

Ultra-Light Overhead Conveyor Systems for Logistics Applications

Batin Latif Aylak and Bernd Noche

Abstract—Overhead conveyor systems satisfy by their simple construction, wide application range and their full compatibility with other manufacturing systems, which are designed according to international standards. Ultra-light overhead conveyor systems are rope-based conveying systems with individually driven vehicles. The vehicles can move automatically on the rope and this can be realized by energy and signals. Crossings are realized by switches. Overhead conveyor systems are particularly used in the automotive industry but also at post offices. Overhead conveyor systems always must be integrated with a logistical process by finding the best way for a cheaper material flow and in order to guarantee precise and fast workflows. With their help, any transport can take place without wasting ground and space, without excessive company capacity, lost or damaged products, erroneous delivery, endless travels and without wasting time. Ultra-light overhead conveyor systems provide optimal material flow, which produces profit and saves time. This article illustrates the advantages of the structure of the ultra-light overhead conveyor systems in logistics applications and explains the steps of their system design. After an illustration of the steps, currently available systems on the market will be shown by means of their technical characteristics. Due to their simple construction, demands to an ultra-light overhead conveyor system will be illustrated.

Keywords—Logistics, material flow, overhead conveyor.

I. INTRODUCTION

OVERHEAD conveyors play out their benefits precisely when demands to the currently available conveyor technology become more complicated and trickier. Overhead conveyor is an extremely efficient way of transport with great diversity for designing the internal goods traffic effectively. They are used for transporting, saving, buffering and providing goods and products with floor-free, innovative conveyor. Due to their modular structures, these conveyors allow application in a wide range of areas. Overhead conveyor systems become particularly suitable as demands to the conveyor systems rise [7]. This way, speed, high availability, high loading capacities and high position accuracy can be achieved. Due to its control system travelling with it, the system offers an optimal material flow and a highest degree of flexibility for a great variety of applications. Each vehicle of overhead conveyor is equipped with a control system travelling with it, which conveys in a suitable way with the central control system. The control commands are relocated and controlled on board in chassis functions, such as driving,

stopping, speed regulation, lifting or commissioning and discharge of transport goods respectively [8]. A permanent or variable coding of drives allows the alignment and administration of driving orders as well as carrying along of process data for the purpose of material flow control.

Ultra-light overhead conveyor systems are much more flexible than ordinary monorail conveyors and can practically follow any path to adapt to any transport plan. Its bolt construction enables a lot of configuration possibilities.

Overhead conveyor systems can be defined as a means of transport where a defined degree of automation is implemented and precise accuracy and speed is guaranteed with the implementation, delivery and the operation of the system. These automated transport facilities make human interventions in the implementation of basic workflows unnecessary, these include:

- Automatic removal of an element from the middle
- Transport of elements on a certain delivery or central point
- After receipt of an element from a delivery or central point it is automatically transported to a designed place.

The advantages of the overhead conveyor at a glance:

- Extremely flexible
- High positioning accuracy
- High loading capacity
- High availability
- Floorless means of transport
- Best possible economic material flow through the control system travelling with it
- Adaptable to all conveyor systems, storage, manufacture and assembling devices

Overhead conveyor systems require considerable amount of investment for a company and operation of a large and highly integrated system requires practice and experience. The costs for installation and implementation of an ultra-light overhead conveyor system are significant as well – starting from the actual installation for overhead conveyor systems as well as the equipment and software up to the change of existing centers or the creation of new centers [6].

In addition, experts notice that in use of electric monorail conveyor systems, companies often have considerable maintenance and system update costs. Therefore, companies should also consider the long-time costs and consequences of the integration of an overhead conveyor system in their work process.

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II. APPLICATIONS IN LOGISTICS

A known European logistics centre has been equipped with 3.5km overhead conveyor. The goods loads ready for delivery on demand are moved on an economical handlebar-conveyor system composed of water pipes and packed on the ground floor, predominantly for the gentle hanging garment distribution of an automatic foil packaging machine. From its new logistics centre in a city, this company provides their branch offices all over Europe with furniture and products for which a high share of order is necessary. The heart of shares of orders in the currently largest logistics centre of Europe, on which five high rack warehouse silos distributed 500000 palette parking places of 68 shelf operating machine are supplied with, forms an approx. 3500m long electric monorail conveyor system with 272 chassises for cargo loads up to 800 kg [3].

The company from Böblingen, an internally leading system provider in the areas; surface technology, material flow automation, environment-and thermo process technology, takes over transport tasks and in addition serves 48 pick-stations with altogether 384 picking workstations according to the goods-to-man-principle. There, employees commission directly on the provided delivery palettes. They get the respective commissioning orders carried out according to the pick-by-light-principle displayed by the overhead conveyor-vehicles installed at the drive where they also confirm the implementation of orders. The palettes for the store fully commissioned are transported to the delivery area by automatic transfer carriages and lift stations.

Particularly due to the high commissioning performance, the pick-by-light principle has a "large" market potential and in combination with a "quick and reliable system, such as the overhead conveyor, a more efficient and quicker handling of logistics process is ensured. This way the electric monorail conveyor system with an efficiency of more than 300 palettes per hour shortens "the reaction times until delivery" according to the responsible persons of this company, "and this way supports the aimed short delivery times from the logistics centre up to the branch offices of other companies. "From the textile-and furniture sector a short view of the overhead conveyor applications in the automotive industry: The company from Böblingen, among others mentions employments for other automobile manufacturers for their electric monorail conveyor of the type KB 180 with loads up to 1500kg, a maximal drive speed of 150m/min and standard availability for increases and slopes up to 45° [4].

Overhead conveyor KB 240 as quick as up to 60m/min has more than 10000kg payload available offering its services for different companies for vans and at Knaus for the motorhome manufacturing and also transports paper rolls weighing tons at Neusiedler. Even these facilities confirm the impressively wide range of overhead conveyors as well as of power-and free systems.

At a city airport, the catering of aircraft fleet is done in a four-floor tract specifically built for it. Among it, there is also

the loading of service-trolleys with food, drinks, duty-free articles and papers as well as their transport to the airplanes. Change of scene: The international logistics service provider completed a high shelf warehouse at the location Gersthofen at the end of 2008, which is served automatically in some areas. In the city, a 1.6km long overhead conveyor with 130 chassises and about 20.000 transports per day serves for the wellbeing of passengers [4]. And since not only speed but also hygiene is important during those services, the manufacturer has developed a special solution in order to accelerate the cleaning process of the trolleys: the company has developed special, releasable pendants. If it now comes to the cleaning of the trolleys, the pendants are uncoupled from the overhead conveyor chassises in order to drive through a kind of washing street with their load. Subsequently, they are automatically recoupled.

III. STEPS TO THE CREATION OF RESPECTIVE OVERHEAD CONVEYOR SYSTEMS

The following procedures help step by step to be able to design an ultra-light overhead conveyor system:

- Draw layout chart
- Design carrier
- Determine the size of the conveying means
- Determine the platform height
- Determine the material flow direction
- Select vertical curve
- Create propulsion
- Select horizontal way curve
- Select preconditions of the safeguards
- Determine the interval of trolleys
- Determine the maximal conveying speed
- Determine the length of conveying means
- Determine the moving payload
- Determine the goods to be lifted
- Determine the pulling cable specs
- Take measures for the operational reliability

IV. MAIN PARTS OF THE OVERHEAD CONVEYORS

In this chapter, main parts of the overhead conveyors will be explained. Main parts of the overhead conveyors are:

A. Rail

The rail is the component connecting different periods of time. It consists of different, straight or curve-formed profiles and is mostly mounted horizontally or with low increases (vertical-popular overhead tracks are the exception here). There are profiles concerning the possible vehicle connections in inner, outer and headwaters, with and without conductor lines. For the setup of an overhead crane facility, ramifications, railway switches, turntables or crossings are intended on top of that. Alternative to conductor lines, also touch-less forms of energy-and information transmission (inductive) can be applied in order to decrease wear [2].

B. Vertical Transcribers

Transcribers, inter-floor lifts or hub/lifting stations have the task to implement an entire guide rail or shuttle table to different levels in order to connect the monorail level with the production level this way. There are one and two column machines. Mostly they are on the ground, since overhead versions would need powerful ceiling constructions. Moreover, the lifting movement is led via rails, bracing ropes, and telescope or scissor systems and used in the upper and lower end position against attacks. Belts, chains or ropes are used as a carrier element [1].

C. Vehicles

Overhead conveyor vehicles consist of a friction wheel drive and an attached support part correspondent to the load-handling device. The vehicles are mostly equipped with non-contact collision protections (initiators, light sensors, ultrasound sensors) and have a control system of their own. For the most part, the vehicle control system is comprised of the selection of the drive unit, surveillance of the engine, surveillance of additional electrical components and the collision protection. Normally, overhead conveyor vehicles do not have any lifting device, since the number of transfer points is low in relation to the number of vehicle and thus the load transfer process is managed with vertical-transcribers or hub stations [1].

D. Load Handling Devices

In dependence of the facility automation, different manual or automatic load handling devices are employed. Mostly, it is about specifically created apparatuses. The load handling device process decisively influences the conveyor performance of the system. It is thus recommended to mount load transfer processes out of the original material flow to parallel routes [1].

E. Control System

Eventually, the control unit of electric monorails represents an increasingly important component. The control either happens manually via operational switches travelling with it or automatically. In doing so, an automatic control is mostly established in such a way that a target indicator is accessed for the drive control before a branching element or decision point and either coordinated via a central or decentralized control system which driveway is operated and released respectively. The target indicator carried along can be a natural indicator (form or weight), a mechanic indicator (switch or cam), an optical indicator (bar code) or an electronic indicator (transponder), for example. Required operational commands are either broadcasted via conductor line or non-contact via radio, inductively or infrared [1].

influences the effectiveness of the entire system. The majority of researches and applications deal with overhead conveyor as partial feed system for production systems, particularly for the automotive industry [5]. There is not only one crab on the ropes, but lots of trolleys along one or several given routes. Furthermore, their automation is possible in a simpler, more economical and more effective way.

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V. CONCLUSION

As the previous descriptions have shown, material flow and conveyor technology are essential components of overhead conveyor systems. The conveyor technology considerably