

“ENERGY PERFORMANCE IMPROVEMENT USING AUTOMATION AND CONTROL APPLICATION IN FILLING LINE OF PAINT INDUSTRY” A MODIFIED REVIEW

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Abstract : Energy efficiency and Energy conservation are the key focus area to fulfill the Energy demand. The world is shifting from conventional energy sources to non conventional energy sources but Energy production is not only the solution, along with this, it is equally important to pay more attention to the efficient usage of energy, In India many industries are running day and night which consume power & where management of every industries are striving to reduce electrical consumption which ultimately reduces running cost of the plant. In order to reduce the overall energy consumption of the running plant, it is discreet to focus on any subtle and crucial part of the plant where continuous energy consumption takes place and to give justice to this concept we need to consider any manufacturing or packaging industry where we can provide energy efficient solution and hence I have deliberately decided to do research on Paint packaging industry where packing line continuously runs & consumes energy for all shifts in a day. This research throws some light on energy efficient solution to paint packing line. Under this research existing paint filling station is studied and electrical consumption in every unit is noted, along with this construction and working of each equipment, PLC logic of each line has been studied thoroughly & It was observed that if we replace some conventional & complicated units and its logic with modern simplified unit, we will be able to save lots of energy that means we can redesign existing line in order to make it more energy efficient. Here we have tried to propose possible modification in existing type of lines which are running in plants by improving design which includes reduction in cost of manufacturing as well as cost of compressed air consumption ultimately reduction in cost of electricity without changing output efficiency of the line.

1. INTRODUCTION

Energy is one of the major part for the economic development of any country. In developing countries, the energy sector to be important as energy needs increasing continuously and required huge investments to fulfill energy demand. Coal and other fossil fuels which have taken million years to form, are going to deplete soon. We consumed more than 60% of all resources. It is very important we must adopt energy efficiency measures most of the energy comes from primary energy sources from nonrenewable and fossils sources e.g. coal and oil and these resources diminishing rapidly and will not be available for future generation. Energy conservation is achieved when growth of energy consumption are reduced. Promotion of energy efficiency will contribute in energy saving. Energy conservation and energy efficiency are separate, but related concept. Very simply, energy efficiency means using less energy to perform same function. In recent years due to the industrialization high energy consumption is observed and likely to increase further. There are many negative impacts seen on the environment due to fossil fuel, to overcome other problem associated with it many countries are changing its dependency from fossil fuels and shifted to Environment friendly alternatives of energy production. Some times in industries due to lack of awareness related to energy efficiency and energy conservation huge amount of power is wasted on daily basis[1]. Nevertheless, energy is an important issue all over the world, saving of energy is not considered on priority where mass production work takes place because practically, meeting of production goal at any cost is most important to fulfill demand of the product in market. In such packaging industries energy saving concept is completely engulfed in raise in demand of product in market and yearly target completion. Consequently, OEM's (Original Equipment Manufacturer) don't take initiative to redesign the existing machine model to make it more energy efficient in future due to the obligation of timely delivery of machine to the client, So here we have more scope to study, this area where continuous energy is consumed so we can work and analyze on the system and find alternate solution to save energy required for the system. To meet this requirement, I have purposely decided to study packaging line where I can give energy efficient and economical solution on the existing system without disturbing its final output. The paint filling line consist of feeder table, can orientor, print inspection, orientor conveyor intermediate feed table, reverse can detector, filler conveyor, volumetric filler, check weigher, lid despencer, lid press, rejector conveyor, accumulator table and PLC unit. The energy performance of the paint filling line can be improved through modification in mechanical design.

1.1 Structure of paint filling machines

Feeder table 1: It is a rotary type table operates on a 3 phase motor drive with 5 rpm speed and used to feed empty cans to the system.

Feeder table 2 : It is another rotary type table operates on 3phase motor drive with the speed of 50 rpm and used to feed empty containers to the system.

Can Orienter conveyor 1: It is a linear motion conveyor operates on 3phase motor drive with the speed of 18 m/min and used to convey cans from can feeder to intermediate table.

Can Orienter conveyor 2 : It is another linear motion conveyor operates on 3phase motor drive with speed of 18 m/min and used to convey cans from can feeder to intermediate table.

Can Orienter (Printing) with UJ Mark Detect Camera : This unit is used to rotate cans for printing manufacturing data i.e. price, date & address etc.

Print Check unit (2 Nos.) : It is nothing but a camera which is used to inspect printing accuracy while can is rotating in can orientor.

No Print Can Rejecter [Air Jet] with Collection Bag (2 Nos.) : This device is used to reject cans from line, if can is found without printing or wrong printing. Once can without printing detected in print check unit, it gives command to 'No print can rejecter' and it gets activated.

Intermediate Feed Table : It is a rotary type table operates on 3 phase motor drive with 50Hz frequency. This unit is used to feed cans from orienter conveyor to indexing conveyor.

Indexing Conveyor : This unit used to convey cans in steps at defined pitch. It is driven by servo motor for speed as well as accuracy. It contains 20 stations.

Reverse/Fallen Can Detector : This device used to identify the fallen can before filling. If any fallen can comes at this station it detects and indexing conveyor stops.

Volumetric Filler unit : There are two type of filling system 1. Weighmetric 2. volumetric in volumetric type filling material in sucked in syringe during suction stroke and deliver it into the container in compression stroke. Flow & quantity of material to be dispense is being control by cutoff valve operated by pneumatic cylinder

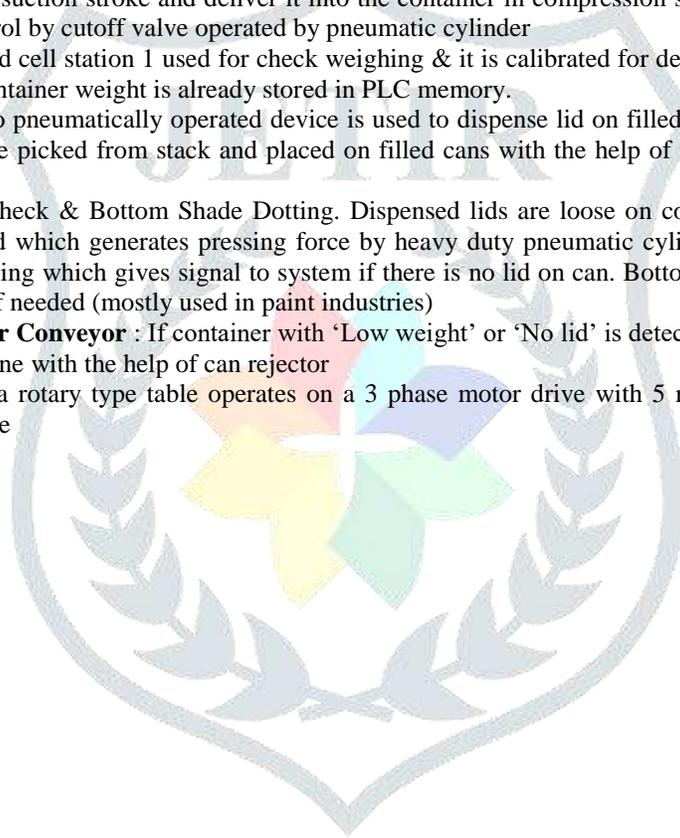
Check weigher : It is a load cell station 1 used for check weighing & it is calibrated for desired weight accuracy. It shows net weight of liquid whereas container weight is already stored in PLC memory.

Lid dispenser : This electro pneumatically operated device is used to dispense lid on filled cans. Lids are placed manually on lid stack holder then lids are picked from stack and placed on filled cans with the help of rotating arm consist of suction cup and pneumatic cylinder

Lid Press : with No Lid Check & Bottom Shade Dotting. Dispensed lids are loose on containers hence in order to press it against can lid press is used which generates pressing force by heavy duty pneumatic cylinder. No lid checking is operation done at the time of lid pressing which gives signal to system if there is no lid on can. Bottom shading is operation for printing shade dot at bottom of can if needed (mostly used in paint industries)

Can Rejecter with Rejecter Conveyor : If container with 'Low weight' or 'No lid' is detected then it is rejected automatically on rejector conveyor form line with the help of can rejector

Can Accumulator : It is a rotary type table operates on a 3 phase motor drive with 5 rpm speed and used to accumulate containers coming out of line



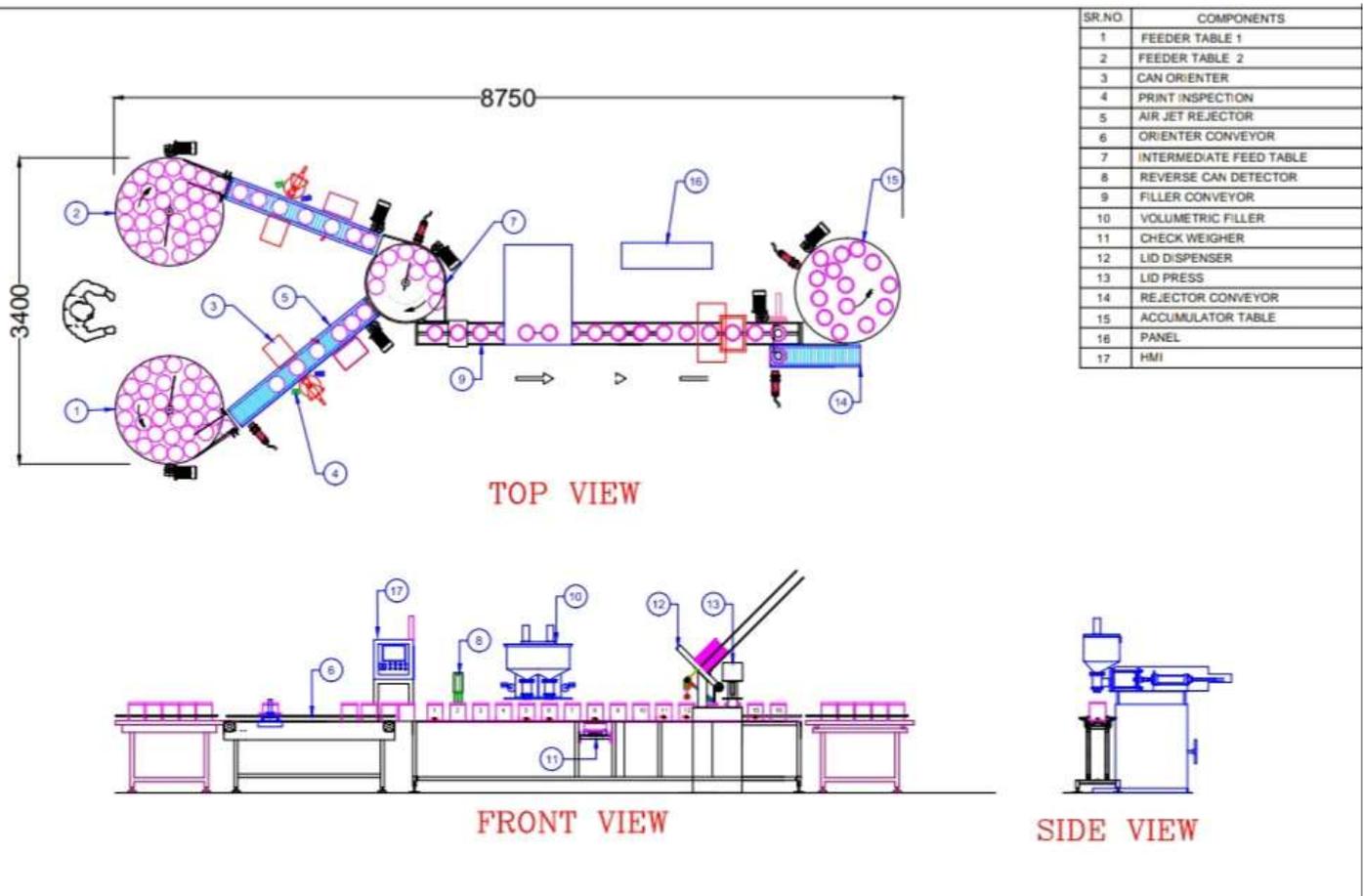


Fig 1.1 Paint filling line with volumetric filler unit

2. REASONS FOR WASTAGE OF ENERGY IN EXISTING PAINT FILLING STATION

1. Can feeder runs continuously if there is spillage occurs in the filling station.
2. On accumulation at intermediate feed can feeder does not stops
3. Orienter conveyor does not stop if there is spillage of can
4. Paint filling station doesn't stop in idle mode
5. Volumetric filling stations consume more power because of two cylinder arrangements.
6. Existing accumulator table is rotary which needs manual pick up for storage

3. LITERATURE REVIEW

Before going for the actual work, it is necessary to study work carried out in similar field from various researches across world. The literature review helps to decide to understand various aspects of the project and project outline. Some research papers, articles describe similar type of issue. In this chapter, summary of such papers and literature is published by various researcher is described. Bipin Mashilkar [2]. India in his research paper proposed, automated bottle liquid filling system. The machine available for such operations in market is highly priced. They have used microcontroller to control the automatic operation. Microcontroller is selected as controller because it is easier to attach with system. Fysikopoulos Apostolas and Papacharalampopoulos Alexios [3] in their research they explained, it is necessary to divide the study of energy efficiency into several different levels as shown in figure. According to them understanding the process provides the energy transformation that take place during manufacturing process. The appropriate selection of process parameters also matters the consumption of machine. Production planning plays significant role on the energy efficiency of the factory. From their research I got motivation that every steps in manufacturing must be thoroughly analyzed to optimize energy conservation. Chitra S. and Vijaya Raghvan [4] in their research, they explained that PLC is used in almost every aspects of industry to expand an enhance production. The paper is based on the systematic conveyor control programming by programmable logic controller using Omron software which is world's smallest PLC. Offers variety of expansion option and it is user friendly software. This research paper help me to thought related to various software available for development of PLC program.

C. Thanga Raj & S.P. Shrivastava [5] in their research, they throw light on energy efficiency optimization of three phase induction motor through optimal contract and design techniques. Optimal contract covered both the approaches namely loss model control and search control. Artificial intelligent technique such as fuzzy logic, genetic algorithm and evolutionary

programming simulated annealing in optimizing were also included in this paper which further helps me to know detail analysis of energy survey in equipment will be done then more power saving can be achieved.

Ivan muller & Renato Machado de Brito [6] explained in their research, the strain gauge which is a thin foil register, the primary sensing element. The strain gauge resistance changes according to the deformation of spring element. When stress is applied to conductors, there is variation in electrical resistance, they gave information about ring type of load cell & other load cell design. Their research helps to understand the concept of strain gauge and later on while selecting weighmetric units it was useful.

4. NEED OF REVIEW

By looking the effort of various researchers in automatic liquid filling line conclude that there is possibility of reducing the electrical consumption of paint filling line by using automation. After the literature survey i understand various automation techniques used in liquid filling line . The compressed air consumption is the main power consumption area have to be studied deeply. By the literature review it can be said that by automation and changes in Mechanical design electrical conservation can be achieved. The goal of present modified review paper is to understand the various methods to reduce electrical consumption in paint filling line.

5. METHOD FOR REDUCING ELECTRICAL CONSUMPTION & MANUFACTURING COST OF UNIT

In the paint filling line can feeders are running continuously so to avoid this sensors will be added at the orienter entry so that during idle time can feeder stops automatically. Instead of volumetric filler unit weigh metric filler unit will be used which will reduce the compressed air consumption ultimately reducing the electrical consumption. In below table both comparison of both units mentioned.

VOLUMETRIC MACHINE	WEIGHMENTRIC MACHINE
Filling done in volume basis	Filling done in weighing basis
Suction and compression operation used for filling	Gravitational force used for filling
Heavy duty pneumatic cylinder used for suction and compression	No cylinder required for gravity filling
Pneumatic cylinder used for top valve operation	Pneumatic cylinder used for valve operation
Does not require load cell for weighing	Load cell platform required
Complicated mechanism required for operation	Easy operation
Can be totally operated pneumatically	Electrical panel needed due to presence of load cell

6. CONCLUSION AND DISCUSSION

With the use of modified weigh metric system there is respective changes in PLC will be done after Giving appropriate logics which will stop the unnecessary movement of the paint filling line. By using above modifications will achieve 50% saving in Manufacturing cost and electrical consumption also will be reduce by 45%.

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