Hygienic design of conveyor belts

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Hygiene is a key issue in any food process. The hygienic design of conveyor belts that transport the food product is, however, often easily overlooked. An overview of conveyor belt applications, some problems, solutions and required design criteria assist in the selection of the right conveyor belt to improve both hygiene and cleanability.

Conveyor belts are the linking element in many segments of the food industry and they are an important part of the process. Choosing the right belt is vital for the efficiency and hygiene condition of the production line.

Application examples

The phrase 'a system is only as good as its weakest part' can be applied to the reliability of a food processing machine and even presumed simple elements such as conveyors.

Well designed frames, welding, splices and bearings will not make any difference if the key elements that are in direct food contact, from primary through secondary processing up to packaging, do not comply with the requirements of hygienic design.

Conveyor belts are not cheap off the shelf items. There are dozens of different segments of industrial food processing, including bakery, confectionery, chocolate, meat, vegetable and ready meals, just to name a few.

Within each segment hundreds of applications that depend on conveyor belts can be found, for example, transfer conveyors, cooling lines, dough forming lines, belt proofers, depositors, power-turns, check-weighers, metal detectors, slicing, portioning, accelerating, spreading and aligning of products, inclined belts to supply form, fill and seal machines, etc.

Careful selection at the beginning may save headaches in the future.

Synthetic conveyor belts

In food processing, there are mainly three groups: coated fabric belts, plastic modular belts and plastic conveyor chains. Depending on the intended use, each construction can provide advantages. Compared to each other, these product groups are quite different and require variable measures to influence their design.

The decision to choose a food conveyor belt from one of the three categories depends firstly on the target application within the target industry segment. This will give designers and application engineers the first indication of a suitable product choice.

To find the most suitable solution, however, there are more criteria to be considered. Some of them may not seem to have any relation to the machine at first glance.

Fig. 1. The vicious circle.

Complexity of factors

In many cases, conveyor belts do not just move products from A to B, but are an important part of the process. Belts may be key elements to guarantee a smooth and trouble free production flow. It is not only the shape, design and construction/material that matters, but also the performance of conveyor belts can be strongly influenced by the kind of food they are in contact with, by environmental factors, correct handling by the operators and, last but not least, by cleaning procedures and cleaning agents. Several tests may be needed to eventually accept a compromise to ensure that the key application and process requirements are fulfilled.

The vicious circle

Synthetic conveyor belts, as other similar components, are parts that wear with use. Depending on the industry segment and the position within the process, surface abrasion, cuts, scratches or micro-cracks can appear over time.

There are materials like certain polyurethanes or polyethylene that do not act as nutrients for micro-organisms but, despite frequent cleaning procedures, micro-organisms harbouring in micrometer size cracks can not always be controlled.

In addition, an increased frequency of cleaning or the application of more aggressive detergents is likely to accelerate wear.

For surfaces in direct food contact this means increasing the risk of contamination and thus a serious hygiene problem. To break this vicious circle, there are several innovative solutions that provide an additional hurdle for micro-organisms.

There has been a marked improvement in overall product design and the implementation of new materials. Some highlights and measures are listed below:

- Melt coated surfaces are smooth, homogeneous, pore-free and easy to clean surfaces that prevent food residues sticking to the belts.
- Reverse side coatings ensure that the bottom side of the conveyor belt is also closed and that no residues or fluids can penetrate into the belt body.
- Edge sealing, in combination with reverse side coating, results in a fully capsuled belt.
- Different colours – blue coated conveyor belts provide better contrast to the conveyed foodstuff. Operators can easily detect if their lines are really clean or if residues are present on the surface of a conveyor belt.
- New materials, such as modified Polyolefin coating, which ensures excellent release of even very sticky goods, reducing product waste and making the whole process more efficient and hygienic.
- Antimicrobial technology – conveyer systems such as HabaGUARD and HyGUARD antimicrobial belts contain antimicrobial additives that are registered and in compliance with regulations. The additives protect the entire belt throughout its service life against micro-organisms, especially in micro cracks and cuts that normal cleaning procedures hardly reach. They provide an additional hurdle in conjunction with regular cleaning.
- Other features, such as an oblong hole in the hinges of plastic modular belts, which makes the pivot-rod more accessible so that food residues can be flushed out during cleaning. Another design feature in plastic modular belts is the dynamic gap that ensures that the hinges open when running over the sprocket so that residues can easily fall out and be removed.

Cost aspects

There is no 'self cleaning' belt available and no conveyor belt can replace proper cleaning procedures. Well designed conveyor belts, on

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the other hand, selected according to the requirements of a certain application, can help to run lines more efficiently and thereby increase hygiene, improve product quality and save money.

1 Good release properties save costs. Some modified Polyolefin compounds (for example Habasit's new Cleanline range) have excellent release properties, especially against sticky products.

In the production of puff pastry products, the consumption of flour to support release of the product was reduced by more than 30% after installing a conveyor belt with such a surface. It may also reduce the loss of a substantial amount of production due to residues sticking to conveyor belt surfaces.

Experience has shown that such a loss may be reduced by up to 90%.

1 Extended service life due to better oil and fat resistance. High grade PVC compound materials (HySAN range) may improve the belt's life time if conveying oily and fatty products. In poultry processing plants, the life time of such conveyor belts has been extended by over 50%.

1 Reduction of cleaning time by installation of more hygienic plastic modular belts. A customer producing frozen fruit and vegetables reduced the cleaning time in one of his lines by 35-40%. The use of plastic modular belts (such as Habasit's LINK) with optimised open hinge design and the alignment of the belt with the machine, minimised the gap between flights and conveyor frame. Cleaning improved and product damage was reduced.

1 Increased service life and performance due to optimal belt selection. In seafood applications, TPU coated fabric belts are often used. In a practical case, belts were replaced once every two weeks. The problem was shrinkage and surface damage because of hourly cleaning with boiling water and chlorine solutions.

Installing a more suitable type, with a special hydrolysis and high temperature resistant TPU coating increased the life time of the belts by several times over 100%.

Understand your sector

The understanding of challenges that are specific to food sectors are key to the selection of the right conveying solution.

In the meat and poultry industry for example, the variety of operations from slaughtering, through cutting, de-boning, weighing, grading, portioning, shrink-wrapping, labelling or packaging, requires a broad variety of fabric and modular belts.

They must cope with the variations in product moisture, be able to move yet protect more delicate products. They must turn efficiently and move up or down gradients with ease. That is why conveyor companies like Habasit have designed modular belts using high quality thermoplastic polyurethane (TPU) and cost efficient systems incorporating food approved polyvinyl chloride (PVC).

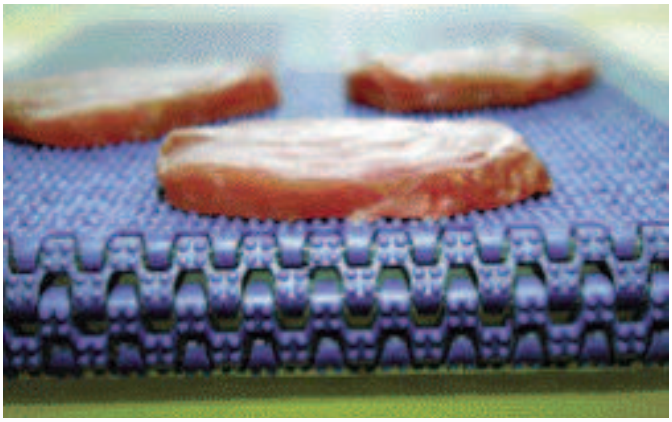
At the same time no one solution fits every company's special needs so it is now possible to produce belts by applying several coatings to achieve a customer's defined surface finish.

In the bakery, biscuit and snack processing industries belts may be required with either raw or impregnated fabrics, as different surface coatings. Fabrics consist of polyester, cotton, polyamide or mixed yarns and every product has special features. These are well known, high quality TPU and PVC belts or special materials, such as Habilene.

To fulfil the requirements for a specific application process or a defined function, the belt surface or the material's inherent properties play a key role.

That is why the various styles and properties of the Clean-line range include blank and smooth, blank, smooth with a structured reverse side, waffle structure and fish/herringbone structured surfaces.

Material inherent properties contribute to excellent release properties, easy cleaning and excellent chemical resistance. They can be tailored to be suitable for low temperature operations, provide resistance against hydrolysis degradation and fulfil the specification for environment friendly components.



Well designed conveyor belts are crucial to good hygiene.

The confectionery industry requires conveyor belting for products as varied as chocolate toffee, sweets and candy and bubble gum and liquorice. Consequently, the conveyor companies need to provide conveyor systems with excellent release properties for the stickiest products, whilst having good abrasion, superior chemical and oil resistance properties and easy to clean surfaces.

The special requirements for conveyors in the fruit and vegetable processing industry include effective drainage and resistance to products sticking to them. As a result, Habasit has patented a number of plastic modular belts to do this. They support ease of cleaning in the hinge area and on both the reverse and top side of the belts. This results in reliable, safe processing which prevents cross contamination, and product damage.

New conveyor developments are increasingly hygiene focused. By recognising the hazards inherent in the wide range of food processes Habasit has realised that they can minimise the contamination risks to their customers. Built-in critical controls can take the form of new coating materials, new ways of applying such materials and the use of clever design and a unique product construction.

"At the end of the day nothing beats good hygiene," Russell Blakeley, the company's UK sales director, told International Food Hygiene.

"That is why we also provide guidance on cleaning regimes, methods and materials so that as the product is conveyed correctly and efficiently, it is also conveyed cleanly."

General recommendations for gross solids removal

After the necessary preparations for cleaning (including turning off electrical supply), the following steps are recommended:

1 **Pre-rinsing:** With pre-rinsing, coarse dirt is rinsed off or detached with water (up to 60°C) at low (max. 25 bar) pressure. The higher the pressure, the more aerosol formation and thus the higher the chances of recontamination. Moreover, material exposed to high pressure is subject to excessive stress and hence to more wear.

1 **Cleaning:** At the main cleaning stage, stubborn dirt (oils and fats) is dissolved with the aid of chemical cleaning agents. Cleaning agents are generally applied as foam. In practice, however, under certain circumstances the belt may have to be scrubbed manually.

1 **Rinsing off:** In this stage, dirt previously detached or dissolved is rinsed off the belt with the aid of warm water (up to 60°C) and low pressure. It is particularly important not to set the water pressure too high so that when rinsing off the conveyor belt neighbouring machinery, plant components, walls or floors are not contaminated again (cross-contamination) by splashes of material which has just been washed off.

1 **Check cleaning result:** Check all critical areas by visual and/or by ATP measurement. Re-clean if necessary.

1 **Disinfecting:** It should always be taken into consideration that surfaces without direct food contact may also present hygiene risks due to cross-contamination. In choosing chemicals in cleaning agents and disinfectants, make sure that these do not adversely affect conveyor belts. Note should be taken of the chemical resistance of the plastic, the directions for use and the dosage instructions of the chemicals used.

1 **Final rinsing off with potable water:** After cleaning, and if required, the conveyor belt is rinsed off with potable water using low pressure. All residue from cleaning agents or disinfectants should be removed from the belt before it is used again.

1 **Check:** The effect of disinfection is checked using an appropriate method for the particular industrial sector, for example microbiologically through swab or contact plate.

Cleaning conveyor belts

All measures will fail, if conveyor belts are not properly cleaned. Several methods are used in practice, suited to the requirements of the respective production process: manual, semi-automatic and automatic (CIP) cleaning.

The basic procedure described in the recommendations (see box) is used in most areas of the food industry to clean machinery and conveyor belts. Certain parameters may vary depending upon the industrial sector, the severity of contamination and the surface material being cleaned. n

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