Innovation in the area of transportation of powdery matters. Elevator conveyors, Redler chain conveyors and Metal spiral conveyors

Jan Fiala¹,², Miroslav Lapka¹,², Milan Mikoláš¹,², Jan Fiala jun.¹

¹Brick factory of Štěrboholy, Nedokončená 163, 102 00 Praha 10, Czech Republic
²VSB-Technical University of Ostrava, Faculty of Mining and Geology, Department of Mining Engineering and Safety, 17. listopadu 15,70833, Ostrava-Poruba, Czech Republic

j.fiala9@gmail.com

Abstract. The article points out the problems occurring on transport routes within the transfer of mined materials on technological lines for mineral processing, finds possible solutions in increasing the service lifespan of individual parts and in the field of maintenance helps to protect the health at work of employees of mining organizations and their suppliers. It contains the issue of the operation of technological line as one large unit, which combines innovative solutions with the use of modern materials, increasing service lifespan, reducing repair costs and reducing the frequency of repairs – especially those that are cyclically recurring. All this helps to eliminate the number of accidents and this is the reason why it protects the operator of the technological line. Ultimately, maintenance costs become more efficient despite relatively higher acquisition costs in the initial phase.

1. Introduction
Processors and producers of products in agricultural and agrochemical sphere are often facing problems with moving of processed material and products in their production plants. This is mostly transportation by elevator lines, redler chain conveyors and metal spiral conveyors. In some cases classic conveyor-belts are used which are in smaller amount used for own expedition of products into means of transport. [1]

2. Case of study
Question is why are these so vastly used in these types of sectors for transportation: elevators, redler chain conveyors and metal spiral conveyors. Main reason is the possibility of total sealing against its surroundings. Thus these systems are usable in both technological buildings but also outdoors. Vast majority of production plants have their production technology separated into different buildings and it is necessary to transport raw materials between these buildings by using transport-technological bridges without option of contaminating transported raw materials. These systems fully meet requirements for the transportation. In the case of using classic conveyor-belts it would be problematic, in some cases even impossible to abide these conditions. Even in case of putting transportation lines of conveyor-belts it is not possible to seal off whole system, moreover the space it would require would also be impracticable.
Unfortunately redler chain conveyor and metal spiral conveyor systems have also several negative aspects. One of them is condensation of moistness inside transportation line (processing of materials is mostly done by heat treatment). After the technological node the same raw material has to be transported (it is not possible to transport several raw materials alternately because of possibility of contamination by different material). Other problem is time, when it is not possible to stop flow of material for longer period of time. In vast majority it is biological material which yields to decay and degrades relatively quickly. In the case that the line would be closed for longer period of time (stoppage of production, unplanned putting out of operation), it is vital to close whole line, clean and remediation against spreading of bacteria and mould which thrive in closed environment.

Elevator lines are used for vertical transportation and in 99 percent it is bucket elevators of different transport capacity and speed. Big advantage is small space, which this elevator covers, it is distinguished by high reliability. There is no abrasive loss to bucket material neither „Height drain“ elevator line with buckets is moving between drive drums. I personally prefer gravitational tensioning to threaded tensioning with pulley regulator. It is a little complex system and demanding on adjusting, however it has indisputable advantage in the elimination of strokes during start while preserving constant tensioning force which is set by sum of weight of transportation belt and buckets fixed to it and gravitational constant. Ideal case the device is equipped with frequency converter for more fluent start of the elevator. Eventual vibration of transportation line in high drain is eliminated by supporting smooth conveyor rollers placed roughly 3 to 5 meters of height. [2]

If correct tensino and centering is kept, there is no danger of any damage and the lifespan is rapidly increasing. Some elevator belts can withstand even 10 years if all necessary measures are held for smooth running. Main parameter which determines the lifespan of whole unit is the frame structure of carrying conveyor belt. This structure due to force strain, dampness and chemical processes degrades and break of this transportation belt will occure. Following change of broken belt could last according to the size of elevator conveyor from 1 up to 3 days. Important aspects of elevator conveyor are height, number and volume of buckets and my personal experience is that this is no such easy change. Financial expenses for repair and used mechanization are not cheap. That is why it is vital to check durability of conveyor or belt so the change can be made prior to any damage or breakage. Elevator conveyor belt in first phase has its buckets removed in accordance with stated method. The old belt is exchanged for a new perforated carrier belt and it put back on, again in accordance with stated method. The only significant problem during operation of the elevator conveyors is possible sticking of materials onto the buckets and decreasing of transport capacity (Figure 1). This can be solved by one of named ways in paragraph „Innovation“. [3]
Redler chain conveyors are used in case of processing and mainly montage when used for transportation of materials and products on long ranges rather than for example metal spiral conveyors. One Redler chain conveyor can substitute even three or four metal spiral conveyors in row basic parts of Redler chain conveyor are returnable head with cogwheel, upper feeding space which serves for feeding of transporters middle part - torso of conveyor, bottom dumping space equipped with damper – Manual, electric or pneumatic, driving head with turbines. Transmission and electric motor, own transportation of materials provides endless chain or pair of chains equipped with carriers. One of the disadvantages of regular chain conveyors is increased friction between the bottom end the chain and carriers and in the case of incorrect or bad construction. The friction can also occur between carriers and this side of conveyor. This happens when the torso of conveyor deflects from axis between driving and reversible wheel. Commonly it is solved by construction of plates from PE-UHMW (high molecular polyethylene, Figure 2), which are wound up onto carriers. These plates must always have overlap over supporting arm. In the opposite case, abrasion of bottom or the two sides of conveyors. The following pictures serve as example (Figure 3).
Another problem causes bad alignment of wheels or in driving case returnable barrel. As a result of this is excessive load of bearings and irreversible damage of gearing.

No less serious problem means condensation of humidity from transported material, which is processed by heat. It could be molding made out of oilseed rape.

Metal Spiral conveyors: are used for short and middle lines with the necessity of tilted transportation of materials. In many cases this system is used for taking out feeders or other technological parts of production. e.g. presses where the materials has relatively high temperature gradient and on the route gradually cools down. The system consists of torso, rotating spiral which is placed inside, electric drive, collecting space for emptying equipped with damper, in same places for storing the bearings (outer position, in some cases middle sliding bearings). These are of low chance damaged devices. Their load is quite easily regulated. The problem might be misalignment of spinning parts. Due to this abrasion of torso of metal spiral conveyor can occure and in some extreme cases even twisting off the spiral shaft.

3. Innovation
Elevator conveyors:
- Linning of inner parts of buckets with polyurethane: Due to the demanding character of shape of individual buckets is ideal method of spraying polyurethane directly into the buckets, which are in numbers of tens or hundreds on one elevator. It is the most efficient way of applying protection against stickiness of individual pieces. An undisputed advantage of such protected buckets is many times higher self-cleaning trait connected with high chemical resistance. With it is also connected anticorrosive protection. Using so called „wear protection rubbers“ would be due to the time-consumption inefficient, uneconomical and the technical aspects will not be as perfect.

Redler and metal spiral conveyors:
- Almost all Redler conveyors are created by single skin torso from steel plates. As it was mentioned above abrasion of bottom and sides of the torso influenced by friction between solid and moving parts of the conveyors. In the final overall solution of increasing durability or lifespan of these conveyors is necessary complete linning of the inner pars of torso with polyurethane spraying, resistant to abrasion, for example Metaline system made by German producer which proved itself several times in practice and which is also useful for local repairs. Linning by polyurethane provides immensely faster remediation of the insides of the conveyor in the case of
putting it out of operation. Furthermore it is temperature and chemically resistant. The only obstacle is the amount necessary to invest into system of protection of this wheel. The problem of misalignment of driving and returnable wheel can be solved by installation of laser range-finders which would monitor both positions of left and right sides of tension of the chain and in any case of undesirable deviation of the wheel would automatically send information about the deviation to the control centre which would then ensure adjustment of that conveyor. The problem with condensation of humidity would be possible to solve by using double-walled construction. Inner shell or wall would be made out of own Redler conveyor and the outer shell or wall would be connected onto the system of compulsory ventilation equipped with recuperation of heat and capture filters for possible particles released during the transport of the materials. System of outer isolation elements would stay the same as is with Redler conveyors. The metal spiral conveyors we recommend use of thermal sensors in the places of storage (Figure 4). Those are bearings and connected onto operation control center. With this option there would be constant overview of temperature of individual bearings and by this way it is possible to control the stability of the temperature of transported material in individual sections of the transport route. [5]

![Figure 4. Metal spiral conveyors out of operation, uloženi-kluzné bearing [4]](image)

### 4. Conclusion

This article points out several ways of increasing lifespan and serviceability of transportation lines in agricultural and agrochemical enterprise. Where majority of production material and finished materials is transported by vertical lines. (elevator transporters), metal spiral conveyors and horizontal lines. Redler conveyors even metal spiral conveyors, which have one common trait. These are completely sealed off from the outer environment. The advantages can be used to maximum and disadvantages are possible to be eliminated in one of the described ways. Everything is only a question of financing individual systems of protection for technological devices.

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