Wash Down Drives without Washing away Profits

Reduce Downtime and Increase Productivity in Food Processing Operations

Introduction

When it comes to power transmission equipment used in the food processing industry, some types of drive systems are easier to clean and sanitize than other types. This paper will examine drive system cleaning and sanitizing challenges facing the food manufacturing industry and compare wash-down considerations for roller chain and belt drives, so that food manufacturers can make informed choices about how to maintain the highest level of productivity while meeting or exceeding food safety standards.

Content

Balancing Food Safety Regulations with Productivity

The food manufacturing industry is subject to food safety regulations designed to control or eliminate microbiological, chemical and physical safety hazards. Microbiological hazards are the most prevalent. They include bacteria, viruses and parasites that can produce disease in humans (pathogens). According to the Centers for Disease Control (CDC), more than 200 known diseases are transmitted through food. In the U.S. alone, an estimated 76 million cases of foodborne disease occur each year, ranging from mild to severe, and resulting in approximately 5,000 deaths annually.

Depending on the type of food manufactured, processors must meet standards imposed by federal agencies such as the Food & Drug Administration (FDA) or the U.S. Department of Agriculture (USDA), plus those of state and local regulatory bodies. In addition, processors must comply with workplace safety and environmental protection regulations imposed by the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA).

The newest set of FDA-backed standards, the Hazardous Analysis and Critical Control Point (HACCP) regulation, sets forth quality guidelines for food manufacturers and requires them to develop a program of good manufacturing practices to keep foods pathogen-free. While HACCP is currently specific to seafood, meat, poultry, fruit and vegetable juice producers, it also affects ingredient manufacturers who supply these industries.

In short, food manufacturers are under relentless pressure to ensure that their manufacturing environments meet or exceed ever-stricter standards for cleanliness and hygiene. The cost of failing to ensure the safety of food can be high, as witnessed by recent, highly publicized product recalls and the ensuing effect on reputations and bottom lines.

Although crucial to food safety, cleaning and sanitizing reduces productive capacity and adds no value to the product.

Paradoxically, cleaning and sanitation to ensure food safety is vital to a food processing operation, yet it adds no value to the product. This paradox poses a challenge for management. To remain competitive, plants must operate with maximum efficiency, eliminating downtime whenever and wherever possible. Cleaning and sanitation, however, requires downtime. While the frequency and intensity of wash-downs vary by type of food produced, any time spent in this activity reduces production capacity.

It stands to reason that food manufacturers are looking closely at durable, maintenance-free equipment designs that lend themselves to quick, effective cleaning, in order to minimize downtime and maintain higher levels of productivity. Power transmission drive systems are no exception.

Productivity Costs of Cleaning and Sanitizing

According to various industry estimates, the American food and beverage industry accounts for $500 billion in U.S. gross output yearly. If downtime spent in cleaning and sanitizing represented a mere 1% of that gross output, the cost of this activity would amount to $5 billion every year.

To cite a more specific example, a major international meat processor operating 24/7 measures downtime in tenth-of-a-second intervals. Due to this operation's high throughput rate, a few minutes of downtime costs thousands of dollars.

How much downtime does a typical plant need to incur in cleaning and sanitation? It depends on the operation. Manufacturers have some flexibility in determining cleaning intervals, as indicated in the USDA/Food Safety Inspection Service (FSIS) requirements: "All food and non-food contact surfaces of facilities, equipment and utensils used in the operation of the establishment must be cleaned and sanitized as frequently as necessary to prevent the creation of unsanitary conditions and the adulteration of product. "

Interpreting this standard, an operator might have to clean processing and packaging equipment at the end of every line change, shift and workday. This could add up to 15 or 20 hours of mandatory cleaning each week. As a minimum, one wash-down per shift is a common practice.

Recognizing the need for food processing plants to maximize productivity, the USDA issued a notice in 2006 (FSIS Notice 27-06) providing manufacturers some latitude in scheduling full clean-ups. In part, the notice reads, "To decrease downtime, increase production efficiency and minimize expense, establishments can extend the period between cleanups. However, establishments must…develop, implement and maintain written standard operating procedures for sanitation and…those sanitation SOPs [must] be effective in preventing direct contamination or adulteration of product."

It goes without saying that food manufacturers can extend the period between clean-ups and minimize downtime more easily when their equipment is easy to clean and maintain to begin with.

Drive System Wash-Down Considerations

Before examining the relative cleanability and chemical susceptibility of roller chain and belt drive systems, it may be helpful to consider some principles of good sanitary equipment design. A number of standards organizations have developed guidelines for the design and construction of food equipment. While these guidelines may differ somewhat in the details, they all adhere to the same general principles, such as those developed by 3A Sanitary Standards for the dairy industry.

3A Standards divide food equipment surfaces into two categories:

1. Food product contact surfaces
2. Non-product contact surfaces

A *food product contact surface* is one in "direct contact with food residue, or where food residue can drip, drain, diffuse, or be drawn" (FDA, 2004b). These surfaces must meet rigid sanitary design criteria to prevent food product contamination. *Non-product contact surfaces* are those parts of the equipment (e.g., legs, supports, housings) that do not directly contact food. Because they may indirectly contaminate food product, however, these surfaces also should follow sanitary design principles.

In terms of sanitary design, all *food contact surfaces* should be:

- smooth;
- impervious;
- free of cracks and crevices;
- nonporous;
- nonabsorbent;
- non-contaminating;
- nonreactive;
- corrosion resistant;
- durable and maintenance free;
- nontoxic;
- cleanable.

Surfaces coated with metal alloy or non-metal material (e.g. ceramics, plastic, rubber) must also meet the above requirements.

Power transmission drive systems, whether belt drives or roller chain drives, would typically fall into the category of a non-product contact surface. Following 3A Standards, non-product surfaces of equipment should be constructed with appropriate materials and fabricated in such a manner as to be reasonably cleanable, corrosion resistant, and maintenance free.

Let's examine roller chain and belt drive systems in the light of cleanability, corrosion resistance and maintenance.

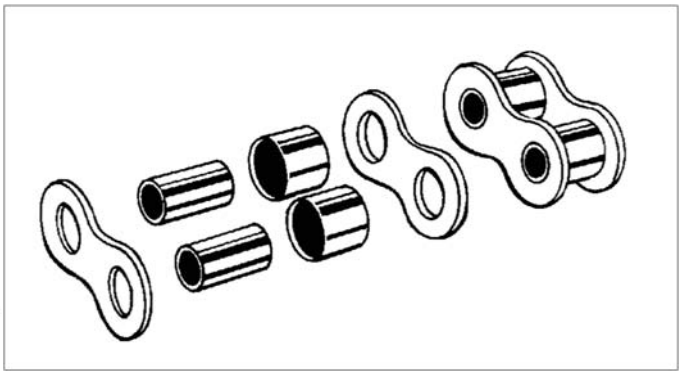
Roller Chain Drives

Stainless steel is the preferred surface for food equipment. It is generally resistant to corrosion, smooth-surfaced and impervious (unless corrosion has occurred), resistant to oxidation at high temperatures, non-magnetic and easily cleaned.

Standard roller chain drives are constructed with carbon steel. Wet environments pose a problem for standard carbon steel roller chain drives. Lubrication is one of the most important factors affecting chain performance, and it is difficult to maintain the proper degree of lubrication in an environment where drives must be washed down at least daily. Insufficient lubrication causes increased wear, chain seizures and galling of pin surfaces. Premature wear will also create the need for more frequent replacement of the chain drive, leading to maintenance downtime and affecting other areas of plant operation.

In lieu of standard carbon steel chain, food processors can turn to "problem solving" chain, such as stainless steel chain or o-ring chain. Both are quite costly. Moreover, a roller chain drive, regardless of construction material, is comprised of many parts—pins, bushings, link plates—that provide myriad nooks and crannies for microbes to hide. Because chemical sanitizers lack penetrability, they may not be able to destroy the microorganisms present in these cracks, crevices and pockets.

Cleaning a roller chain drive with a high-pressure spray poses another problem, namely, dispersion of the lubricant. Lubricating greases and oils are insoluble in water, alkali, or acid. Melting them with hot water or steam often leaves a residue, requiring surfactants to emulsify the residue to make it suspendable in water and flushable. In any case, one should use care when cleaning a roller chain drive to avoid dispersing lubricant onto food contact surfaces.

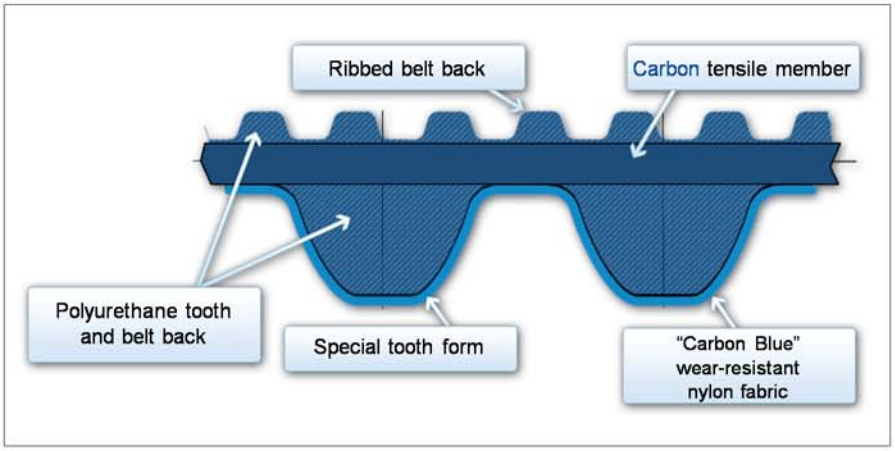


A single roller chain link presents hiding places for microbes.

Finally, one should also use care with sanitizing chemicals to ensure their compatibility with the material on which they are used. For example, the halogen family of chemical sanitizers (chlorine, iodine, bromine and fluorine) can attack some grades of stainless steel, causing corrosion and pitting of the surface. Chlorine, a sanitizer commonly used in food processing plants in various forms and concentrations, forms an acid in solution, which can also cause pitting on stainless steel surfaces if used in high concentrations.

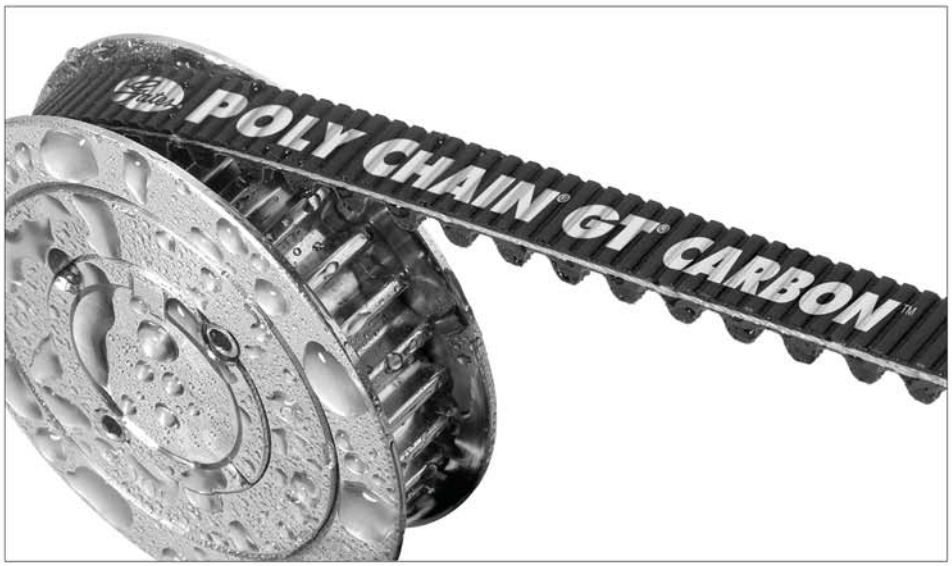
Belt Drives

Belt drives are relatively simple in design, consisting of sprockets, bushings and a belt of one-piece, uniform construction. Compared with roller chain, a belt presents a relatively smooth, cleanable surface. Belt drives are also clean running, needing no lubrication. Moreover, without metal-to-metal wear, belts and the sprockets they run on last considerably longer than roller chain and roller chain sprockets. All these factors add up to a maintenance-free drive system that is easy to clean.



The surface of a synchronous belt is smooth, impervious, non-porous, non-absorbent and free of cracks and crevices, making it easily cleanable.

In the wet, wash-down environment of food processing operations, stainless steel or nickel-plated sprockets can provide an extra measure of protection against corrosion for belt drives. Stainless steel sprockets cost more than conventional ones, but unlike roller chain drives, only the sprockets have to be stainless steel, not the entire drive.



Stainless steel or nickel-plated sprockets protect against corrosion.

Belt materials vary depending on the application. Rubber belts with fiberglass tensile cords, such as Gates PowerGrip® belts, are commonly used for low-horsepower applications (1750 rpm motors under 50 HP) in place of roller chain drives. Alkaline detergents do not affect rubber, which stands up well to wash-downs. Exposed tensile cords along the sides of the belt can wick moisture into the belt over time, so maintenance personnel should inspect belts for wear regularly. In addition, organic solvents and strong acids used as sanitizers can attack rubber, so one must exercise care when using these types of sanitizers.

For high torque applications, food processors can use a polyurethane belt with carbon fiber tensile cords, such as Gates Poly Chain® GT® Carbon™ belt. Carbon fiber tensile cords provide excellent resistance to moisture and chemicals, and polyurethane stands up well to most cleaners and sanitizers. This belt offers a number of properties that make it highly suitable for food processing operations, including:

- Excellent resistance to oils, fats, fruits, juices, vegetables, dairy products, tomatoes, wine and vinegar
- Good resistance to food industry soils and chemicals
- Good resistance to high-pressure wash-down sprays
- Excellent abrasion resistance
- Operating temperature range of -65°F to +185°F

What productivity advantage can be gained by using belt drives instead of roller chain drives in food processing applications? Again, it depends on the operation. In the case of the hog processor mentioned earlier, converting a large number of roller chain drives to Gates Poly Chain belt drives reduced cleaning/sanitizing and maintenance requirements dramatically, saving an estimated 2,000 hours annually. That translates to a lot more ham and pork coming off the production line, and dollars falling onto the bottom line.

Conclusion

In food processing operations, the easier it is to clean and sanitize equipment, the faster it is done. When food manufacturers measure downtime in fractions of a second and tally the cost in thousands of dollars per minute, they will spend every effort to speed the cleaning and sanitizing process along, commensurate with food safety. Belt drives help accomplish this goal better than roller chain drives, adding profit to the operation.

Additional Resources

Engineering design assistance with belt drive systems for food processing applications is available from Gates Corporation. Contact the Gates Product Application Helpline, (303) 744-5800, email ptpasupport@gates.com, or visit www.gates.com/foodprocessing.