L. Lopes and Dr. O. Mielenz, HEKO, highlight the technical knowledge and manufacturing expertise required to provide customised chains and components for tailor-made conveyor systems.

CUSTOMISED SOLUTIONS FOR CONVEYORS

A reliable supply chain for customised spare parts and equipment for existing tailor-made conveyors is of vital importance to the bulk material handling industry. This is especially true in cases where the original supplier is no longer in the market and/or when the technical description and documentation is incomplete or no longer available. In such cases, customers benefit from reliable partners able to provide the required customised spare parts. In the case of customised conveyor chains and accessories for chain conveyors, this requires not only a deep knowledge of conveying technologies and an understanding of the specific conveyor and its components, but also maximal manufacturing flexibility. Moreover, customised chains and accessories pose a challenge in relation to the design, selection of materials, and heat treatment. HEKO accepts this challenge and throws all its technical competence and manufacturing know-how into realising customised chains and components for individual, tailor-made conveyors. Special designs are possible, even for smaller quantities.

Engineering

At the beginning of the development process of a customised chain, data collection and an analysis of the individual conveyor and chain system is performed in close cooperation with the customer and chain experts. If possible, existing drawings are considered and checked against the actual situation onsite. If no drawings are available, testing of samples provided by the customer allows a detailed specification of the inquired non-standard parts and ensures that the quality of the part is identical to the customer's demands. The results of sample testing and recording of the actual installation onsite can be used by in-house specialists to develop and recommend improved solutions. The data acquisition and analysis is completed by collecting and reporting the customer's experiences and relevant operational practice data.

Based on this data, possible weak points in the actual design are identified, the main mechanical loads on the chain and corresponding components are calculated on the basis of advanced knowledge and a pre-design is defined. This pre-design comprises the selection of suitable materials and the definition of appropriate heat treatment parameters, as well as a model-based functionality check to maintain the fatigue strength and long service life of the respective components and to avoid any non-desirable collisions between components. If necessary, finite elemental analysis or other computational simulation methods can be used.

In the next step the pre-design is discussed and agreed with the customer and, finally, the design is fixed and drawn. The close cooperation of customer experts and the supplier's engineers, as well as the integrated consideration of the interaction of components in the engineering process, assures a target-orientated development.

Figure 1. Heavy duty apron conveyor for limestone hopper discharge.

Figure 2. Damaged supporting roller with plateau formation on the running surface (left) and supporting roller flange running against guiding rail (right).

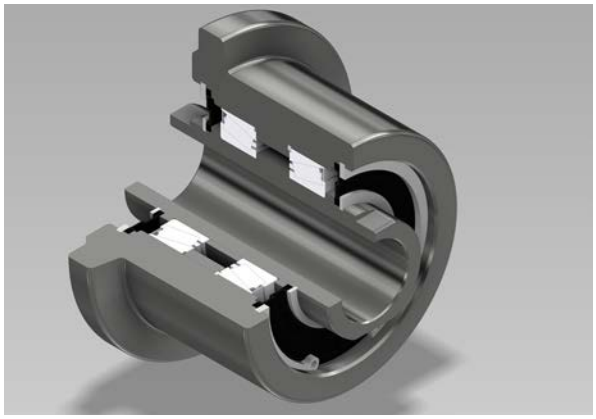

Figure 3. Newly designed supporting roller.

Manufacturing

Corresponding to standardised chains and components, the manufacture of customised conveyor chains, sprockets, and related assembly is performed by applying cutting edge manufacturing technologies and using high grades of steel. Flexible manufacturing facilities enable the easy adaptation of different components corresponding to the customer's specific requirements and lead to an optimised price-performance ratio. Thereby, the customer benefits from the supplier's experience in manufacturing reliable chains, sprockets, and accessories which apply to a wide range of individual applications in different industries.

Installation

The best chain design and manufacturing quality is worthless without an accurate chain installation onsite. A great deal of the damage incurred by chains during operation is caused by an inaccurate installation.

Experienced engineers and technicians provide extensive support onsite, helping customers prevent problems during installation and commissioning.

Case study: Apron feeder for limestone hopper discharge

In 2022, HEKO received an enquiry from a European cement manufacturer concerning the

delivery of conveyor chains, plates, drive shaft, and tail axle, mounted with chain wheels for an apron feeder for limestone hopper discharge.

Conveyor description

The considered heavy-duty apron feeder shown in Figure 1 with a centre distance of about 3.94 m discharges crushed limestone with maximum grain size of 300 mm from a hopper with a maximum capacity of 120 tph. The limestone is taken up by heavy-duty plates (width 1.213 mm) and transported via a non-standard bushed link conveyor chain with a pitch of 315 mm. High vertical loads on the conveyor sections are absorbed by means of flange-supporting rollers integrated into the chain as well as sliding blocks below the plates sliding on supporting beams. The conveyor sections are not only affected by gravitational forces from the limestone filling height inside the hopper but also by high shearing forces induced by scraping limestone from the material column inside the hopper. These shearing forces are at their highest level when starting the conveyor and, hence, the conveyor chain is affected by frequently increased dynamic loads since the conveyor is not running continuously.

Recording of the actual state

Besides information on the actual conveyor design given by the customer additional information regarding actual problems and optimisation needs were gathered during further discussion. The main problems raised were:

- Occasionally broken chain link plates.
- Regular failure of the supporting rollers.
- Strong wear on railways and flanges of supporting rollers.

Optimisation measures

Occasionally broken chain link plates have been identified as the main focus of optimisation efforts. A re-evaluation of the apron conveyor led to the understanding that the actual chain that was installed had insufficient dimensions to withstand the high dynamic loads during regular restarts of the conveyor. Accordingly, the chain link plates have been reinforced by increasing their thickness. However, this measure requires a partial re-construction of the entire chain design to meet the given assembly dimensions. The modified chain design was re-calculated and, finally, discussed and agreed with the customer.

Figure 4. Chain segment of modified apron conveyor chain.

Figure 5. Examples of standardised conveyor chains – wear-resistant round link chains (upper left), central chains for high-performance bucket elevators (upper right), pan conveyor chains (lower left), and forged link chains (lower right).

Figure 6. Examples of customised conveyor chains – Roller chain with toothed sprockets and drive shaft (upper left), reclaimer chain with shovels (upper right), double strand forged link chain with scrapers (lower left), and pivoting pan conveyor chains (lower right).

The simple design of the actual supporting rollers with friction bearings and without any sealing against dust penetration has been identified as the root cause for their occasional failure. The challenge was to design a roller with a reliable bearing and sealing which can absorb high vertical loads. The final solution has been a completely new roller design with a double set of sealed tapered roller bearings in an X-configuration with additional labyrinth steel sealings, as shown in Figure 3.

During the measurements onsite it was found that the actual chain gauge did not fit the gauge of the guiding rails and, consequently, the flanges of the supporting rollers were in contact with the rails which in turn led to the wearing of both components. This finding has been considered not only in the final chain design but also in the dimensioning of the sprockets centre distances for the drift shaft and tail axle.

Since no information on the heat treatment parameters of pins, bushings, and rollers, of the original chain were available, HEKO has defined parameters like surface hardness, hardening depth, and core strength on the basis of its long-term experience in heat treatment and expertise in the field where it has successfully realised comparable applications.

In a final step of the optimisation routine a CAD based functional test of the interaction between the modified chain, toothed drive, and tail sprockets were performed.

After final approval of the drawings, the plates, chains, sprockets, drive shaft, and tail axle were manufactured in HEKO workshops and delivered to the customer. In Figure 4 a chain segment of the modified apron conveyor chain is shown.

In this specific case the attended time from the inquiry to the delivery of the modified apron conveyor chain has been about 12 weeks.

Summary

In addition to its well approved standardised chains, sprockets, and accessories for bulk material handling conveyors, HEKO also provides customised solutions for individual applications. As an example of customisations, the development and optimisation of a heavy-duty apron conveyor chain has been presented. During this project the actual chain was not only re-designed but further improved by taking customer experiences into account. The company's flexible production processes and experience in the development, design, and manufacture of conveyor chains helps ensure an optimised ratio of performance, price, and delivery time. ■