VERTICAL CONVEYORS FOR BULK MATERIALS - THE ECONOMIC SOLUTION

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INTRODUCTION

With different types of belt conveyor systems, bulk materials can be transported over horizontal, inclined and even vertical paths.

The inclination angle of trough belt conveyors is limited by the bulk material properties. The maximum inclination angles of such conveyors vary from 15° to 20°.

U-cleat profile belts with cleat heights of 20 to 40 mm raise the maximum inclination angle to 35°, depending on the conveyed material. For steeper inclination angles and up to vertical, conveyor belts with larger cleats and flexible lateral sidewalls are used. These conveyor belts are well known under the trademark "Flexowell".

To overcome a certain height, conveying systems with inclination angles of 20° to 35° require a long substructure. With vertical conveying systems conveyor length reduces to the elevation height plus the length of the mostly horizontal sections for feeding and discharge (figure 1)
In the vertical path of lift no substructure nor support rollers are necessary. Compared to horizontal or inclined installations, a saving in the space required (surface area) and a reduction in investment costs occurs.

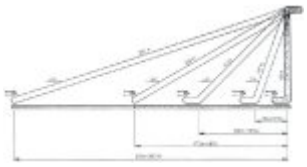

Figure 1. Required length of surface area in relationship to conveyor angle and conveyor height [1]

Principle of operation

Figure 2 shows a typical design of a vertical conveyor with Flexowell belt. The feeding of the bulk material takes place on a mostly horizontal feed path, where the Flexowell-belt is supported by loading impact idlers. The feeding of the conveyed material can be achieved by direct feeding from a hopper, over a chute, a feeding belt or a feeding pulley. The selection of the optimum feeding station depends on the properties of the bulk material and the belt speed of the vertical conveyor. Investigations into this problems are described in [2].

After the horizontal loading section a deflection wheel bends the belt into the vertical path of lift. The upward and downward strands are encased from the bottom to the top. Substructures or support rollers are not necessary in this section.

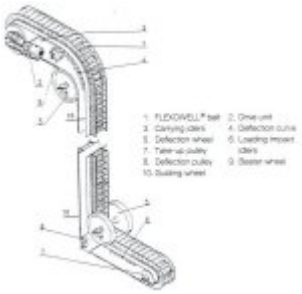

Figure 2. Isometric view of a vertical conveyor [3]

The vertical section leads over a deflection curve into the horizontal discharge section. The deflection curve is made up of a number of high-specification pulleys. These pulleys experience the vectored load of deflecting the belt tension from vertical to horizontal.

At the drive pulley the bulk material is discharged and the belt is returned to the back-going strand. Depending on the bulk material properties the drive pulley is followed by a beater wheel for belt cleaning in the return side.
The beater is self driven. Material that fails from the belt goes into the main delivery chute.
Lateral deflection wheels turn the belt from the horizontal back to the vertical.

In figure 3 a Flexowell conveyor belt is shown. Flexowell belts are manufactured with flexible lateral sidewalls in heights of 40 to 400 mm. The flexibility of the sidewalls is necessary for the belt to wrap around the drive and bend pulleys. For steeply inclined or vertical conveying, the belts are provided with transverse cleats. -

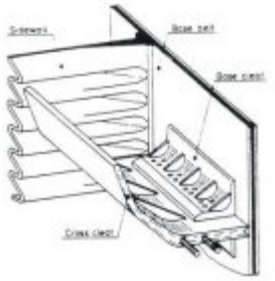

Figure 3. Flexowell belt for vertical conveyor systems [4]

Project Descriptions

BINDER+CO AG, Gleisdorf Austria is an Austrian Company working in the field of conveying of bulk material. Since 1970 BINDER is supplying belt-conveyor systems on a world wide basis. Early in 1980 BINDER was contracted for engineering and supply of the first vertical conveyor. Since then BINDER has delivered about 50 systems of this special conveyor for applications in mining, gravel plants and even in steel-making plants. Since 1995 BINDER is working on a new development which is supported by VAI's Corex-plant technology. Two projects will be discussed.

I. Vertical Conveyor for Jindal Steel, India

In 1995 BINDER+CO signed a contract with VAI, a company of the Austrian VA Technology group, for the engineering and the supply of two S-shaped vertical-conveyors for COREX-plant C-2000 in Jindal, India. The first lay-out of the COREX-tower C-2000 with two S-shape FLEXOLIFT-systems for Jindal Steel, India is shown in figure 4.

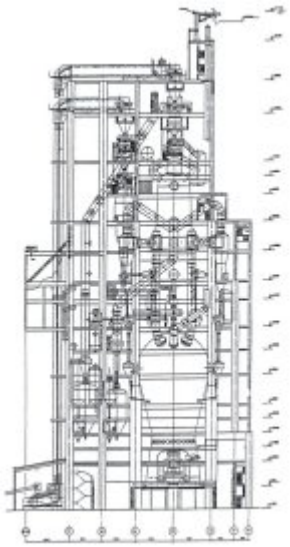

Figure 4. Tower Corex C-2000 with two S-shape Flexoturn-systems for Jindal-Steel, India

The material feed of the Corex-tower will be handled by two Flexoturn vertical belts, one with a vertical lift of about 80 m and a capacity of 250 t/h coal and the other one with a vertical lift of about 90 m and a capacity of 400 t/h iron ore. Both belts are twisted by 14.9'. The system design and installation was carried out by the BINDER+CO AG, Gleisdorf/Austria. The endless belt system and the installation is supervised by Trellex Flexowell GmbH.

JINDAL Vijayanagar Steel Ltd. with the support of the JINDAL Group and the Karnataka State government, signed a Letter of Intent for the supply of a second Corex plant of the same size. Both plants are for installation within a green field' integrated steelmaking complex under construction at Toranagallu in the Indian State of Kamataka. The complete project will allow for the additional production of 1.25 million t/a of hot strip for the rapidly growing Indian market.
This integrated steelmaking complex will be the first "green field" plant world-wide to feature Corex technology and will therefore rank as one of the most cost-effective steel producing centers in all of Asia.
Duhng the preparation of this paper, BINDER+CO AG signed the contract for the second plant for Jindal Steel.--Supply of the conveyors will be effected early in 1998.

II. Vertical Conveyor for SALDANHA Steel, South Africa

Two of BINDER's vertical conveyors will be installed at Saldanha-Steel Company in South Africa. Both conveyors will feed the Corex-Fumace (VAI). Lifting heights of 80 m and 90 m and capacities of 250 t/h coal and 400 t/h iron ore are approximately the same as for Jindal 1.

Conveyor 1: IRON-ORE

Technical data:

AA = 116.8 m
Belt width = 1200 mm
Belt speed = 2.35 m/s operating speed and 0.3 m/s for maintenance

Design capacity: 430 t/h (240 m^3/h)
Installed power: 2x90 kW main drive and 1x11 kW for maintenance

Conveyor 2: COAL

Technical data:

AA = 99.1 m
Belt width = 1200 mm
Belt speed = 2.1 m/s operating speed and 0.3 m/s for maintenance

Design capacity: 280 t/h (320 m^3/h)
Installed power: 2x75 kW main drive and 1x7.5 kW for maintenance

Figure 6 shows the bottom station of the vertical conveyor. Take-up unit and deflection unit are the main components. In figure 7 the top deflection-unit with the roller curve for loaded belt and deflection wheels for the return belt are shown.
The conveyor drives and the discharge of the conveyor are shown in figure 8. The discharge station is equipped with a belt cleaner and a conveyor for the fine material, which is situated underneath the Flexowell-belt.

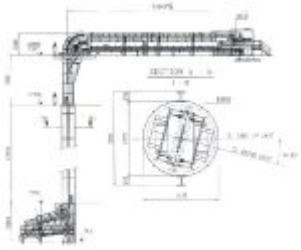

Figure 5. Vertical conveyor for Saidanha Steel/South Africa

Figure 6. Bottom station of the vertical conveyor

Figure 7. Top deflection unit of the vertical conveyor

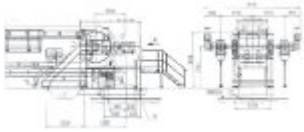

Figure 8. Drives and discharge station of the vertical conveyor

(At the end of the presentation slides of vertical conveyors built by BINDER+CO are shown to the audience. The photographic material is to extensive for presentation in the proceedings.)

Summary

In all areas of conveying of bulk materials, it is more important than ever to pay careful attention to the cost/benefit ratio. This applies equally to capital investment and the ongoing costs for operation and maintenance [5]
Bulk materials handling and transport today require environmentally acceptable, dust-free and noiseless operation as well as a high degree of functional reliability. Vertical conveyors build by BINDER+CO AG, Gleisdorf Austria meet all these demands.
About 20 years of experience in vertical conveying makes BINDER+CO to an excellent partner for all customers in any type of industry.

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Prof.Dr.KESSLER studied mechanical engineering at the University of Leoben. His doctoral dissertation concerning belt conveyors with horizontal curves was presented at the Department of Conveying Technology and Design Methods at the University of Leoben, where he worked as Assistant Professor from 1982 to 1 995. Since 1 995 DR.KESSLER has been an Associate Professor at the same department. He is also a consulting engineer with several companies.