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Performance Enhancing of Transporting Grains from a Silo to a Mill by Using Transporting Tubes's

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Abstract--- This study investigated milling performance under various conditions to address the rapid corrosion of pipes, a problem arising from the local unavailability of abrasion-resistant metal. Given the high cost of importing suitable materials, the study focused on the common practice of using reinforced stainless steel alloy pipes as a countermeasure. A combined theoretical and practical analysis was conducted, calculating grain flow over time using operational data from a mill. Furthermore, the research highlights a critical challenge in data collection: the yield monitor's mass flow sensor is highly susceptible to the harvester's mechanical vibrations. These vibrations introduce significant noise and measurement error, compromising data accuracy. Therefore, the study concludes that effective vibration dampening is essential not only for the pipes' structural integrity but also for ensuring the reliability of the yield data crucial for precision agriculture.
Keywords: transporting tube's, wheat flow, transporting grains

Introduction

The flour mill is regarded as one of the most significant food factories since it creates flour, which is a staple food item consumed by a large percentage of the global population.as show in figure (1) the grain flow balancer device is one of the machines and pieces of equipment used in the mill to make flour. It is typically placed beneath the silos for raw and moisturized wheat and is used to measure the amount of grain that flows out of each silo and to calculate the cleaning and moistening sections' capacities.Receiving and storing wheat grains, which is done in several steel or reinforced concrete silos, is the most crucial step before the milling process starts.[1] The primary cleaning department's cleaning system transports wheat grains to the cleaning section. One popular mechanical handling tool for moving things from one place to another is a conveyor system. When moving large or heavy objects, conveyors are especially helpful. In the Conveyor systems are widely used in the grain handling business, including the packaging sector, because they can move various kinds of coarse grains fast and effectively. Conveyor systems come in a range of designs that can be employed to meet the various requirements of various industries. Additionally, there are overhead and floor chain conveyors.[3] An I-beam, a drag chain, a power trolley, a free trolley, and a closed track make up a chain conveyor. Energy and conveyor system utilization in the grain handling sector [4]. Because of their many

Advantages, belt conveyor systems are widely utilized in a variety of industries. Materials can be safely moved from one level to another using the conveyor. Performing these levels by hand is costly and time-consuming. They are safer than forklifts and other material handling equipment, and they can be mounted practically anywhere. They are capable of moving loads of any weight, size, or shape [5] as show in figure (2). Numerous cutting-edge safety measures also aid in preventing mishaps. The transmission system can be operated in a variety of ways to suit individual needs, such as mechanical, hydraulic, and completely automated systems. [6]. which has various machines and equipment spread over its several floors. Installation problems arise since the pipes are thick (6 mm) and have high hardness and a diameter of 25-30 cm, which makes it difficult to shape and direct them according to demand, in addition to the difficulty of installing traps and curves. As for the slopes, the grain transport pipes must have a slope ranging between 30 and 45 degrees to ensure easy movement of grains at high capacities such as 100 tons/hour. In the case of low construction, it is difficult to obtain this slope. As for the work problems, there is the problem of pipe corrosiondue to the passage of grains inside them, which leads to holes in the pipes, and thus the grains are scattered outside the pipes.[7] The second problem is that the material from which the pipes are made is solid iron, and with the movement of grains inside the pipe, it leads to the generation of stable electrical charges (static), which, if not discharged to the ground, may lead to an electric spark, and with the presence of straw and dust, it may lead to a dust explosion, as happened in the Dora silo affiliated with the General Company for Grain Trade in the year 2004-2005. There are also problems of blockages occurring inside the pipes due to the presence of protrusions. Inside the pipes, where impurities, threads, wires, etc., get stuck, it is difficult to open these blockages due to the lack of maintenance hole.

Figure (1) Distribution Assembly and Motorized Valve System

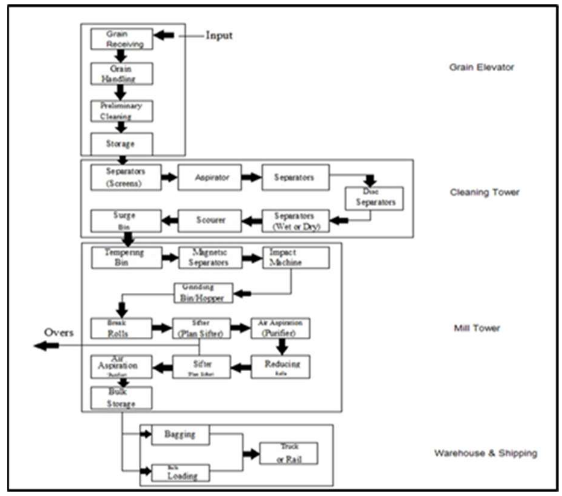


Figure (2) Flour milling process diagram [5]

1. EXPERIMENTAL PART

The Clamps are used to join the pipes together. As show in figure (3) there are rubber-lined clamps to stop dust from spreading or metal clamps for regular connections. For vertical pipes, flanges and screws are used to join the pipes so they can support large weights. Gravity equipment for grain, sometimes referred to as grain flow, is a transport system made up of sectors, separators with manual or electric drive, and grain lines, based on the grain washing facilities' and elevators' technical schemes. Grain and other bulk goods are intended to be moved by gravity under their weight. The reason this equipment is dubbed gravity is because the inertial force causes the conveyedcargo to accelerate in horizontal parts, while the pipes' inclination causes it to "flow down" without any further external impact.The entire conveyor system of the elevator, including bucket elevators, conveyors, and grain bins (silos), grain dryers, separators, and dump pits, is composed of auxiliary equipment known as grain flow. Without a grain pipeline infrastructure, an elevator could not function. Grain pipelines are typically made and developed for each elevator based on a specific project. The primary component of gravity transport.

The gravity pipe, is available in three cross-sectional types

- The most typical round portion
- The Square Area
- Rectangular portion (which may have a detachable bottom.

Figure (3) Ground-Level View of the Flow Monitoring Zone

Choice of gravity pipes:

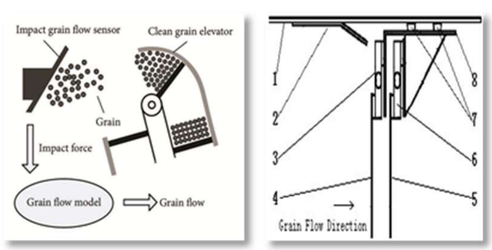
Gravity pipes, which are made to function in every region of the elevator world, are essential for the effective operation and communication of long-term pile handling equipment. In addition to a variety of other components that enhance system administration, the pipes can be further coated with polymer powder or Therefore, the circular pipe for gravity is gently revolved on its axis. To ensure that the corrosion happens evenly on various areas of the grain walls, thereby reducing the corrosion of the bottom wall. The pipe will be able to prolong its service life, but it still needs to be replaced after multiple love spells. There are some disadvantages to the circular line flow. The truth is that round pipes that are costly and extremely corrosive and made for heavy labor are utilized less frequently. Extras because they are more expensive than rectangular ones, rounded-edged ones are only utilized at junctions with adapters, etc. Square or rectangular drain lines are the most widely used since the side walls are., particularly the bottom, wear out less than round ones, and they are polyurethane paint to increase their dependability. A basic law of permissibility, which can be applied to any portion, permits the writing of texts to flow freely across challenging sections. Therefore, the most discreet transactions are made, and premium materials are chosen for their proper manufacturing even during the development stage of systems like this construction. At the moment, gravity bars of a section or cross-section are used; as a result, you will need to pay close attention to this when selecting the appropriate product. You must also buy the necessary protocol for the vehicle in order to obtain the necessary slope from you for the free transportation of raw materials. Special flanges, which might be square or round, are used to attach the grain lines to a rigid unit. The flap valve influences the grain flow's direction, The air drive can be created manually or electrically, and the wires can be used to construct one-sided or two-sided models. According to basic guidelines for a certain project, it is required to determine how many unneeded pipes entered the group from it and where they are located. Grain storage facilities and feed mills can use three-wire lines since they offer dependable self-driving electric motors. The chemistry for steel is round-grain pipes or round-grain pipes (notice whether you have round-grain pipes or round-grain pipes). The bottom of round-grain pipes is nearly always prone to corrosion (the corrosion rate in affordable materials can be 13%). Because of this, round-grain pipes will require less steel to produce with an equal flow capacity, which will result in a reduced cost. It turns out that corrosion affects practically the whole bottom of a round pipe. Therefore, the circular pipe for gravity is gently revolved on its axis. To ensure that the corrosion happens evenly on various areas of the grain walls, thereby reducing the corrosion of the bottom wall. The pipe will be able to prolong its service life, but it still needs to be replaced after multiple love spells. There are some disadvantages to the circular line flow. The truth is that round pipes that are costly and extremely corrosive and made for heavy labor are utilized less frequently. Extras because they are more expensive than rectangular ones, rounded-edged ones are only utilized at junctions with adapters, etc. Square or rectangular drain lines are the most widely used since the side walls are., particularly the bottom, wear out less than round ones, and they are easier to install and maintain. Additionally, these devices can be used to connect and swap out distribution and adjustment devices. Rectangular-section pipes are often preferred for lines with high output. The square and rectangular pipes can also be turned around their axis to increase their service life. They take more time and are more difficult. The benefit of granulators with a detachable bottom is that the rectangular grain's side walls and top roof hardly ever wear out. Additionally, the bottom may be replaced multiple times, allowing for significant cost savings by removing the need to replace the entire pipe. Rectangular open gravity is a viable option, but because of the massive amount of dust that is produced, it is rarely utilized for grain transportation.

Throughput of grain lines:

It should be kept in mind while developing gravity systems that elevator and conveyor performance shouldn't be constrained by the gravity flow capacity. In order to achieve this, gravity flows in a specific area must be appropriately chosen and positioned at a specific angle to allow grains of different kinds of crops to freely flow through it rather than hang in it, which lowers the elevator's overall productivity. But increasing the speed at which grain is transported by gravity can lead to damage (breaking), a decline in the grain material's quality, and more wear on the grain pipeline's components the lowest grain inclination angle. The ideal angle is between 38 and 45 degrees, while the gravity line is 36 degrees. Because moist, viscous, sticky goods always move more slowly and with difficulty by gravity, it should be noted that the angle of inclination of gravity for wet grain or grain waste should be steeper than for dry grain. As a result, the cross-sectional area and angle of inclination of gravity pipes must be chosen while considering the potential product types, the level of grain mass contamination, and fluctuating humidity. Grain pipeline theoretical throughput, t/h, and grain wire diameter (at a 36-degree gravity's angle of inclination with respect to the horizon). Grain pipelines' estimated theoretical throughput (at an angle of inclination of gravity to the horizon of 36 degrees), t/h as seen in table (1) below:

Diameter of Grain Wire (mm)	Estimated Theoretical Throughput (t/h)
200	50
250	100
300	175
350	250
400	350
450	500

Table (1): Grain pipelines diameter prosperity



(A) **(B)**

Figure (4) (A) The impact grain flow sensor's work schematic (B) Diagram of a dual parallel beam-based grain flow sensor.

The dual parallel beam can be explained, as seen in the above diagram, where each number denotes a stage. As show in figure (4) Fix holder number one, flow-guide board number two, 3-Affected beam, Impacted handle number four, reference handle number five, reference beam number six, vibration absorber number seven, and triangle holder number eight.

Grain Flow Sensors

Given that since the early 1990s, grain flow monitors have been available for purchase Continuously measuring and documenting the crop production per unit area is the aim of a grain yield monitor.. Grain flow is frequently monitored using impact-based sensing. Centrifugal force turns the paddles 180 degrees, lifting the grain onto the paddles' clean grain silos and then ejecting it from them at the elevator's top. Until it hits an impact sensor is located across from the elevator for clean grain. The grain is put through a projectile motion. A strain gauge mounted load cell on the impact plate is used by the impact sensor to measure the grain mass. The grain In a Wheatstone bridge design, a strain gauge can be used to monitor the grain deflection from the impact plate, which results in deformation in the load cell's structural elements. The impact sensor experiences different pressures depending on the amount of grain flow; this modifies the electrical output signal from the sensor. The electrical signal is updated to account for variations in elevator speed and can be altered to match varying grain mass flow rates. After being deflected by the impact sensor, the grain is sent to the grain tank.The object dropped into the fountain auger after landing in its base. A camera is used in the volumetric flow sensing technique that was chosen to gauge the grain's velocity as it passes through the combine. The cross-sectional area of the grain must be understood to translate this velocity into the flow volume. Because the flow of grain through the combine is correlated with its cross-sectional area. Specific moment, this figure fluctuates Depending on the crop harvester. The stated grain velocity would vary depending on the volumetric flow rate and fill level in the tube if all of the Grain was fed through a 0.2 m (13 in.) tube as it passed through the combine.

$$V = \vec{v} * A = \vec{v} * \frac{\pi * D^2}{4}$$

Multiple velocity measurements have been made for various cavity areas and volumetric flow rate combinations [8]. On the other hand, there is a direct correlation between the volumetric flow rate of grain (V) and its velocity ($\vec{v}$) assuming the filled cavity area in a tube remains constant. If the grain velocity is constant throughout the cross-section, the connection is likewise linear. Known diameter (D) and area (A).

Results and Discussion

The figure (6) illustrates how grain flow and flow time vary over the course of several days; it was seen from the above that the grain flow at the the flow rate decreased from 11.5 kg h⁻¹ at 08:30 h to 10.0 kg h⁻¹ at 09:30 h, indicating an early-stage perturbation or inefficiency. Thereafter, a steady rise was recorded, culminating at 13.8 kg h⁻¹ by 13:40 h. The pattern suggests a system that required an initial stabilization period before achieving optimal throughput.

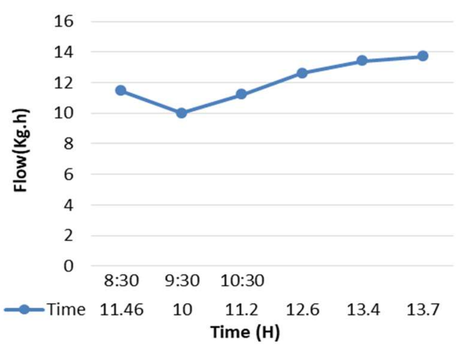


Figure (6) Flow-Rate Profile – Observation I

The figure (6) show Starting at 11.5 kg h⁻¹ (08:30 h), the flow rate climbed steadily, peaking at 13.7 kg h⁻¹ (11:00 h). A modest decline followed, with values reaching 12.6 kg h⁻¹ by 12:00 h. This behavior implies a short interval of peak operational efficiency, succeeded by a controlled reduction that may be attributable to load adjustments or thermal effects.

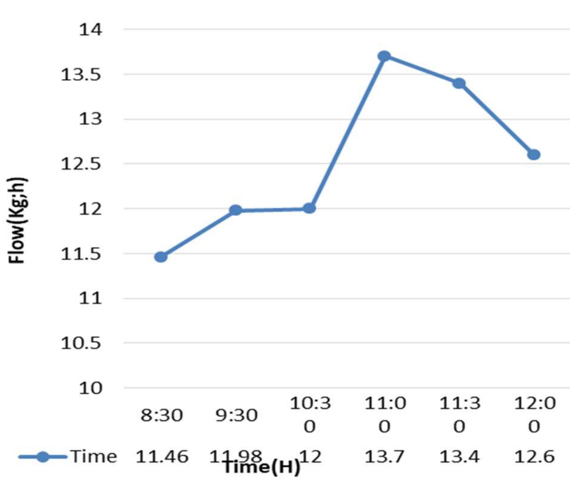


Figure (7) Flow-Rate Profile – Observation II

The figure (7) show the system began at a comparatively lower baseline of 10.0 kg h⁻¹ (08:30 h), rose to a plateau of 12.0 kg h⁻¹ between 09:30 h and 10:30 h, and reached a maximum of 13.8 kg h⁻¹ at 11:00 h. A slight downturn ensued, ending at 12.7 kg h⁻¹ (12:00 h).

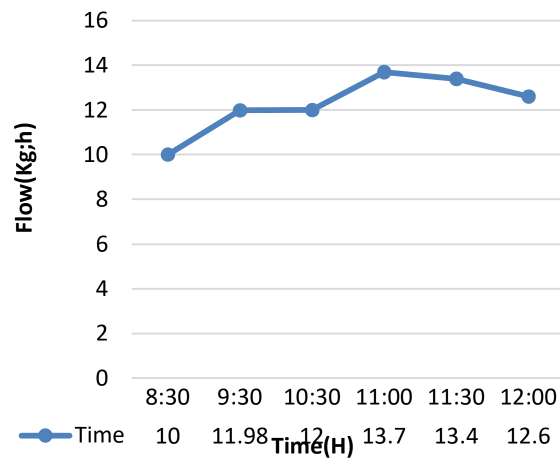


Figure (8) temporal Flow-Rate Profile – Observation III

The figure (8) show the data indicate consistent process improvement from a low starting condition, followed by minor post-peak attenuation.The analysis of the three observation periods reveals a clear pattern in flow rates, which generally rise during the morning, peaking around 11:00 AM before stabilizing or declining slightly. Observation I shows an initial decrease, likely due to start-up dynamics, before aligning with the upward trend of the other observations. Observation II reaches its peak the fastest and then experiences the sharpest decline, suggesting a potential transient overload or rapid environmental change. In contrast, Observation III, despite its lower initial flow, achieves the same peak, demonstrating the system's ability to adapt to less-than-optimal conditions.The subsequent mild decreases may reflect deliberate throughput modulation, rising fluid temperature, or incremental fouling effects. Future work should examine these hypotheses via temperature logging, pressure drop measurements, and statistical control charts to isolate causative factors and enhance sustained peak performance.

Conclusion

A vital tool in contemporary precision agriculture, the grain yield monitor measures and logs crop production per unit area in real time. It does this Using a grain flow sensor; determine the mass or volume of grain collected over a specified time period. Accurate yield mapping and analysis are then made possible by scaling this data according to the combine harvester's velocity and harvesting head width. Yield monitoring sensors are made to endure challenging farming settings, guaranteeing dependable operation in trying circumstances. For instance, the clean grain elevator's top sensors are subjected to constant mechanical vibrations. For these sensors to remain accurate and useful in spite of the difficult circumstances—such as vibration, dust, and fluctuating environmental factors—they must be strong and long-lasting. Increased vibrations can lead to mistakes in sensors for evaluating yield, particularly impact-based mass flow sensors. These sensors quantify the force that the grain applies when it hits an impact plate using parallel beam load cells. Due to their intrinsic design, these sensors are susceptible to the harvester's mechanical vibrations, which may introduce noise or false signals and compromise measurement accuracy. In order to reduce these inaccuracies and guarantee accurate yield data, effective vibration dampening and strong signal processing are essential.

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تحسين أداء نقل الحبوب من الصومعة إلى المطحنة باستخدام أنابيب النقل

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الخلاصة – هدفت هذه الدراسة في أداء الطحن في ظل ظروف مختلفة لمعالجة التآكل السريع للأنابيب، وهي مشكلة ناجمة عن عدم توفر المعدن المقاوم للتآكل محليًا. ونظرًا لارتفاع تكلفة استيراد المواد المناسبة، ركزت الدراسة على الممارسة الشائعة المتمثلة في استخدام أنابيب سبائك الفولاذ المقاوم للصدأ المقوى كإجراء مضاد. وأُجري تحليل نظري وعملي مشترك، لحساب تدفق الحبوب بمرور الوقت باستخدام بيانات تشغيلية من مطحنة. علاوة على ذلك، يُسلط البحث الضوء على تحدٍ بالغ الأهمية في جمع البيانات: مستشعر تدفق الكتلة في جهاز مراقبة العائد شديد التأثر بالاهتزازات الميكانيكية للحصادة. تُحدث هذه الاهتزازات ضوضاء كبيرة وخطأ قياس، مما يُضعف دقة البيانات. لذلك، خلصت الدراسة إلى أن التخميد الفعال للاهتزازات ضروري ليس فقط لسلامة هيكل الأنابيب ولكن أيضًا لضمان موثوقية بيانات العائد الضرورية للزراعة الدقيقة.

الكلمات الرئيسية – أنابيب نقل، الرطوبة، جريان القمح، نقل الحبوب.