an individual carcass.

The exact customer order cut specification for that primal can be sent to the operator to slice or trim as required.

The weighing capability of the mover can track the yield from the individual primal.

This type of system could unlock the benefits of the planar motor.

4.4 A stage 2 submission (if applicable)

Further submissions will be submitted later as use cases are worked through with AMPC and at least two processors.

5.0 Discussion

It was possible to demonstrate that a planar motor conveying system can withstand the harsh environment of a meat processing plant. The system is very expensive, but the cost of this technology will drop with time. The next opportunity for the technology to be adopted will be when a specific task can be identified that can generate the value required to offset the cost of the equipment.

6.0 Conclusions / Recommendations

The 6-month trial has been completed, demonstrating the robustness of the magnetic conveying solution in an Australian meat boning environment.

There are many use cases that can be explored next – the advantages of being able to weigh and move in a nonlinear manner can unlock more efficiency and yield in the boning room and allow for product traceability.

The tracking information can be transferred from the side to the quarter and then to the primal magnetic planar mover. It can then travel in a non-sequential manner to the required boning station. The optimum boner for the task can be selected increasing efficiency. The boner can then be informed as to the required cut specification for that particular primal. This means that different cut specifications can be run at the same time. The best fit for yield can be applied to that particular primal, and that yield can be measured in real time. The system is able to trace all parts and pass the information to the bagging stations. This means that there can be real time management of the order fulfillment of the boning area.

The system also allows for improved food safety through improved hygiene by having no moving parts and reduced cross contamination, because the work surface can be cleaned before a new primal is put on it.

One other potential application is regarding carton packing to ensure correct carton contents. Once the identifiable bag has gone through the sealer it can be identified again and placed on a mover such that the pre-calculated carton order contents can be assembled before going to the operator to pack the carton.

Although the cost of the system is still high, as time progresses it should drop so that a viable commercial project can be undertaken.

IR will work with AMPC to see how any of the benefits of the planar motor system could be implemented in next stage trialling of a specific use-case as agreed between AMPC and IR.