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Create an Automation Technique in the Food Powder Plant

Prof. Purvi D. Chauhan[1], Rushabh Hirenkumar Vora[2], Jaimin Pradipbhai Domadiya[3], Jashminkumar Bharatbhai Vaishnav [4]

[1]*Assistant Professor, Department of Production Engineering, Birla Vishwakarma Mahavidyalaya, Gujarat, India*
[2]*UG Scholar, Department of Production Engineering, Birla Vishwakarma Mahavidyalaya, Gujarat, India*
[3]*UG Scholar, Department of Production Engineering, Birla Vishwakarma Mahavidyalaya, Gujarat, India*
[4]*UG Scholar, Department of Production Engineering, Birla Vishwakarma Mahavidyalaya, Gujarat, India*

Abstract -*To meet specific requirements authors invent a design that creates a new era of packaging. Like many other inventions to answer a particular problem authors try a workload balancing algorithm. Architecture and hardware are run well as per requirements. Tolerance must be taken into count to best meet specific requirements.*

Key Words: Weight load cell, Roller conveyor, Semi-automatic machine, Packing solution.

1.INTRODUCTION

The authors are successfully designed powder weighing a filling machine that works on a semi-automatic automation system. As an improvement in the current situation powder filling machine allow to fill requires a number of fine particles once a necessary amount is filled powder off to sacks that hold on bag clamping device. The Roller conveyor works as a primary material handling device that helps to sacks point to the desire location.

1.1 literature review

Weight load cell:

Load cells have long been used to detect agitation as a force. They are very precise and effective sensors when correctly built and used. A load cell is constructed by attaching multiple strain gauges to an elastic member (with a highly repeatable deflection pattern).

This is the simplest way to calculate the basic workload.

The formula:

$$basic\ work\ load = function * time(required\ to\ function) * frequency$$

How does loadcell work?

A load cell is constructed by attaching a variety of strain gauges to an elastic member (with a highly repeatable deflection pattern).

There are four strain gauges bonded to the upper and lower surfaces of the load cell seen in the above diagram.

- When a load is acting to the body of a resistive load cell, as seen above, the elastic member deflects and produces a pressure at the indicated positions due to the applied stress. As a result, two of the strain gauges are compressed, while the other two are tensioned.

During a calculation, the weight acts on the metal spring part of the load cell, causing elastic deformation.

A strain gauge (SG) mounted on the spring part converts this strain (positive or negative) into an electrical signal. A bending beam with a strain gauge is the most basic kind of load cell.

The Wheatstone bridge circuit is used to transform this transition in strain/resistance into a voltage that is proportional to the load.

Roller conveyor:

Roller conveyor systems are the most common type of conveyor system used in industry. It is commonly used for material conveyance due to its basic operating principle and low cost. One of the most common types of conveyor systems is the belt conveyor system.

Roller conveyors are a type of conveyor belt that uses rollers, which are equally spaced spinning cylinders, to allow items to skate across its surface. They transport material from one location to another, often using gravity or small motors. The transported material must have a rigid riding surface backed by at least three rollers. They are suitable for aggregation applications, and the rollers can eliminate commodity inertia at higher speeds, making them effective conveyors following high-speed sorting machinery.

Types of roller conveyor:

- Gravity roller conveyor
- Chain-driven roller conveyor
- Line shaft roller conveyor
- Zero pressure roller conveyor

2. WEIGHING AND FILLING MACHINE

An innovative solution of packaging weighing machine has four main components that are listed below:

1. Reserve hopper
2. Weighing hopper

3. Bag clamp device
4. Roller conveyor

Overall, the design is simple to understand the opening of grain form of powder is connected with reserve hopper that collects and store powder as reserve stock. Reserve hopper release powder by controlling an automatic signal. Furthermore, the powder is going to the weighing hopper sense a load with help of an electronic device named a load cell. When filling match with required accuracy electro signals give a commends to gate and gate is open towards sacks. An empty sack holds on a bag clamp device that will release a bag after the bag is filled with powder. Then sacks straight to the roller conveyor and conveyor transfer sacks at the desire location.

2.1 Working principle

The machine works weight balancing principle of a load cell. Weighing hopper designed to hold a load on a point to measure the required weight of powder. To adjust compression force weighing hopper provided with sliding contact. In the end, we provide a stiffener that attaches with a compression load cell. Compression load cell measures pushing force along with a single axis. A Digital system called Arduino receives load cell signals and operates a gating system by DC motor.

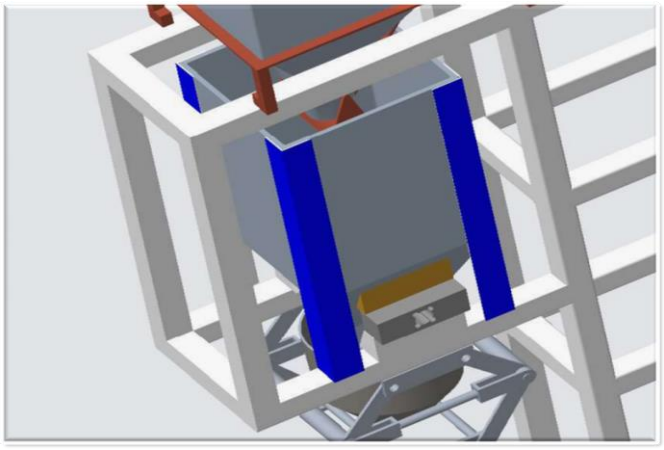

Fig. 1 Schematic view

3. COSTING

In machine, manufacturing cost various cot for manufacturing are checked i.e., the material used in manufacturing machine, labor cost, machining cost done on the machine and material handling and packaging. The below table shows the overall cost of the manufacturing machine.

3.1.1 Manufacturing cost

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Table -1: Machine manufacturing cost

No.	Description.	Type	Price	Cost.	Total
1	Material Cost (SS316)	SS316	250/kg	250*450kg + 10,000	1,22,500
		Control system	10,000		
2	Labor cost	-	-	70,800	70,800
3	Machining cost	Grinding & cutting	275	275*3	825
		Welding	600	24*3*600	43,200
		Drilling	200	200*14	2,800
		punching	800	800*0.5	400
		Shearing	600	600*4	2,400
4	Material handling & packing	Crane, truck, packing material	600+1000+3500	5,100	5,100
Total machine manufacturing cost					**2,48,025**

3.2 Cost comparison between manual operation and automation

As per data obtained from the industry, the wages provided to workers per day is nearly 300 RS. The packaging plant of that industry operates one Vibratory Machine and packaging. Out of which 2 workers are dedicated to milk powder production and filling of sacks. 3 workers are required for sealing and dispatching. If we assume the plant is operated for 365 days, the cost for this manual operation comes to 5,47,500 RS. If a proposed design is implemented with certain modifications, then it would help to save a large amount of money for the industry. The detailed cost estimation for the proposed design is shown below.

The Implementation cost of a proposed design for the automatic weighing and filling system is nearly Rs. 2,48,025. The cost of components is considered using several online price portals. The actual cost may differ by 30-50% respectively based on the industry need.

No.	Description	Price	Amount	Total
1	Electricity cost	7.07/unit	5000*7.07	35,350
2	M/C deprecation cost	17,000 per year	17000	17,000
3	Labor hrs.	600 a day	301*600	1,80,600
4	Maintenance	2000 a year	2000	2000
Yearly maintenance cost				**2,34,950**

Table 2 Comparison between manual work and automation

3.3 Return of Investment:

Return on Investment (ROI) is a performance amount used to estimate the efficacy of a machine or compare the efficiency of various investments. ROI tries to directly measure the amount of return on a particular investment, comparative to the investment's cost.

To calculate ROI, the benefit (or return) of an investment is distributed by the cost of the investment. The result is indicated as a percentage or a ratio.

The return-on-investment formula is as follows:

$$\text{Return on investment} = \frac{current\ value\ of\ investmrnt - cost\ of\ investment}{cost\ of\ investment}$$

"Current Value of Investment" refers to the profits gained from the sale of the investment of interest. Because ROI is measured in percentage, it can be easily related with returns from other investments, allowing one to calculate a variety of types of investments against one another.

$$\textbf{Return on Investment (In years)} = \frac{I}{N \times S}$$

$$\textbf{Return on Investment (In years)} = \frac{2,48,025}{3 \times 1,09,500}$$

Return on Investment (In years) = 0.755 Years.

So, an investment could be obtained in **9 months.**

Where, I= Total investment in rupees
N= Number of Workers removed
S= Salary of Worker in that month

4. CONCLUSIONS

To conclude, the reasons behind this study were to overcome manpower in the hazardous condition in industry. Secondly, hygiene is the most important thing when it comes to the food industry built a semi-automatic machine can maintain hygiene properly and provides touch-free contact from humans. Finally, weighing and filling machine can give more productivity than manual work. It will give more productivity than the current situation.

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BIOGRAPHIES

(Prof. Purvi D. Chauhan)
A highly experienced faculty of BVM Engineering College, Gujarat, India, with a teaching experience of over 15 years. Has taught a variety of subjects at UG/PG level and wrote 35 projects.

(Rushabh Hirenkumar Vora)
UG Scholar, Department of Production Engineering, Birla Vishwakarma Mahavidyalaya, Gujarat, India

(Jaimin Pradipbhai Domadiya)
UG Scholar, Department of Production Engineering, Birla Vishwakarma Mahavidyalaya, Gujarat, India

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UG Scholar, Department of Production Engineering, Birla Vishwakarma Mahavidyalaya, Gujarat, India