final report

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Novel meat meal and cake handling to prevent salmonella contamination and growth

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1 Background

A large proportion of the meat meal produced in Australia is used as raw material by pet food processors and stockfeed manufacturers. All feed producers, especially those supplying to the poultry industry, require a very low or zero incidence of Salmonella in the meat meal that they use as raw material. Conditions in the cake and meal handling equipment during the production of meat meal using a typical dry rendering process are often conducive to Salmonella growth.

In particular the equipment immediately after the presses and at the mills and their discharge screws is hard to clean and can often harbour condensation as hot cake and meal cools. The Australian Renderers' Association (ARA) auditing process, and industry surveys by ARA and CSIRO, has identified that these areas often have a high incidence of Salmonella positive meal present and that this is a common problem across the rendering industry.

Management at an Australian red meat processing plant building a new dry rendering process made a conscious decision to address these issues during the design and construction of the new plant. This Plant Initiated Project was to develop and trial some alternate material handling systems not previously used for this purpose in an attempt to solve this common problem.

The design team identified the following four initiatives as most likely to produce the required reduction in risk of Salmonella contamination and growth:

1. Fitting of steam jackets to all press fed screws and press barrels. By preheating the screws and barrels with steam to operating temperatures prior to starting product feed would effectively pasteurise any stale meal present and eliminate Salmonella contamination at this point, and eliminate or minimise the amount of press cake to be reprocessed.

2. Replacement of conventional screw conveyors immediately after the presses with a cleated belt. Improved safety of the cleated belt and easier cleaning would allow the transfer system from the presses to the cake bin to be left open to allow the press cake to naturally steam off and cool, and for ease of access and ready cleanability.

3. Fitting of forced draught air manifolds to cake bins to rapidly cool cake prior to milling. This was designed to enable the mills to produce meal at a lower temperature and reduce the formation of condensation that was likely to promote Salmonella growth.

4. Replacement of conventional screw conveyers immediately under the hammer mills with vibrating deck conveyers. This would allow the transfer system from the mills to the meal bins to be easier to access and clean. Careful management of airflows and the use of novel air cleaners at the mill would assist by reducing dust and potential Salmonella "hotspots".

2 Activities undertaken

2.1 Benchmarking of Salmonella incidence in meat meal

A survey on the incidence of Salmonella in meat meal at existing rendering plants was conducted by Food Safety Services (SA) Pty Ltd. The survey determined a baseline incidence of Salmonella in meat meal, from the 22 responding ARA accredited plants using the ARA Code of Practice sampling method, of 6%. However this incidence is well below the average for ARA's annual Salmonella test result returns from all plants.

This survey did not conclusively identify any particular design feature that would cause a high or low incidence of Salmonella. The ability of a high proportion of plants to achieve no Salmonella positives in their meat meal suggests that control of Salmonella is as dependent on other production issues as it is on plant and equipment construction.

Any new plant to be assessed for Salmonella reduction
The report was however planned to provide a baseline for sampling and testing of the novel meal and cake handling equipment in the plant's rendering plant which must be capable of achieving an absence of Salmonella positives on an ongoing basis.

2.2 Construction and installation of novel equipment

The following steps were carried to complete the construction and installation of the novel aspects of the rendering plant:

1. Review of the performance of cleated belts and vibrating bed conveyors in other processing industries to identify the design parameters required to use these items as identified in this proposal.
2. Preparation of detailed drawings of the novel conveyers and the required modifications to the presses and press-feed screws using contract engineering and drafting services. This was carried out as part of the overall plant design process.
3. Construction of the novel conveyers and modification of the presses and press-feed screws using engineering and fabricating contractors.

Installation of the novel equipment during the general rendering plant construction an installation activities. The following equipment was constructed and installed:

- Steam heated shafts in press feed screws
- Steam heating of press barrels
- Intralox belts from screw press's to cake bins
- Vari-speed blower piping, valves and manifolds in cake bins
- Vibrating conveyors beneath mills
- Stainless steel cyclones for mill air with discharge to main ventilation system.

2.3 Construction and installation of novel equipment

The plant and process was commissioned using the plant's process staff with contract engineering support where necessary. All novel equipment above was initially commissioned ready for plant operation.

During the post-commissioning period a number of modifications were made to the novel features of this plant, including the removal of the mill discharge vibrating conveyors and relocation of the cake bin ventilation dust collection system.

3 Problems encountered

This project fell well behind schedule due to the difficulty in attracting competent tradesmen to the plant to work on the phase of this project. In particular a shortage was encountered with stainless steel welders and industrial electricians. After at least 12 months delay, all novel equipment was eventually installed and commissioned. The plant is currently in regular operation processing a range of raw materials.

The plant has, since commissioning, had difficulty maintaining an experienced workforce in the rendering plant to allow for on-going efficient operation to meet design criteria. Despite the use of specialist rendering consultants not all novel items of equipment have been successfully implemented into the process. In particular the operation of vibrating conveyors ex the mill has not been resolved. While this is not specifically related to the design of the equipment and its operation, it has been removed and replaced with conventional screws to allow the process to operate continuously. The difficulty with the plant's ability to resolve these problems has been compounded by the on-site Project Mangers absence through ill-health and the non-availability of a stand in.

4 Outcomes

Despite difficulties with construction and commissioning of the plant a number of successful innovations have been included in the meal handling section of this plant.

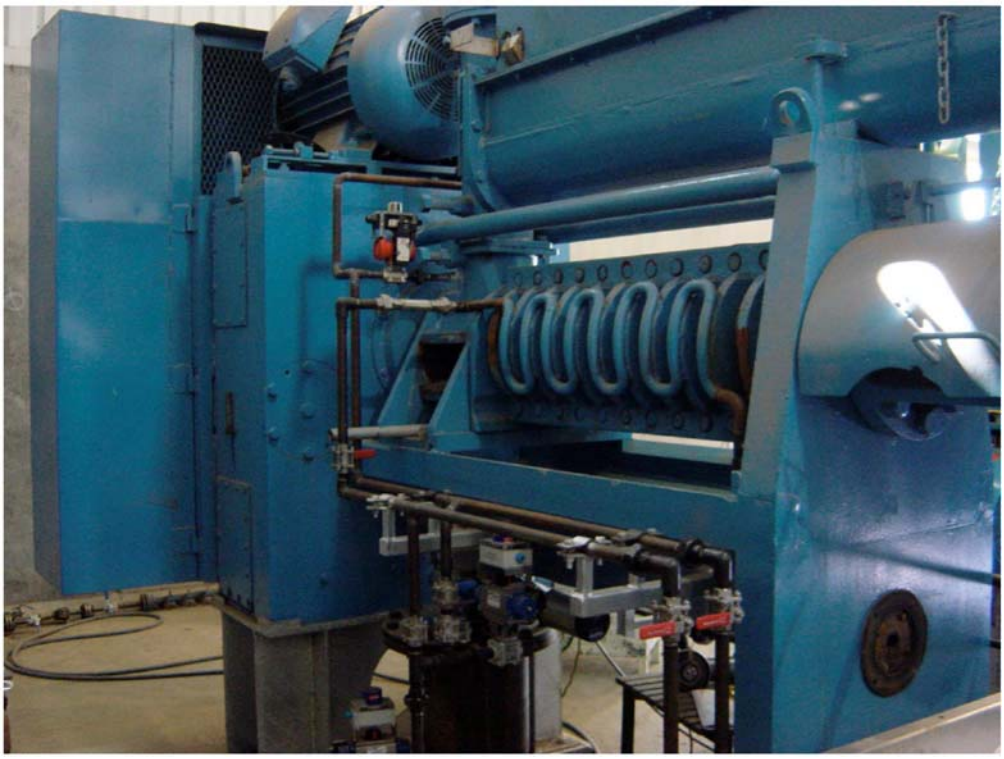
These are:

- Press feed screw shaft preheating.

  The bottom screws in the percolators and all ‘ring’ screws creating circulation and return from percolators to presses have been fitted with steam heated shafts. Ata steam pressure of 23 bar the shafts can be preheated and maintained hot throughout production. This has ensured that crax remains hot to maximise press performance and minimise contamination in the ‘ring’ screw system. Other advantages include improved free run tallow recovery and breaks in production create minimal problems at the presses.

- Steam injection to the press throat.

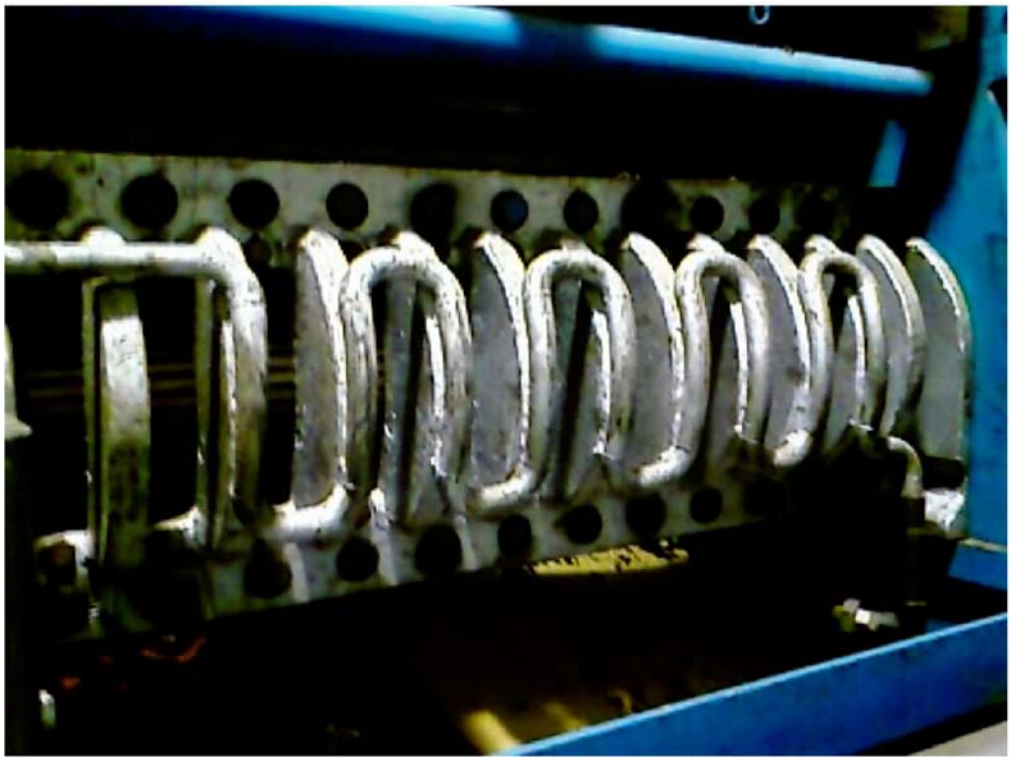
  Provision of direct steam injection to the press feed throat has provided the ability to reduce load on press drives more rapidly than by opening the choke. The addition of heat and moisture effectively reduces the press load. Steam supply to the throat is by an automatic control loop activated by the amperage load of the press motor.



Photograph 1 -. Press steam supply.
The upper feed supply is direct to the press throat, the lower to the barrel preheating coil

- Steam preheating of the presses.

  The attachment of steam coils to the outside of the press cages and supply of steam at 2 bar pressure has allowed the press to be preheated and 'sterilised' prior to commencement of production. This has allowed the minimal collection of reprocess material at start-up. Less than half a wheelbarrow load is recycled at press start-up. This material has been heated sufficiently to eliminate the need to fully reprocess it so that it can be returned with the decanter fines to crax screw and blended with pre-press material.



Photograph 2 - Preheater coils welded to the outside of the press cage

- Intralox belts from screw press's to cake bins. A single piece Intralox belt elevator effectively carries cake from the presses to the cake bins without the use of enclosed screws that can trap condensation. The horizontal lower (exiting the presses) section and the upper (entering the bins) section are able to remain uncovered to allow maximum ventilation, as they pose no safety risk. The vertical section is enclosed but is open at top and bottom to maximise ventilation. This system is very effective at transporting cake. No sign of condensation has been evident even though the system is naturally ventilated without the need for forced ventilation.

Photographs 3, 4 and 5 show the components of the Intralox belt elevator during construction. Photograph 6 shows the Intralox elevator in use.

Photograph 3 - The lower press discharge section frame

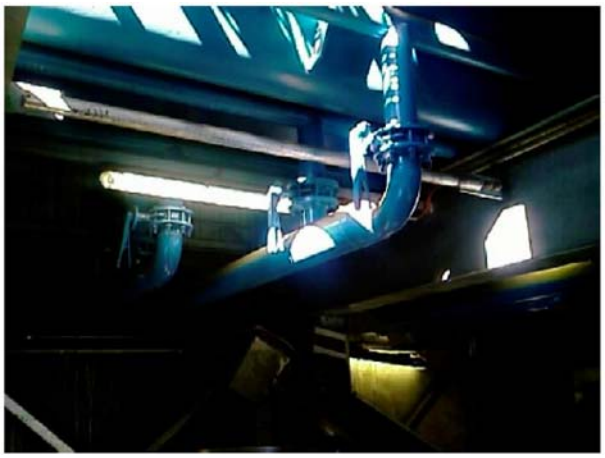
Photograph 4 - The vertical section and upper horizontal section frame

Photograph 5 -. Anton Reiter demonstrating the flexibility of the Intralox belt

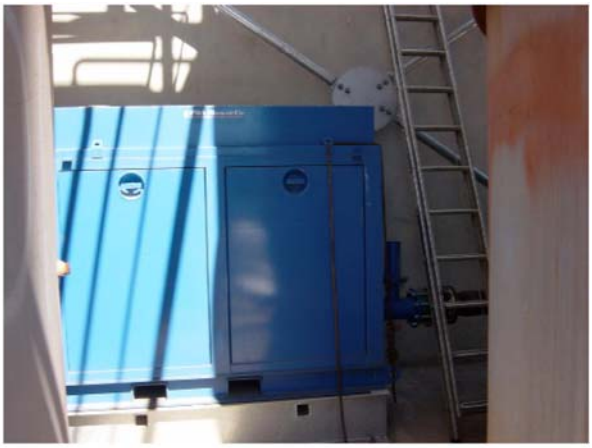
Photograph 6. - The Intralox belt elevator in use

- Cake bin forced ventilation. The forced ventilation system fitted to the cake bin forces 1,937 m^3 of ambient air through the cake bins every hour. With 4 x 5 tonne bins with a total working capacity of 10 tonnes, this gives a minimum of 200 m_3 /tonne/hour of air ventilation when all bins are full and significant more under normal operating conditions.

  The system has worked effectively with no evidence of condensation found through the bin system including in the discharge air filtering system.. The Torrit dust filtering system that traps any airborne dust from the discharge air is self-cleaning. Air pulses loosen dust from the filter socks for recovery as meal. Initially located within the confines of the cake bin housing, the Torrit filter has been relocated outside the bin for ease of cleaning and maintenance.



Photograph 7 - Air feed to the cake bins



Photograph 8 - The PDA Blower air supply unit

Photograph 9 - The vibrating mill discharge conveyor during construction

- Vibrating conveyor mill discharge. This aspect of the project has not been effective and has been removed from the system and replaced by

conventional screws. Clumping occurred in the vibrating conveyor causing blockages below the mill and in subsequent augers. It is possible that when problems with establishing consistent production flows are achieved, that the vibrating conveyors may be retried as the failure is thought to be due to inconsistency in fat content prior to milling.

- Salmonella status. As a result of difficulties in obtaining steady state operating conditions, sampling and testing for the presence of Salmonella at different locations within the process including in the finished product has not been carried out and is unlikely to occur in the foreseeable future. Given that this sampling and testing will at best give equivalence to the results achieved at a number of other rendering plants ie zero Salmonella contamination, it will not be able to achieve the original aim of demonstrating the superiority of this meal handling system.

  Salmonella testing will be implemented as a routine activity when ARA Accreditation is sought later in 2007.