THE SIZING OF FLAT-BELT CONVEYERS FOR THE SALT CRUSHING MILL FROM THE SALT MINE OCNA DEJ

PhD, Associate Prof. Eng., Iosif DUMITRESCU, Department of Industrial Mechanical Engineering and Transport, University of Petroşani, iosifdumi@yahoo.com
PhD, Eng, Lecturer, Bogdan Zeno COZMA, Department of Industrial Mechanical Engineering and Transport, University of Petroşani, cbogdy@netlog.com

Abstract: *The increase in demand of industrial salt by internal and external beneficiaries, the increase of the diversity of salt that is demanded and the physical and moral wear of the existing pre-grinding station (functioning since 1997) compels the Ocna Dej salt mine to fiind a new grinding flux, which is to be modern, have increased productivity and quickly shift from one sort of salt to another sort of salt. This paper presents a basic chart of the grinding installation for a capacity of production of 300 tons/hour for the sorts of salt of 0 – 15 mm and 0 – 4 mm. The paper also presents the sizing stages of the 800 mm roller conveyers for lengths up to 100 metres and angles of up to 30 degrees and 3D modellation of its elements in order to obtain an easy and fast flux of transportation of the installation.*

Keywords: flat-belt conveyer, sizing, salt grinding installation.

Introduction

In the year 1979, at the Transilvania mine, exploitation works have begun and they go on to this day. The mine was designed to have five horizons: horizon +204 m, exploited during 1979 – 1985; horizon +188,5 m, exploited during 1985 – 2000; horizon + 173 m, exploited since 1999, which is close to finish at the present moment; horizon +157 m, where exploitation will begin in the current year; horizon + 142 m, which will be opened and exploited in the future.

At the level of horizon + 173 m, a pre-grinding station is emplaced (fig.1) through which the salt resulted from the blow-up operation is brought to a granulosity of maximum 15 mm, with the help of an 4840 impact crusher.

In figure 1, one can see the design of the salt pre-grinding installation, which is to be found at horizon + 173 m, where the following were noted: G1 – grate for taking in the salt; A1 – feeder with an engine of 30kW/1000 rotations/minute; B1 – flat-belt conveyer of 1000 mm, with the length L= 35 m and action group (engine of 22kW/1000 rotations/minute and a reducer 2CHB 250 with i = 1/25); B2 – flat-belt conveyer of 800 mm with the length L=58 m and action group (engine of 15 kW/1500 rotations/minute and reducer 2CHB 250 cu i = 1/25); M1 – impact crusher 4840 with an engine of 55 kW/1000 rotations/minute; B4 – flat-belt conveyer of 800 mm, with the length L=25 m and an action group (engine of 7,5 kW/1500 rotations/minute and a reducer 2CHB 250 with i = 1/25); B4ref – flat-belt conveyer of 800 mm with length L=26 m and action group (engine of 5,5 kW/1000 rotations/minute and a reducer 2CHB 250 with i = 1/25); B5 – flat-belt conveyer of 800 mm with length L=30 m and action group (engine of 15 kW/1500 rotations/minute and a reducer 2CHB 250 with i = 1/25); S1 – 15 tons silo; B6 – flat-belt conveyer of 800 mm with length L=28 m and an action group (engine of 7,5 kW/1000 rotations/minute and a reducer 2CHB 250 with i = 1/25); Tr0 – flat-belt conveyer of 800 mm with length L=216 m and two action groups (engine of 45 kW/1500 rotations/minute and a reducer 2CHB 250 with i = 1/16); Tr1 – flat-belt conveyer of 800 mm with length L = 980 m and two action groups (engine of 75 kW/1500 rotations/minute and a reducer 2HDO 1003 with i = 1/25); Tr2 – flat-belt conveyer of 800 mm and length L = 780 m and two action groups (engine of 55 kW/1500 rotations/minute and a reducer 2HDO 1003 with i = 1/25); G2, G3 – grates with bars at 15 mm.

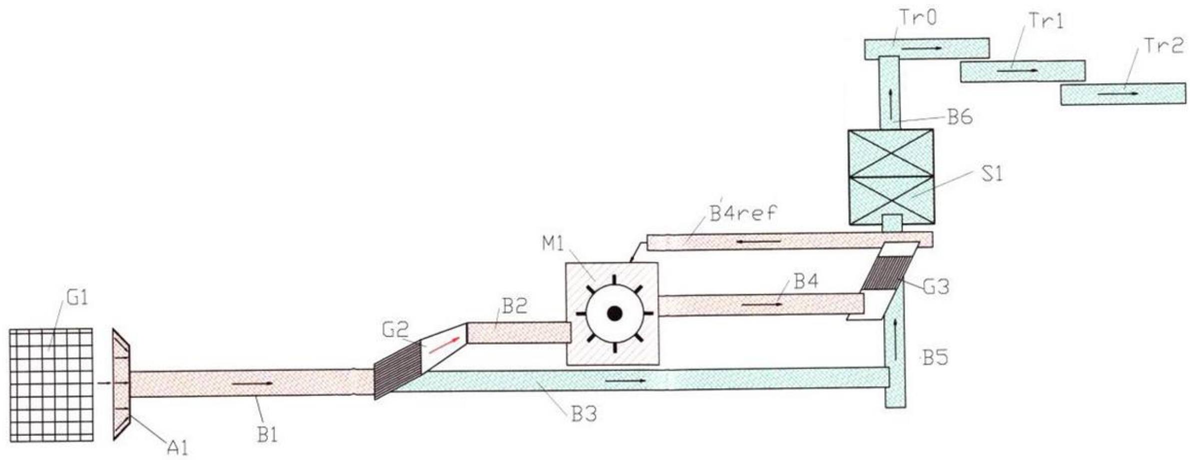

Fig. 1. The design of the salt pre-grinding installation, which is found at horizon + 173 m

The main equipment in this flux is the impact crusher 4840, produced by S.C. SIMATEC Baia Mare, with a nominal capacity of 50-100 t/h of salt. The entry granulosity of the material is of maximum 350 mm, and the exit granulosity is of maximum 12+15 mm. Practice has confirmed a capacity of 90 t/h. For 275 working days and 15 hours of daily actual functioning, the capacity that results is of approximately 371.000 tones of salt/year, processed by pre-grinding at a gabarit of maximum 15 mm

There is a possibility of obtaining this basic sort, (at the same time with the grinding), by gravitational selection, by sieveing through a grate with bars at 15 mm, avoiding the mill. Thus, we can obtain a supplementary quantity of around 259.000 tons salt of 0+15 mm. This results in a capacity of 630.000 tons/year of the basic sort of 0+15 mm, from which the other sorts can be obtained: 0+1 mm, 0+2 mm, 0+4 mm, 0+8 mm, packaged in boxes, bags and big bags.

For the sort of salt for roads of 0+8 mm, we install grates for this granulosity and we use a dumper which collects the resulted refused material, which will be reintroduced in the production process.

From horizon +173 m, the salt with a granulosity of between 0-15 mm, respectively 0-8 mm, is transported at the surface, by using three flat-conveyer belts of the TBS 800 type.

The increase in demand for industrial salt to be delivered to internal and external beneficiaries, the diversification of the sorts of salt requested and the physical and moral wear of the existing pre-grinding installation (installed in 1998), force the salt mine of Ocna Dej to find a new grinding flux, which is to be modern, with a high productivity and with the capacity to rapidly switch from one sort of salt to another sort of salt.

The design of the grinding installation for a capacity of production of 300 t/h

Choosing the type of crusher is the main stage for the designing of an installation for grinding the salt. There are many types of crushers, each suitable for different purposes, each with its advantages and disadvantages.

The jaw crusher is a primary type crusher, ideal for big quarries which exploit by perforating – blowing-up. The main advantage is reliability, because the parts do not deteriorate too fast, so it is perfect for grinding big chunks of up to 1000 mm. The disadvantage is that the obtained product is rough and has big dimensions of over 25 mm.

The hydraulic cone crusher is successful, as it replaces impact crushers or crushers with spring cones. The main advantage is the finesse of the finished product and excellent results are obtained even in the case of processing hard or very hard materials. As a disadvantage, we can only name the price which is quite high: over 200.000 Euro.

The impact crusher is used mainly as a secondary crusher in quarries and to crush the materials refused by the gravel pit. The main advantage is the small finished product, which is fine and cubical and perfect for road asphaltum. The disadvantages are the high costs of usage and the fact that the parts that get worn are quite expensive and they must be replaced often.

In figure 2, we show the design of the grinding installation for a capacity of production of 300 t/h. The following were noted: 1 – tilting grate at 75 mm; 2 – jaw crusher CJ412, with Q = 165 t/h at 75 mm and Q = 605 t/h at 275 mm; 3,4,6 – sieves with three stages; 5 – hydraulic cone crusher CH440, with Q = 220 t/h at 13 mm and Q = 135 t/h at 8 mm; 7, 8, 9 – silos; TB1 … TB8 – flat-belt conveyers of 800 mm; TB9 – conveyer to surface.

In figure 2, we show the granulometric classes of salt and the capacities of transportation between different equipments in order to obtain, at exit, two sorts of salt: 0 – 4 mm and 4 – 15 mm. By using the two silos, 8 and 9, the second conical crusher is eliminated, in order to obtain a grinding installation of 0 – 4 mm at a capacity of 300 t/h. Also, we used the dotted line to represent the transportation flux for obtaining chunks of 150 – 275 mm and for recycling the sort of 4 – 15 mm through the conical crusher regulated at CSS8, in order to obtain a larger quantity of the sort of 0 – 4 mm. Using the tilting grate we obtain a continuous grinding flux, while it is intermittently fed by dumpers.

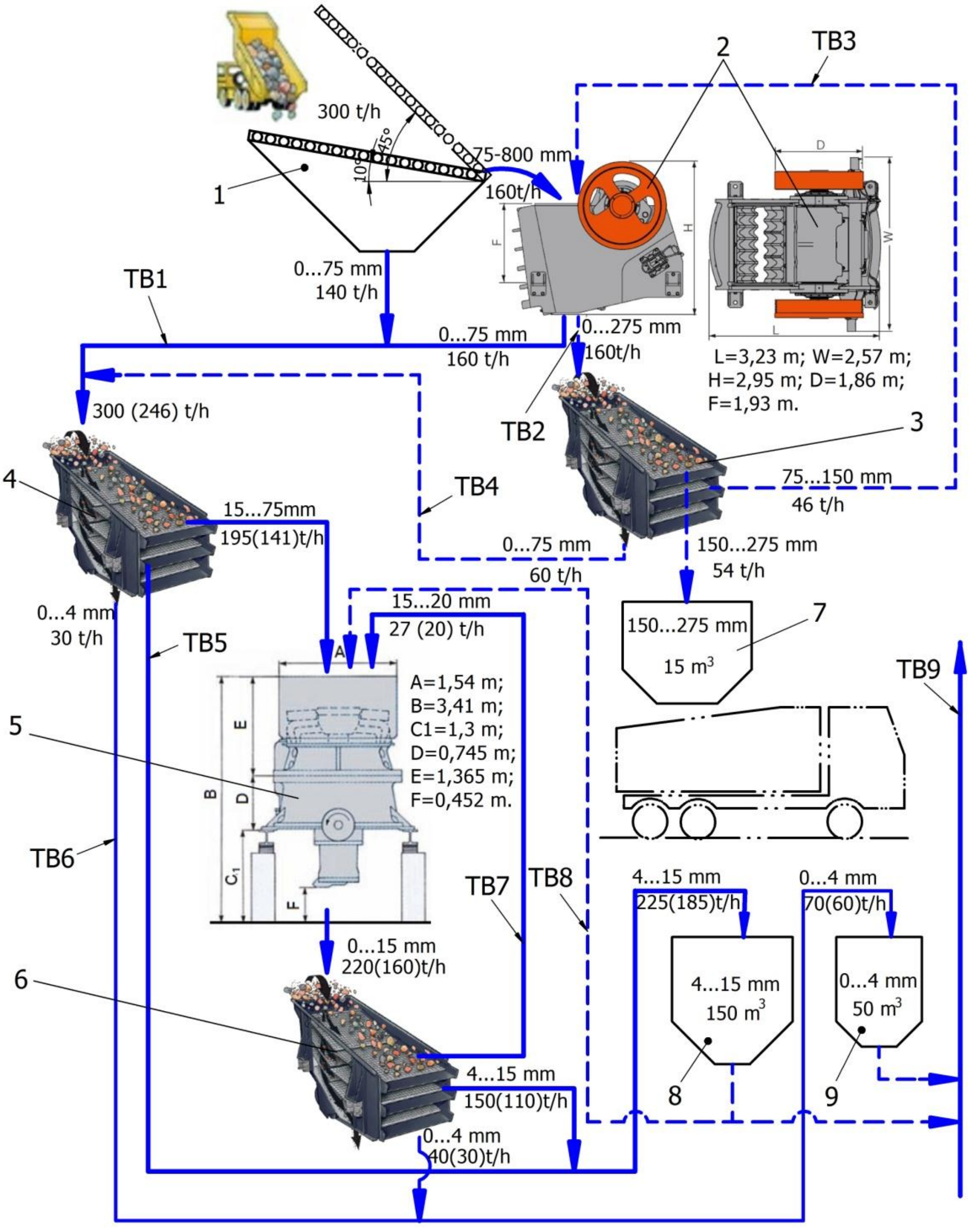

Fig. 2. The design of the salt grinding installation at the capacity of 300 t/h.

Sizing the conveyers with a belt of 800 mm.

Because of the large number of conveyers with a belt of 800 mm of the salt grinding installation, we made a calculation abstract of the power of the action group for the type of belt conveyer shown in figure 3. In order to do this, we began by establishing the dimensions and the transversal section of the flux of the transported salt, which, according to calculations based on the relations from speciality literature, gave the result of 0,07 square metres, and according to STAS 7539-84 is of 0,06 square metres. Subsequently, we established the technical features of the belt, the diameter of the action and return drum of 400 mm, the mass and the disposition pace of the roller set on the carrier and return side and the resistance of motion. Also, we imposed the inclining angle of the transporter δ (0, 10º, 18º) and the transportation flow from empty functioning (Q = 0 t/h) to the maximum flow of 300 t/h.

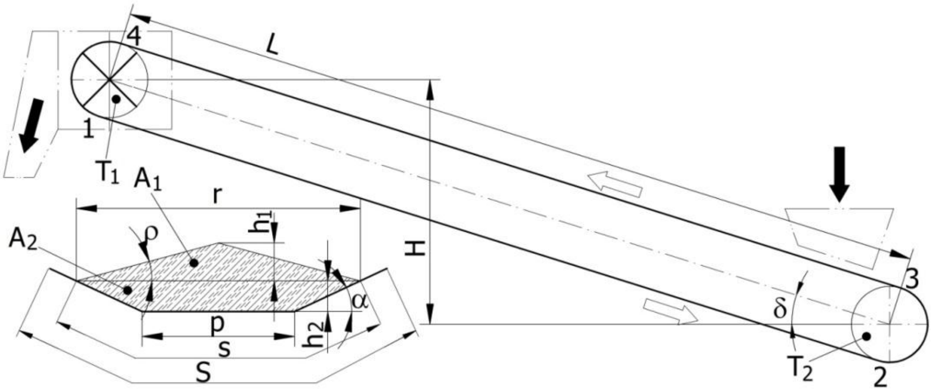

Fig. 3. The calculation design of the belt conveyer of 800 mm.

With the help of this data and of the variation of the length of the conveyer between 10 and 100 metres, the variation margins were drawn of the power of the action group of the conveyer, which are shown in figure 4, where the following were noted: 1 – empty functioning (Q = 0 t/h); 2 – transportation flow of 50 t/h; 3 – transportation flow of 150 t/h; 4 – transportation flow of 200 t/h; 5 – transportation flow of 300 t/h. The graphic shown in figure 4.a is for a transportation angle of δ = 0º, the one shown in figure 4.b is for a transportation angle of δ = 10º, and the one shown in figure 4.c is for a transportation angle of δ = 18º.

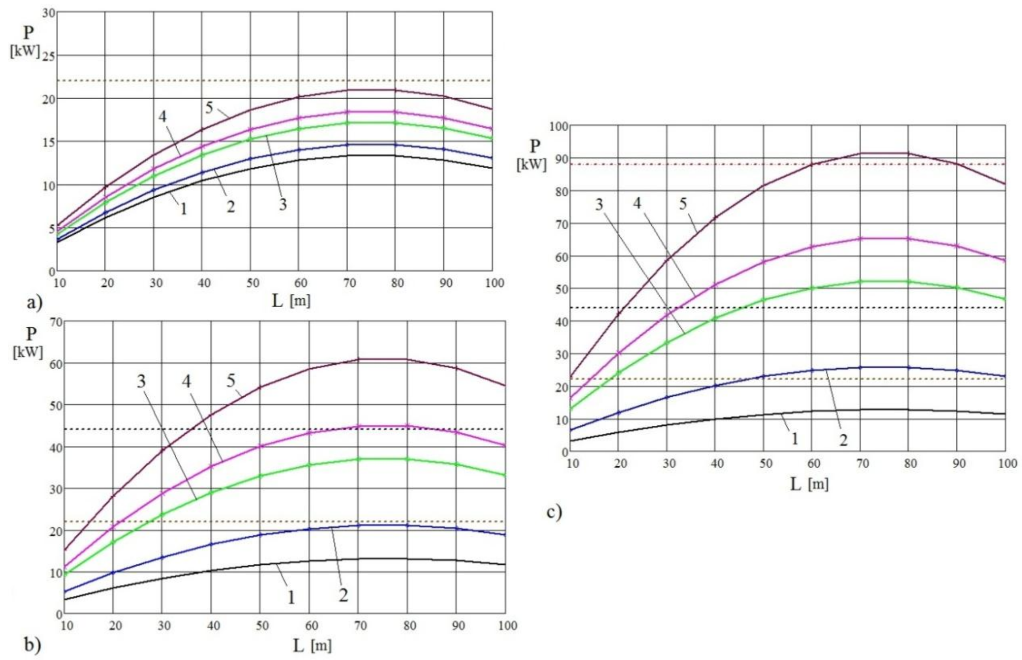

Fig 4. The variation of driving power depending on length, transport capacity and inclining angle.

By analysing the variation margins of the driving power in figure 4, the following observations have resulted:

- The form of the power curves is influenced by the value of the coefficient for the secondary resistances of the conveyer belt, which has a length maximum of between 70 and 80 metres;

- With a single action group of 22 kW we can transport the maximum flow of 300 t/h for lengths greater than 100 m;

- In order to surpass 6 metres at maximum flow (300 t/h) we need two action groups of 22kW if the length of the conveyer is of 20m.

3D modelling of the conveyer belt of 800 mm.

Due to the large number of conveyer belts of 800 mm shown in the design of the salt grinding installation from the salt mine Ocna Dej, and due to the insufficient space in the mine (which asks for different lengths and inclinations), we undertook a 3D modelling of the conveyer belt of 800 mm, which is shown in figure 5. In figure 5.a, we show the 3D model of the modular construction of the conveyer belt of 800 mm, where the following were noted: 1 – action station; 2 – section of the transportation route of L=6m; 3 – the return station.

In figure 5.b, we show the 3D model of the action station, which is made up of: 1 – metal frame; 2 – a set of three pulleys ϕ89x304 mm, with an angle of 25º; 3 - pulley ϕ89x950 mm; 4 – electric engine of 22 kW/1460 rotations/minute; 5 – flexible coupling with pins, with electromechanical brake; 6 - reducer 2CHB 200, i = 1/ ; 7 – chain coupling; 8 – action drum, with a diameter of 400 mm.

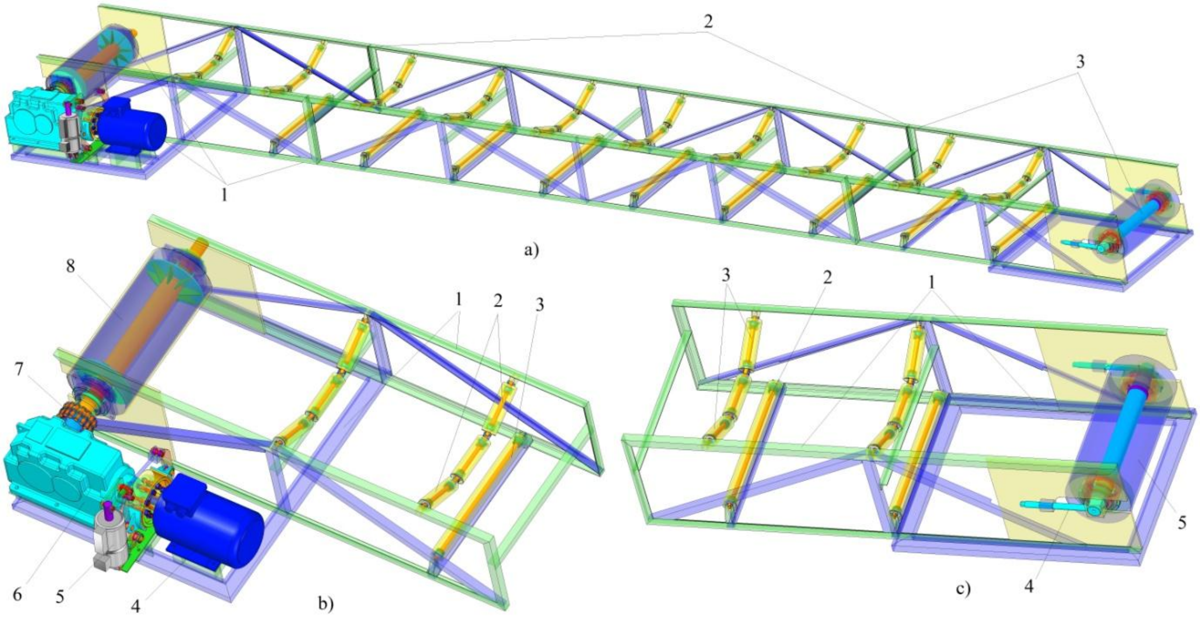

Fig. 5. 3D model of the construction of the conveyer belt of 800 mm and action group of 22 kW.

In figure 5.c, the return station is shown, which is made up of: 1 – metalic frame; 2- pulley ϕ89x950 mm; 3 – set of three pulleys, ϕ89x304 mm, with an angle of 25º; 4 – screw bolt mechanism for stretching the belt; 5 – return drum, with a diameter of 400 mm.

Fiabilitate si Durabilitate - Fiability & Durability No 1/ 2018
Editura "Academica Brâncuşi" , Târgu Jiu, ISSN 1844 – 640X

Conclusions

An important role in the build up of the salt grinding installation from the salt mine Ocna Dej is played by the conveyer belts of 800 mm, besides crushers and sieves.

Due to the large number of conveyer belts, their correct sizing is important, in order to estimate the power of the electrical network to feed the grinding installation, the transportation flow and the fitting in the narrow space from the mine' s underground.

Also, making a modular construction of the conveyer belt and the 3D modelling of its components will allow the exact and correct positioning in the transportation flux and exact correlation with the other equipments (crushers, sieves etc.).

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