OPTIMIZING THE INTERNAL CONVEYING SYSTEMS IN CEREAL MILLS

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Abstract: *This paper underscores the importance of the internal conveying systems for the optimal operation of the technological equipment, the hygienically-sanitary restrictions as well as the environmental protection. The authors demonstrate that the use of the air flow conveyance is in line with the European requirements, but requires at the same time huge special energy consumptions. Trough the utilization, if possible, of the mechanical conveying systems which lead to a decrease of these consumptions and implicitly of the conversions costs. All researches keep sight to the mill production capacity, the flow sheet organization (horizontally or vertically), the technological characteristics of the equipment etc.*

Key words: *internal transportation, milling, hygienically-sanitary restrictions.*

1. Introduction

Nowadays the milling technologies of wheat have been extremely proficient in separating the endosperm from the cover and in improving the quality of bakery meal. The technical equipment which participates in the milling process was permanently improved, manufacture lines were endowed with new equipments so that the modern mill is now a completely automatic computer coordinated assembly, based on wheat characteristics, as input data and the output characteristics can be also established according to the desired flour quality and size [1].

The internal transport belongs to a category with very important activities in every unit which hold or transport intangible assets, essential for the production, for the sale and for the consumption.

The main characteristic of the internal transport is represented by the fact that this process increases the cost of finished products, while their value of usage remains the same.

For this reason the present research is necessary with the main aim of finding the organization and internal transportation solutions, which are necessary for technical-economical elements, but also to observe the norms and the specific rules universally valid in the milling industry.

2. The Conveyers Used For Internal Transport in Cereal Mills

The technical equipment used in the milling process was improved permanently, manufacture lines were provisioned with new equipment, so that the modern mills are a completely automatic computer coordinated assembly in which based on wheat characteristics, such as input size, there the characteristics of the wanted meal (output size) and the remaining operations being changed in the technological system can be established. In Figure 1 the principle scheme of wheat milling technology is presented.

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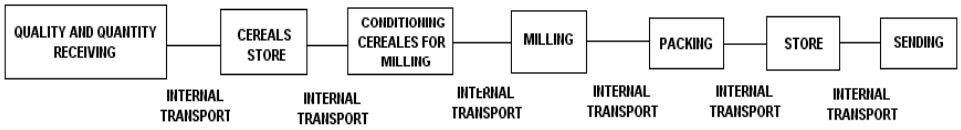

Fig. 1. *The main diagram of wheat milling technology*

In modern mills, where hygienic restrictions allow it, pneumatic transportation with great energy consumption as well as mechanical and gravitational transportation are equally used in internal transport. The mechanical transport can be realized with many types of conveyers, which are chosen according to many criteria, but almost in any situation two constructive types, with different power consumptions can be used. The gravitational transport is met on the flow-sheet from mostly any mills, the mechanical transport is used in old mills and partially in new ones, and the pneumatic transport is used in mills built after 1960's and in restyled mills.

2.1. The Gravitational Transport

The gravitational transport in mills represents more than 60% of the vertical transport - downwards from an upper level. When gravitational transport is performed the fractions result in the passage of sift, these fractions being re-conveyed to other technological phases. This transportation type is made through pipelines made from different materials (wood or steel sheets).

For the products to be transported through this method it is necessary for the etch angle of the pipeline to be in concordance with the product characteristics.

Beside the proper etch angle, for a good operation, the pipelines must assure a perfect tightness. The pipelines made from wood assure a better tightness than the pipelines from metals. Through frequent changing steps in the milling diagram, the gravitational transport lines are modified very often. With direction changes it is necessary to punch the bridging in the points where the pipelines pass through it, without damaging the resistance system of the building.

The transport installations used in gravitational transport are the *gravity spiral conveyers* (Figure 2) or the *cradle* type [3].

These are formed of many drop-forged fixed segments placed on a central soldier. The speed movement of the products depends on the size of the etch angle of the screw and on the surface condition.

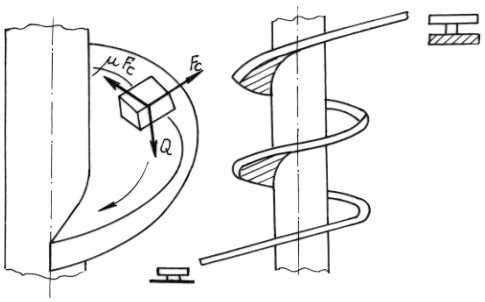

Fig. 2. *Gravitational spiral conveyer* [3]

2.2. The Mechanical Transport in the Cereals Mills

Vertical transportation with upraise advancing is realized by means of a *bucket elevator*, and the one on the horizontal line with a *conveyer worm*.

The majority of *bucket elevators* (Figure 3) used in the milling process are made of wood, are driven by a centralized transmission, the cups having a larger opening and the discharge being done gravitationally, except for the bucket elevator in grit I, where the discharge is done in a mixed way (gravitational and centrifugal) [3].

Bucket elevators are by far the most hazardous equipment used in grain mills. Tests have shown that elevator legs routinely

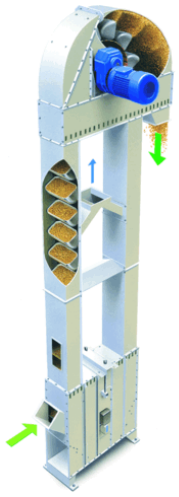

Fig. 3. *Bucket elevator*

produce airborne dust levels exceeding the minimum explosive concentration. Although any location where dust is present can be hazardous under certain conditions, bucket elevators are exceptionally hazardous.

Development of specific preventive and protective measures for bucket elevators should be given high priority. Certain techniques, such as the use of slow speed legs, appear advantageous and should be further developed. The advantages of using plastic buckets to reduce the chance of sparks should be evaluated, along with the possible disadvantages associated with the addition of flammable materials, the possibility of static charge build-up on plastic buckets, and the possibility of health hazards from the burning of plastic materials. The advantages and disadvantages of PVC versus rubber belt material should be evaluated. Investigation of internal dust levels with respect to the location, configuration, and capacity of the dust-collection system would also be valuable. Other aspects of bucket elevators including basic design, reliability, and maintainability should be investigated from a system safety standpoint. The possibility of removing the suspended dust should be considered.

The conveyer worm

The cradles of the conveyer worm are made in most cases from wood, with rectangular forms, the blades are mobile in the majority of cases, and the diameter doesn't exceed 180…200 mm^2 [5].

The oscillatory tubes transport

In mills which manufacture the grific flour, instead of the conveyer worm it is preferable to use oscillatory tubes transport in order not to produce crumbliness and modification of products' granulation.

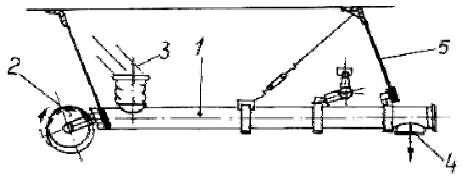

Fig. 4. *Oscillatory tubes conveyer* [4]

An oscillatory conveyer (Figure 4) is composed in principle of tube 1, the actuator mechanism 2, the charging hole 3, the outlet 4 and the oscillatory support 5 [4].

The transported products are put in motion by the movement of the tube. On the first movement of the tube the products go through at the same distance and then, by means of inertia, the products are raised, and the tube is withdrawn. At the next movement of the tube, in the first direction of the motions, the products get a new impulse through the continuous back and forth motion of the tube, the products moving continuously until reaching the outlet and leaving the equipment.

As it can be seen in Figure 4, the tube is hinged up on oscillatory supports, inclined vertically by an angle of 15…20° in order for the oscillation to be performed on an inclined direction with the same angle in relation to the horizontal line. The support must have a high degree of elasticity, in order not to be deteriorated. Usually band steels or beech bars are used, such as the ones in plane sifting [4].

2.3. Pneumatic Transport in Cereals Mills

The conveying of intermediary products obtained from the milling process with the help of air flow is called *pneumatic transport*. The pneumatic transport of products obtained from the milling process gradually supplant for transport with bucket-type elevators and helical conveyers. Pneumatic transport proved to be the most efficient conveyance method for this product category. Among its main advantages the following can be enumerated: the transport, the cooling of the machines, the products as well as the dusting are achieved simultaneously; they intensify the production of sift; lessen the danger of fire; grow the space of circulation; improve the state of products and of installations; lessen the danger of injuring workers; the use of pressure filters triggers the equilibrium of the air inside the building, and during winter the superior mill floors don't need heating [6].

To perform transport in optimal conditions the products need to abide by certain conditions:

- for each line products must be close to the size and specific mass;
- the particles must have approximately the same humidity.

In most cases a pneumatic transport installation consists of the following components: the product receiver, centrifugal air separator, air lock, transportation lines, air main, pressure fan and air strainer.

The consumed energy, in the case of pneumatic transport, is strictly connected to the fan's required power, which creates the necessary air flow for the realization of cereals' transportation through the absorption and lifting through pipelines.

Due to the fact that most milling factories are endowed with pneumatic transport installations, in order for them to be operated certain rules must be respected. The installation adjustment for no-load and in load operation, which is done through the opening of the sliding dampers fan, for the necessary air flow installations has to be performed.

3. Hygienic - Sanitary and PSI Norms in Cereal Mills

From the category of norms and specific rules of milling industry we can mention the sanitary hygiene rules and those of environment pollution, a particular case of protection being the defense against explosions.

3.1. Hygienic Rules in Cereals Mills

The procedures of general hygiene are established by the elaboration of a characteristic program of hygiene and which will refer to: the ground and the location units (the location of alimentary units which must be done as far away as possible from the strong polluted places, the external appearance of buildings; the improvement of the interior aspect of factory, the water supplying of the factory, equipments and technological equipments; transport, the food products; the hygiene of staff and their sanitary-hygienic instruction; the cleaning operations, washing and disinfection become compulsory, distinctly components and organic incorporated within a manufacture unit [2].

3.2. The Garbage Removal

The garbage removal (solid waste with a high potential of physical, chemical and bacteriological contamination of foods, as well as through direct or indirect contact passing through the working surfaces, on tools, equipments, and from the hands of workers on food).

The collection and the removal garbage, is done in vessels with lid which is opened with a pedal, which are lined inside with

tight plastic bags. These are thrown away together with garbage, and the vessels are washed and are disinfected after depletion.

3.3. The Properly Washing

This operation is specific submissive surfaces of the cleanness (for difficult of access places is used the hose with warm water with terminal head narrowed, as good as a feast of long and easy of handled; for demountable equipments is disjointed all the innards components and is washed with different all attention the dishevelment's in which it can remain dirt; For spaces of storage and pulverous equipments - how is the case of the industry of the bakery and milling - don't is used the washing with water but the aspiration of the dusts and erase damp).

3.4. Antiexplosive Protected Rules in the Cereals Mills

Because the milling industry is one of the most exhibited sub industry of food industry to the production of the blasts, this is due to respects the rules considering the of a prevention incidents of this kinds.

Among these rules are enumerated:

- The leakage prevention of dusts from equipments through a construction machines and tight fittings, as well as the compulsory endowment every machines can generate the dusts with systems aspiratory of the dust;
- The realization of tight equipments, operation in depression warned the elimination of the dust outside their;
- The isolation of packing places in the shape of boxes, and if this isn't feasibly, the installation of chimney hoods in right the jobs of thing;
- The avoiding stockade of the bags with flour in the rooms of production, in chief in one with rolls and site;
- Maintain of a exemplary cleanness through the permanent evacuation of the dust from floors, walls and equipments, on the measure produce this;
- The projection constructions of such the nature that in rooms to don't exists prominent, asperities and pillars, witch favorites the deposit of dust;
- The avoiding of the use of the water in the case of appearing of a little fires, warned the formation of clouds of dusts. The water can used only when the dust is deposited in film, preferred the pulverization from ceiling and the use of fittings type Sprinkler;
- Open the window panes, but matinees closed door, windows from the stairwell and elevator warned the propagation of the fire through these places, in whole room.

To remark that explosion of the mixed air and dust have 2-3 stages. Initially triggers which outbreak initiation the second a blast much more and after short time appears the third blast, all accompanist of a burning.

In take bake of the first tow blasts the burning is in progress quick the fire propagated in direction of the blends of dusts, the flames walk below the effect of the shock waves ale the blasts. The temperature of about 500 ˚C favors spread of front's flames.

The destructive effect of the blasts demonstrated as much through the shock wave, quotient and through heat developed, carry drives to apparition of fires. The phenomena are with noises of different intensities depending on the volume, fineness and concentration of the dust.

The fires from mills propagated with big speeds through openings of doors, gaps between rooms and the planes, arriving apace feather to roof, through the stairwell.

The fires generate before apparition of the blasts are attribute of not open flames. These are still more dangerous as the sources of blast, because diffuse the big amounts of energy and persist much more

in average explosive than the sparks, the flames challenged on path electrical or of to sources of the nature the mechanics. In style of exploitation normal of the equipments and a fitting, the open flame appears in mills, and they are ascribable exclusive of his negligent perturbations.

The sources most fervently of generation of the blasts represent them the abstracted heats through the friction bearing to the idle running of the roll mill.

To these added the sparks generate by a included metallic bodies between steam rollers. All to the roll mill they pointed out frequent phenomena of generation of static electricity, carry through the sparks produced the by-paths fowled of fires and blasts.

A frequent path of generation and quick propagation of the blasts, with the concomitant of an activation fires is constitute by the pneumatic transport fittings of the flour. To this is added the ventilation installations.

At the metallic bucket conveyers deteriorate or unbind by impact with other parts of the equipment generating which sparks drive to the ignition, respectively to the blast of inland dust of the equipment, even to concentration of 4000 g/m^3.

4. Conclusion

• The design of mills for grain milling must consider the internal conveying system of raw materials and products from and to various technological installations, so that, simultaneously with the assurance of a continuous working process, the environmental pollution and the dangers of explosions and fires should be avoided.

• The most common internal conveying systems are the gravitational, mechanical and pneumatic ones as well as combinations of the three conveyers. Each of the above-mentioned systems presents advantages and disadvantages that recommend them to be used in specific situations.

• The internal transport in the milling industry is mostly realized with the help of pneumatic transport, which is characterized by high flexibility and relative simplicity.

• The milling industry is always exposed to explosions and fires because of the dust released during grain milling. To avoid unpleasant situations it is recommended to maintain strict hygienic and sanitary conditions, which are broadly presented in the paper.

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