DESIGN AND FABRICATION OF MATERIAL HANDLING EQUIPMENT

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Abstract*—Applications of conveyor are increasing day by day in manufacturing industries due to its flexibility and accuracy in material handling. Industries like packaging and food processing uses conveyor for the rapid production and less power utilization in material handling. In general only a single type of object like boxes or trays are monitored and controlled on a single conveyor in pharmaceuticals industries. The trays on the conveyor are to be stopped at the required station and material filled in trays on conveyor. This can be done using the induction type proximity sensors and load sensors placed at different positions in the system. In given system we can do design and fabrication of gravity roller conveyor used in the packaging and transportation system in pharmaceutical industries. The number of trays /boxes to be filled can be set in the indexing sequence using pneumatic stopping arrangements and proximity sensors. Trays/boxes after reaching desired output the system will be automatically stopped/start flow of boxes on conveyor. The output packaging fixed can easily altered between processes.

Keywords — Gravity roller, pneumatic system, limit switch, cycle time.

I. INTRODUCTION

A conveyor system is a common piece of material handling equipment that moves material from one location to another. Conveyor systems are commonly used in many industries including the automotive, agriculture, computer, electronics, food processing, aerospace, pharmaceuticals, chemical, bottling and canning, print finishing and packaging. Although a wide variety of material can be conveyed, some of the most common include food items such as beans and nuts, bottles and cans, automotive component, scrap metal, pills and powders, wood and furniture and grain and animal feed. Many factors are important in the accurate selection of conveyor system. It is important to know how the conveyor system will be used beforehand. Gravity conveyors provides one of the most versatile & economical means of moving product gravity conveyor can quickly move large quantities of items in virtually any direction with a minimum of efforts & expense. Gravity or non-powered, roller conveyors are ideal for moving most unit loads which have a firm, flat bottoms surface. They can be use in both permanent & portable applications. In existing design, the weight of roller & C-Channel (Frame) is more, so there is scope of weight reduction & material optimization of this component.

II. PROBLEM STATEMENT

(1) Process based: The gravity roller conveyor assembly normally involves the use of channels, rollers and shaft that are heavy by virtue of their structure and material use as steel.

(2) Operator based: There is only belt conveyor having indexing operating by using electronics system but it consumes continuous power. To overcome this problem we can use gravity roller conveyor with pneumatic indexing system.

III. DESIGN AND CALCULATIONS

From Clavarino's equation for closed end cylinder at both ends. For ductile material used to determine the thickness of cylinder.

$$t = ri\left[\sqrt{\frac{\sigma t + (1-2\mu)P}{\sigma t - (1+\mu)P}} - 1\right]$$

Assume, P = 3 bar
Using this pressure, we calculate thickness, t = 0.5mm.
From calculated thickness, we select the pneumatic cylinder. By using standard table is given below,

MODEL No.	PISTON DIA(mm)	A	ØB	ØC	D P.C.D.	E	EE B.S.P.	F	G	GA	H	J	JJ	KK	L	LL	M	N	O	V	W	ZB
AM 32	32	22	30	12	46	47	G1/8"	32.5	M6	16	27.5	14	4	M10 x 1.25	6	7	-	66	10	16	26	120
AM 40	40	24	35	16	53.7	53	G1/4"	38	M6	16	29	14.5	6	M12 x 1.25	6.5	8.5	-	76	13	18	30	135
AM 50	50	32	40	20	65.8	65	G1/4"	46.5	M8	17	30	15	7	M16 x 1.5	6.5	8.5	-	75	17	25	37	143
AM 63	63	32	45	20	80	75	G3/8"	56.5	M8	17	31	15.5	9	M16 x 1.5	7	8	4	89	17	24	37	158
AM 80	80	40	45	25	101.8	95	G3/8"	72	M10	18	35	17.5	11.5	M20 x 1.5	9	13.5	-	93	22	30	46	174
AM 100	100	40	55	25	126	115	G1/2"	89	M10	18	36	18	14	M20 x 1.5	10	14.5	4	102	22	32	51	189
V 125	125	54	60	32	155.6	140	G1/2"	110	M12	22	40	17	18	M27 x 2	19	15	10	126	28	40	65	225
V 160	160	72	65	45	198	180	G3/4"	140	M16	22	50	22	22	M36 x 2	20	19	10	136	41	50	80	260
V 200	200	72	75	45	247.5	220	G3/4"	175	M16	22	54	26	22	M36 x 2	20	19	12	128	41	65	95	275

Figure 1: Standards provided by Phoenix pneumatics

Selected dimensions, from fig.1 as standard pneumatic cylinder with given specifications is available with the manufacturer Phoenix pneumatics.

Pneumatic Cylinder Specification:
Piston Diameter = 40mm.
Stroke Diameter =50mm.
Piston Rod Diameter =12mm.

IV. PROCESS SHEETS

A) Part Name:Supporting frame
Part size: 300mm X 1200mm X 1200mm.
Part Quantity: 1
Part Weight: 12kg
Part Material: M.S

Table 1: Process sheet for supporting frame

Sr. No	Operation	Machine	Tool	Time
1	Cutting the material as per our required size	Saw machine	Saw machine blade	130 min
2	Drilling the hole for height adjustment	Drilling machine	Drilling Bit	75 min
3	Welding the Frame	Welding machine	Arc Welding torch	150 min
4	Grinding the Frame	Grinding machine	Grinding machine	20 min

B) Part Name: Roller conveyor frame
Part size: 1200mm X 300mm X 25mm.
Part Quantity: 1
Part size: 6 kg
Part Material: M.S

Table 2: Process sheet for roller conveyor frame

Sr.No	Operation	Machine	Tool	Time
1	Cutting the material as per our required size	Saw machine	Saw machine blade	30 min
2	Drilling the hole for height roller fitting	Drilling machine	Drilling Bit	95 min
3	Welding the Frame	Welding machine	Arc Welding torch	45 min
4	Grinding the Frame	Grinding machine	Grinding machine	10 min

V. ADVANCEMENT

- Implementation of pneumatic interlocking system in place of conventional indexing type sensors in which push rod lever clamps is solution to eliminate the use of sensors and hence increase the productivity and reduce the operating cost of project. In order to install pneumatic interlocking, it is necessary to calculate pneumatic cylinder diameter that would be suitable for our system.
- Replacement of metal rod roller by nylon roller therefore the weight of the system is reduced achieving easy operating and handling of system is possible.

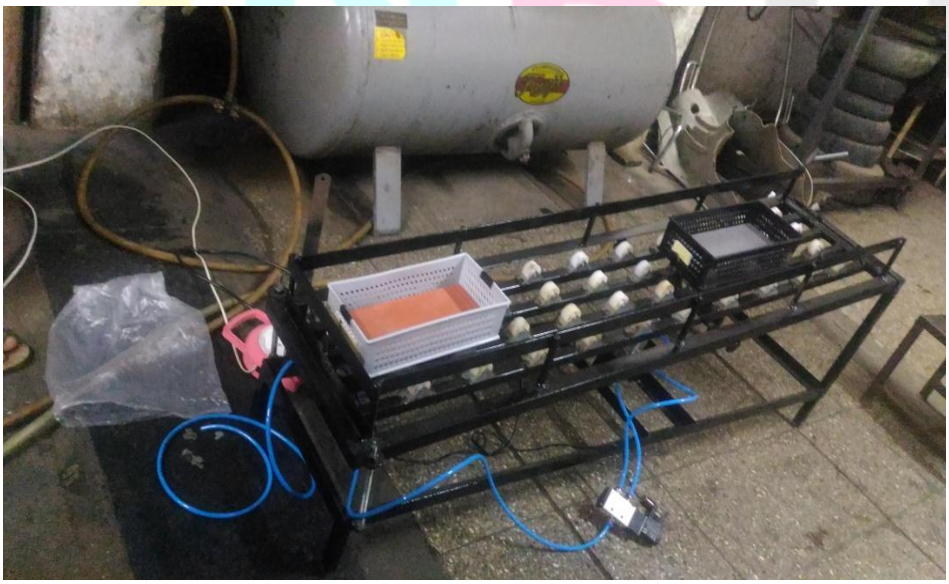

Figure 2: Final Manufactured system

VI. CYCLE TIME ANALYSIS

To understand the entire work flow, the cycle time analysis is carried out. Cycle time is the time requiredfor box to reach limit switch from starting point. Our Aim is to reduce this time to possible extent.

Table 3: Time Study

Sr.no	Distance	Time (sec)	Velocity(mm/sec)
1	1225	2.1	583.3
2	1225	1.87	655.08
3	1225	1.63	751.53
4	1225	1.25	980
5	1225	1.09	1123.85

VII. RESULT AND GRAPHS

1) Velocity Vs Angle of inclination (at no load)

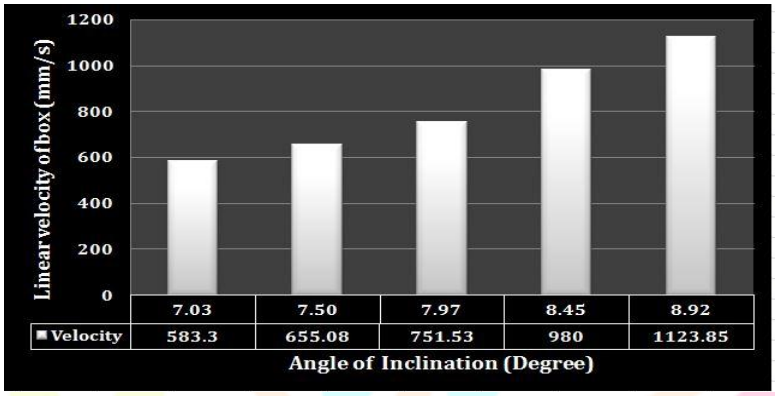

Figure 3: Graph of velocity Vs angle of Inclination

2) Velocity Vs Angle of inclination (at 500gm load)

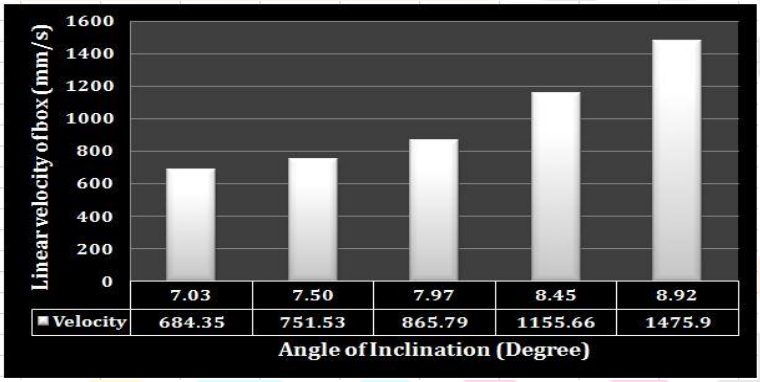

Figure 4: Graph of Velocity Vs angle of inclination (for 500gm load)

VIII. CONCLUSION

The aim of our project to design and fabricate a material handling conveyor system is achieved. In this paper an attempt is made for optimizing the weight of the gravity roller conveyor by using composite material i.e. Nylon for roller and mild steel for roller conveyor frame and increase productivity and reducing the overall manufacturing cost of the system.

ACKNOWELDGEMENT

The authors are grateful to the Management of Passion Automation & Engineering LLP for grantingus permission to carry out the work. The authors also thankful to our head of the department of mechanical engineering Prof. Saurabh Kerhalkar and our college project guide Prof. V.S Thete for their help in research assistance.

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