Development of Gearboxes for Conveyors in Poultry Processing Facilities by Technicon

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Poultry Processing Facilities Have Many Gearboxes Driving Conveyors

- If you see poultry moving with a conveyor, there is likely a gearbox nearby.

Source: https://www.sumitomodrive.com/modules.php?name=Industry&op=industry_applications&subindustry_id=8
Background on Gearboxes

- A gearbox is a mechanical device that transfers power from one device (an electric motor) to another (a conveyor) and is used to increase torque while reducing speed.
- Gearboxes are also called “Speed Reducers” or “Reducers”.

![Gearbox with Motor](image1)

**Gearbox with Motor**
- Motor
- Gearbox

![Gearbox Components](image2)

**Gearbox Components**
- Input Shaft
- Gear Set
- Output Shaft
- Housing (Technicon’s area of focus)
Government regulations from organizations like the USDA have required poultry processing facilities to increase the effectiveness of their sanitation efforts.

This has resulted in more aggressive washdown processes.

These processes continue to present challenging environments for gearboxes in poultry processing facilities.

Current housing options leave opportunity for improvement.

1. Painted cast iron housings
2. Cast stainless steel housings
Challenges with **Painted Cast Iron Housings**

- Cast iron housings are painted to prevent corrosion.
- High pressure washdown process with high-temperature, caustic solutions often damage the paint.
- The paint then chips leaving open cast iron surfaces to eventually rust.
- The paint chips have the potential to enter the food stream, and the rusted areas present locations for bacteria to grow.
Challenges with **Cast Stainless Steel Housings**

- Cast stainless steel housings are primarily chosen due to corrosion resistance.
- From published academic research:
  - Microorganisms can remain in a viable state on stainless steel equipment surfaces even with cleaning and sanitation processes consistent with good manufacturing practices.*
- Gearboxes with cast stainless steel housings are priced at a significant premium compared to gearboxes with painted cast iron housings.

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* Antimicrobial Materials, Coatings And Biomimetic Surfaces With Modified Microtography To Control Microbial Fouling Of Product Contact Surfaces Within Food Processing Equipment: Legislation, Requirements, Effectiveness And Challenges; Frank Moerman, *Journal of Hygienic Engineering and Design*, 2014
Technicon’s Innovation: Composite Housing

**No More Rust**
- Engineered composite housing material is 100% corrosion-resistant and eliminates the possibilities of rust on the housing.

**Inhibits Growth of Bacteria**
- Composite housing is blended with an antimicrobial material and does not exhibit odor or staining in harsh environments.
- Antimicrobial properties exist throughout the composite housing, so any type of scratch will not decrease the proprieties.

**High Pressure Washdowns are Quick, Easy, and Effective**
- Washdowns are quick and easy with rounded geometry where all liquids flow down the sides; composite housing material is smooth and non-absorbent.
- The design includes side plates that prevent the high pressure washdown solution from directly impacting the seals around the output shaft.
- Composite material is chemically compatible with a wide range of washdown cleaning solutions.
### Challenges and Requirements with a Composite Housing

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<tr>
<th>Challenges</th>
<th>Solution Requirements</th>
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<td>1. The gearbox needs to firmly hold the gears in place</td>
<td>The gearbox must:</td>
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<tr>
<td>• If the gears are not held in place, the gear mesh will shift, and the gears will generate excess heat.</td>
<td>• Have the required strength and rigidity to keep the gears in place.</td>
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<td>2. Composites are insulators</td>
<td>• Dissipate the heat generated in the gearbox.</td>
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<td>• If the gears generate excess heat, the composite housing may have difficulty dissipating the heat.</td>
<td>• Be compatible with the chemicals used in washdown solutions.</td>
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<td>• This will result in rising gear and oil temperatures which will reduce the ability of the oil in the gearbox to effectively lubricate the gears.</td>
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<td>• This will result in even more heat being generated, and at some point, the gears will fail.</td>
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<td>3. Composite material must be able to withstand the washdown processes.</td>
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Strength and Rigidity Requirements are Met With a Patented Housing Design

1. Composite Housing

2. Steel Endoskeleton

Gearbox with Composite Housing
Composite Material Selection Driven by Thermal Conductivity, Strength, and Chemical Compatibility

Thermal Conductivity
• Thermal conductivity was modeled to confirm the chosen composite material and gearbox design will dissipate the heat.

Strength and Chemical Compatibility
• Strength of composite material was tested before and after chemical exposure (at room and elevated temperature) to confirm performance.
• Component testing was conducted to confirm material performance in the designed form.

Chemical Testing
Control Exposed

Exposure to Bevro-Sheen and Vortexx was tested

Component Testing

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Summary of Progress and Next Steps

1. Concept Evaluation
   - Market need and opportunity (Global)
   - Detailed competitive analysis
   - Review product concepts with technical experts, customers, and influencers

2. Design Specification
   - Required product capabilities
   - Selection of antimicrobial material
   - Evaluation of supply chain options
   - Detailed concept drawings
   - Concept test results
   - Intellectual property (IP) protection

3. Development and Evaluation
   - Detailed production drawings
     - Confirm production supply chain
     - Source production validation units
     - Production validation build and field test
     - Design refinements
     - Confirm market positioning

4. Production Release
   - Confirmation of production processes
   - Product launch
   - Continued customer feedback
   - Define possible next product concepts

Timeframe:
- Completion of Phase 3 within the next year
- Phase 4 will depend on the breadth of product mix; launch of gearbox size will likely be done in phases

Capital and expense: Requirements depend on product mix
Thank You!