DRY BULK®

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Conveyors Q&A

Dry Bulk Magazine asked several companies to discuss some issues regarding conveyors used in the dry bulk industry.

ASGCO

Jeff Jurasits – Vice President Business Development & Training

Jeff Jurasits is ASGCO's Vice President of Business Development & Training, with 36 years of experience working in various capacities. Since joining ASGCO, Jeff has held several positions over the years, including Field Service Crew Leader for five years, performing numerous field installations and maintenance of many ASGCO products, followed by 15 years as Operation Manager of ASGCO's Manufactured Products Division, where he continues to be involved in the overall daily operations.

In his current position as VP of Business Development & Training, for the past 16 years, Jeff has travelled globally, attending industry events and conferences, providing feedback and information on market and creative trends, while also performing conveyor site inspections and ASGCO Conveyor Training (ACT™) sessions created to provide the highest quality training to solve conveyor problems. His work has included using his knowledge of the market and competitors to identify and develop unique selling propositions and differentiators, while working with the technical and other internal colleagues to meet customer's needs.

BEUMER Group

Martin Rewer – Team Leader, Overland Conveyor

Martin Rewer has been working for the BEUMER Group since 1996. He studied Mechanical Engineering and spent almost 15 years as a Research and Development Engineer. Since July 2011, he has been the Team Lead for Overland Conveyors.

Doppelmayr

Ivano Dossi – Mechanical Engineer

Ivano Dossi is a mechanical engineer at the Austrian ropeway manufacturer, Doppelmayr, and has almost 20 years of experience in sales. He has been cooperating with Doppelmayr for six years now, and is part of the material handling division.

Emeritus/Martin Engineering

R. Todd Swinderman, P.E. – CEO

R. Todd Swinderman earned his B.S. from the University of Illinois, joining Martin Engineering's Conveyor Products division in 1979 and subsequently serving as Vice President and General Manager, President, CEO and Chief Technology Officer. Todd has authored dozens of articles and papers, presenting at conferences and customer facilities around the world and holding more than 140 active patents. He has served as President of the Conveyor Equipment Manufacturers' Association and is a member of the ASME B20 committee on conveyor safety. He retired from Martin Engineering to establish his own engineering firm, currently serving the company as an independent consultant.

Q. What factors are considered when designing a dry bulk handling system?

Martin Rewer – BEUMER Group

The system must be designed or dimensioned in such a way that the specified requirements are fulfilled, such as the mass flows which have to be transported. In addition, there are the aspects of maintainability, as well as the consideration of environmental impacts such as noise and dust, which are becoming increasingly important.

R. Todd Swinderman, P.E. – Emeritus/Martin Engineering

The starting points are the physical properties of the bulk material, the desired capacity and the general path the conveyor will follow. The designer must then consider any major requirements, such as: local and national codes that apply, dealing with hazardous materials, environmental concerns and system requirements, such as surge capacity, integration into the existing layout, and access for cleaning and maintenance. Any additional constraints the customer requires are accommodated, such as giving preference to selecting the same components or accessories used on other plant conveyors (e.g. belting, pulleys, idlers or belt cleaners) to reduce spare parts requirements and simplify maintenance. It then becomes an iterative process of determining the belt tension required to select the belt, calculating forces applied to the main components, selecting the belt, components/accessories and finalising the layout. Next, the engineer and customer decide on one of the design combinations that will best meet the requirements at an acceptable cost. Then detailed design of the conveyor, controls and supporting structure can proceed.

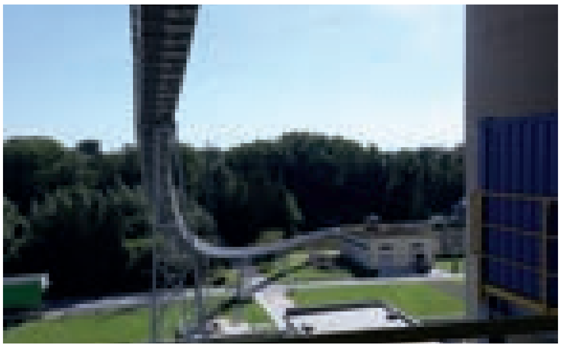
While safety is rarely considered the primary objective in designing new systems, in reality, the design/engineering stage is one of the best opportunities to minimise common hazards and specify safety-first components that enhance efficiency while reducing the potential for injury. Safety is becoming increasingly recognised as a source of cost reduction over the life of a conveyor, rather than an added expense.

Q. How are conveyors designed to minimise dust and spillages?

Martin Rewer – BEUMER Group

To minimise dust generation during conveying, the open troughed belt conveyors can be covered or enclosed along the conveyor flight. A pipe conveyor is a conveyor belt shaped into a tube, the closing of the belt helps to reduce contamination and spillage: protecting bulk materials from the sun, rain and wind – and protecting the environment at the same time. The same also applies to a U-shape conveyor: in this solution, a special idler configuration brings the belt in a u-shape.

Furthermore, the transfer points shall be designed in such a way that dust generation is minimised. Here, the use of the discrete element method can help to create the optimal design of the transfer.



BEUMER Group's U-shape conveyor.

R. Todd Swinderman, P.E. – Emeritus/Martin Engineering

The answer is they are generally not, because of the extra engineering time and cost required. Unless planned for in the initial design, the customer is often put in a position where a retrofit to solve these problems cannot be effective, often due to lack of space. Those who do want to control dust and spillage are willing to accept slower belt speeds, wider belts, adequate access for cleaning and maintenance and increased attention to the design of the loading and discharge chutes to accommodate components that will mitigate dust and spillage. In general, longer and taller transfers than designs traditionally sized using generic rules of thumb are required to contain dust. The wider belts at a slower speed provide the same capacity but with more edge distance for engineered sealing systems to reduce spillage.

Q. How are conveyor lifecycle costs kept to a minimum?

Jeff Jurasits – ASGCO

The best way to keep a conveyor system running smoothly is always to prevent problems before they happen. This plan requires constant vigilance, and it calls for operators to regularly check the system for anything incurring excessive wear, or any elements slightly out of the ordinary.

Martin Rewer – BEUMER Group

Predictive maintenance and high-quality components are taken into account when designing an overland conveyor. It is not only necessary to know the load and utilisation of individual components (belt, idlers, gears, etc.) during operation in order to avoid overloads and peaks. The condition of individual components should also be continuously monitored. Today, various sensors and remote monitoring systems are used for this purpose.

Furthermore, to provide the best service, BEUMER Group can send a highly skilled technician to site for repairs, preventive and corrective maintenance, system checks and unexpected breakdowns.

Ivano Dossi – Doppelmayr

Apart from the capital investment, the operating costs of a conveyor system play an important role in the lifecycle costs calculation. With increasing energy costs, it is important to take a look into the energy consumption of a system. How can the system be optimised in this respect? A system with low energy consumption, due to, for instance, an optimised friction coefficient by design, will help to reduce the lifecycle costs. An example for this would be the RopeCon® system, where polyamide wheels run on steel track ropes. Depending on the topography of a project, some systems can also make use of the energy regenerated through braking. Such energy can be fed back into the grid and helps to reduce the overall energy costs.

R. Todd Swinderman, P.E. – Emeritus/Martin Engineering

Because most bulk conveyors are custom designed but considered a commodity, there is a constant tension between capital cost and life cycle cost. When engineering is limited by cost constraints, it generally results in a conveyor that requires significantly more maintenance over time and struggles to meet the capacity requirements. Engineering is usually ≤10% of a project cost. Spending a little more on engineering up front to improve reliability and maintenance access is the first step. The second step is buying components based on lifecycle cost and not initial price. Both of these suggestions increase the initial capital cost, which is often the owner's main concern, and life cycle costs are rationalised away by assuming that any issues will be addressed by maintenance after start-up (which rarely happens).

Q. What component of a conveyor is most prone to failure and thus requires the most maintenance?

Martin Rewer – BEUMER Group

The utilisation of the entire system, as well as the individual components, should be known. With the sensors and monitoring systems installed for this purpose, the data can be analysed to determine the possible failure of components at an early stage. It is not a question of whether a component will fail, but it is important to know when the component will fail before possible secondary damage occurs.

Naturally, components such as belt, idlers, drums and drives require regular maintenance. Some conveyor solutions, such as those offered by BEUMER Group, are quick and easy to maintain due to their simple design.

R. Todd Swinderman, P.E. – Emeritus/Martin Engineering

This varies mostly by material conveyed and the tonnage. With abrasive materials, wear parts such as chute liners, skirtboard seals, and belt cleaners are prone to shorter mean time to failure. In high tonnage applications, wear on idlers/slider bars in the impact area of the loading chute increases the maintenance on these components. Where very sharp, unusually shaped lumps, or material with lots of debris are handled, the conveyor belt typically has a shorter life due to cover wear or carcass damage. Feeder belts under high vertical loads will tend to have the shortest wear life of any component in the feeder assembly.

Q. Numerous conveyor types are available. Detail the process and design behind one of your most popular conveyors.

Martin Rewer – BEUMER Group

The troughed belt conveyor with horizontal curves allows high mass flows even in case of heavy and robust materials. Their open design makes them suitable for coarse materials and very large volumes. The design with horizontal and vertical curves allows overland conveyors to be built without material transfer for several kilometres, as the existing obstacles can be bypassed with clever conveyor line alignment.

On the contrary, the pipe conveyors present other specific advantages. The idlers form the belt to a closed tube protecting the material transported against external influences and the environment from emissions such as material loss, dust or odours. The pipe conveyors allow the implementation of narrower curve radii and larger angles of inclination than troughed belt conveyors. The system requires little space and can be adapted better to the topography of the terrain.

Ivano Dossi – Doppelmayr

RopeCon is a continuous conveying system that essentially relies on a flat belt with corrugated side walls to transport all kinds of materials. The belt performs the hauling function and is driven by, and guided around, a drum at both ends. Axles are mounted on the belt at regular intervals to support it and have plastic running wheels attached to their ends. These wheel sets run on track ropes with fixed anchoring and guide the belt. The track ropes themselves run over tower structures so that this conveyor system is lifted off the ground. The system features three track rope pairs in total, with the bottom pair supporting the empty belt and the pair in the middle carrying the loaded belt. One aspect of this conveying system that contributes to a safe work environment for the operating staff is that the wheels are mounted on the belt. Therefore, almost all moving parts are attached to the belt and pass through the stations at regular intervals. Service and maintenance works can thus be performed easily at one central point in a safe work shop environment. There is no need to go out into cold, windy or rainy weather to perform maintenance tasks. The controls of the RopeCon system can be integrated in the main controls of a logistics chain and the system works completely automatically. This helps to reduce maintenance and operating costs.

Q. Describe some recent developments in conveyor technologies.

Jeff Jurasits – ASGCO

Wider and faster conveyors are being deployed to drive down the cost per-tonne of conveyed material. Traditional troughed designs will likely remain a standard, but the push toward wider and higher-speed belts will require substantial development in more reliable components, such as idlers, impact beds and chutes.

Martin Rewer – BEUMER Group

The U-shape conveyor allows the implementation of narrower curve radii than a troughed belt conveyor and higher mass flows than a pipe conveyor. At the same time, and contrary to the troughed belt conveyor, it protects the material and the environment from material loss and emissions. Thus, this u-shaped conveying solution has proven to be an ideal alternative in the cement and mining industry, as well as in port terminals, if high capacity is required with little space available.

R. Todd Swinderman, P.E. – Emeritus/Martin Engineering

Developments in conveyor technology are driven by customer requirements to increase production rates and meet return on investment goals. Belting development is driven by this need for ever-increasing capacity. Even though belts can be developed to handle the required tonnage and speed, many standard components cannot, so component development tends to follow innovations in belting. Because of the capital cost, conveyors are often designed for long lifetimes. The capital cost and the time it takes for new technology to be field tested and accepted tends to be a cycle of 20 – 40 years. In the last 40 years, there has been a lot of development for specialty belts, particularly closed belting. The pipe conveyor is one of these, but there are many other types of closed conveyors, such as pocket belts, fold belts, sandwich belts.

The trend in monitoring is finally catching up to bulk material handling. Today, many more accessories, such as belt cleaners, are being remotely monitored because the importance of a clean system for safety and productivity has become recognised.

Q. Detail a short case study of a conveyor installation at a mine/port/etc.

Jeff Jurasits – ASGCO

A cement plant was experiencing severe material spillage, carry-back problems, and belt wear issues from the raw material that discharged into the head chute on a 90° angle of impact on the reversing conveyor.

ASGCO® 3-DEM Transfer Chute at a cement plant.

Before initially installing their reversing conveyor, raw material was discharged into a diverter gate and directed into either of the two silos. Their design was efficient but was causing excessive wear on the silo walls due to using the silo as a pass-through chute, not as a surge bin.

The company's consultation expressed that the original design worked if the silos were allowed to operate as designed as a surge bin. The challenges discussed were that the diverter gate would jam in one position due to material build-up in the seal area or cause the material to leak into the unused silo due to edge seal clearance. The gate blade also saw excessive wear over time.

ASGCO® removed the reversing conveyor and installed an ASGCO 3-DEM Transfer Chute that is similar to the original design but with a modified swing hood/material diverted. This new design would eliminate the frozen gate issues and seal leakage that a conventional diverter gate experienced.

Martin Rewer – BEUMER Group

An economical solution was required for transporting large quantities of iron ore from the Chinese port of Langshan to the plant of steel manufacturer Shandong Steel Group & Rizhao Steel Group.

The general contractor, Shandong Harbour Engineering, tasked BEUMER Group with the installation of additional efficient pipe conveyors. Project implementation took around eight months. In only four months, the system provider installed the mechanics of the systems with a total conveying length of approximately 6.6 km and a conveying capacity of 5500 tph.

Ivano Dossi – Doppelmayr

Bardon Hill Quarry, near Leicester in Leicestershire, is one of the UK's oldest continuously operated quarries. Aggregate Industries UK Ltd has recently developed a new quarry extension at this strategically important site. In order to sustain quarrying activities, a separate material handling system was required to extract, process and transport overburden for emplacement within the existing quarry as part of its restoration.

The goal was to develop a unique solution that will dramatically reduce carbon dioxide emissions and environmental impact compared with road haulage or the footprint associated with a conventional surface conveyor system.

The quarry restoration solution makes use of the RopeCon system, a combination of ropeway technology and conventional conveying technology. Track ropes will span 850 m across the entire pit, upon which the belt which transports the overburden will travel. The RopeCon system includes a reversable second belt that will

Doppelmayr RopeCon® at Bardon Hill – part of the quarry restoration solution.

enable simultaneous conveying and emplacement activities. During the life of the operation, the RopeCon track ropes will be periodically retensioned to allow the system to be lifted above the placed material. This ability to control the drop height minimises the impact from noise and dust during operation of the system.

R. Todd Swinderman, P.E. – Emeritus/Martin Engineering

With one of Alaska's few year-round ice-free harbours, the Port of Seward has the shiploading resources to feed the expanding international export market. It is also the southern terminus of the state-owned Alaska Railroad, with terminal facilities owned by the railroad and operated by Aurora Energy Services, LLC (AES) (operator of the Seward coal terminal).

A major obstacle to expansion was the port facility's ageing infrastructure, which had seen few improvements prior to 1999. Upgrades began that year when Alaska Railroad purchased the terminal but, despite best efforts, the facility had become a logistical bottleneck and a source of occasional dust complaints by 2008.

One of the issues was the shiploader itself. With a view to expanding Usibelli Coal Mine's export market share (the company currently exports more than 45% of its annual production), AES began taking steps to increase throughput at the port facility, but initial efforts to reach 2000 tph proved almost entirely unsuccessful. Even as some gains were realised, AES found that with higher-speed operation, dust became an increasing problem. The shiploader was not designed to contain fugitive material, and airborne coal dust threatened community relations.

The need to increase throughput at Seward while protecting the region's air quality and landscape led AES to investigate new conveyor technology from Martin Engineering. After testing the Usibelli coal to determine its flow properties, Martin specialists used Discrete Element Method modelling to design a chute capable of properly handling the coal.

The new transfer point makes use of an advanced transfer chute that is custom-engineered and modelled in 3D to provide the optimum design for the material and flow rate needed. The design controls the flow of material from the discharging conveyor, maintaining a coherent material stream and minimising induced air. A smooth loading chute places the stream of coal onto the shiploader's boom conveyor at the proper speed and angle with minimal impact, reducing material degradation, belt abrasion and the expulsion of airborne dust.

Martin Engineering supplied other redesigned components to contain material and improve serviceability. Belt support cradles were installed under the drop chute to absorb impact, stabilise the belt line and prevent spillage. An external wear liner was also mounted on the load zone's existing skirtboard for improved sealing. Because it is attached from the outside, the new liner is easier to install, inspect and adjust than conventional designs, without requiring confined space entry.

During the initial shakedown run, operators noted the conveyor's weigh scale pegged at 100%, but the belt did not shut down. The old system peaked at 1000 tph (including ship and hatch moves), but with new components in place, the system now hits peaks of 1500 tph. By installing a new conveyor load zone, the terminal has increased the average load rate for the entire shiploading process from 700 tph to 858 tph, while enhancing control over dust and fugitive particle emissions. The terminal has also progressed from an absolute maximum of 18 000 tpd with dry coal and optimal loading conditions to more than 20 000 tpd on average – including operations in poor weather and less than ideal operating conditions.

Equally important, following the system's initial run, the shiploading area was virtually free of fugitive material and dust build-up, allowing AES crews to reduce their cleanup time from days to just hours. The company reports that the recent chute upgrades have virtually eliminated spillage and dust issues. DB

Martin Engineering's conveyor technology at Port of Steward., operated by Aurora Energy Services, LLC.