ABSTRACT: In this research paper the detail analysis of modified paint filling line is mentioned along with electrical consumption of each stations. Nowadays every industry is concern about the utility bills hence the paint filling lines should be made electric efficient during manufacturing stage only. This research includes solutions related to saving of electricity which is useful for every paint manufacturing industry those are using semi automatic machines for filling operation of paints. Many of the machines used in paint filling stations are supplied by the local vendors, and if the designers at vendor place forgot to take unwanted operation in account then it leads to wastage of electricity. In this research we have concentrated on those parameters which is ignored during the manufacturing of such machine. To refine our research, we visited to such companies those are suppliers of this kind of machines to the leading paint manufacturers, while discussing with the designers and engineers on shop floors who are involved during trial of such machines help us in innovating the energy efficient operation. This paper present scope to apply energy saving methods for paint filling machines so that overall consumption in manufacturing plant will reduce. With the help of continuous improvement & innovations, awareness towards understanding the concept of energy efficiency can full fill dreams of need of electricity in many parts of India.

KEYWORDS: programmable logic controller, paint filling lines, energy efficiency

I. INTRODUCTION

The paint manufacturing industry shown the consistent growth in the sector till date & with growing population & development in the nation there is tremendous opportunity lies in it. This paper include the result analysis of energy saving in filling line of paint industry. In this analysis various unwanted operations are studied and automation solution is provided for saving of electricity. During the study it was noticed, absence of feedback system in the line created the wastage of electricity in the line. This result analysis includes the detail energy consumption of each station of paint filling line. The operation of the filling of paint studied starting for entry of the empty can in the can feeder till the final packaging of the paints. Volumetric filler units are replaced with weighmetric fillers which results in huge energy saving. Sometimes customers may not knowing all the functions of the machine properly. In this case leading paint industry are the customers which are taking this lines during the plant set up but according to us its designer job to get the feedback of machine from the customer place & do the continuous improvement to make the design more efficient so that the paint line manufacturer can withstand in the competitive market and provide energy efficient line to the customers. This result analysis is a attempt of continuous improvements and innovations done to redesign the entire line & will make the paint filling line as Energy efficient.

1.1 working of paint filling machines & Modifications

The feeling line of paint consist of various stations which includes empty can feeder stations this can feeders are driven by motor. During inspection of paint filling line at manufacturer place I have noticed, if there is spillage of can occurs during the filling line there is no such machenasm available to stop the feeding of the can feeder and all cans are accumulated in the accumulator and rotating continuously which results in wastage of power. The can feeders are running on 3 phase motor drive. To overcome such drawback we added inductive sensors which are capable of sensing the excess accumulation of the can in the accumulator and it will give signal to the can feeder to stop the unnecessary movements. This line are controlled by programmable logic controller hence any if want to do any modification in the
system, we have to make necessary changes in the PLC. Before going to the accumulator cans are passing form the can orienter conveyor. This can orienter conveyor are running on 3 phase motor. The function of the can orienter conveyor is to detect the orientation of the cans properly for printing the necessary information in exact location. The can thus moves to the next station after printing towards the print detector camera which will check whether information such as price date and address are accurately printed or not. No print can rejector in the next station will detect can without printing. The printed can only allow in the next operations and all cans will reach in the intermediate table. The next operation is the paint filling operation which was earlier done by the volumetric filling but we modified this station with weighmetric station, which reduces the electrical consumption explained in details in the calculations below.

Fig 1.1 Paint filling Station

1.2 Weighmetric Liquid filler
1.3 Volumetric Filler
II. METHODOLOGY

[A] Understand the operation of existing paint filling line
[B] Record specification of each equipment in automatic liquid filling line
[C] Calculation of power consumption of exiting automatic filling line
[D] Modification in the existing system for reducing electrical consumption
Addition of inductive sensor 2. Replacing volumetric filling by weigh metric filling to reduce air consumption
[E] Modification in the programmable logic controller
[F] Design calculation of energy saving
[G] Costing and estimation

III. RESULT ANALYSIS OF ENERGY SAVING

Indian paint industry is growing due to the great demand in housing, automobile etc sector. Asian paints, Berger paints etc enjoys market leadership in Indian paint industry hence there is great demand for research and development in the manufacturing processes of paint. With this project I am providing the modified energy efficient automatic liquid filling line which helps manufacturer to reduce the cost of the product.

Step 1: Recording specification of equipments involved.

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>EQUIPMENT</th>
<th>TYPE</th>
<th>HP</th>
<th>Current Amp</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Can Feeder -1</td>
<td>FLP</td>
<td>0.25</td>
<td>0.31</td>
</tr>
<tr>
<td>2</td>
<td>Can Feeder -2</td>
<td>FLP</td>
<td>0.25</td>
<td>0.31</td>
</tr>
<tr>
<td>3</td>
<td>Can Orientor -1</td>
<td>STD</td>
<td>0.125(1/8)</td>
<td>0.155</td>
</tr>
<tr>
<td>4</td>
<td>Can Orientor -2</td>
<td>STD</td>
<td>0.125(1/8)</td>
<td>0.155</td>
</tr>
<tr>
<td>5</td>
<td>Can Orientor Conveyor -1</td>
<td>FLP</td>
<td>0.5</td>
<td>0.62</td>
</tr>
<tr>
<td>6</td>
<td>Can Orientor Conveyor -2</td>
<td>FLP</td>
<td>0.5</td>
<td>0.62</td>
</tr>
<tr>
<td>7</td>
<td>Intermediate Feed Table</td>
<td>FLP</td>
<td>0.25</td>
<td>0.31</td>
</tr>
<tr>
<td>8</td>
<td>Dodging Conveyor with Servo</td>
<td>STD</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>Can Accumulator</td>
<td>FLP</td>
<td>0.5</td>
<td>0.62</td>
</tr>
</tbody>
</table>

|                  | 4.5 HP                           | 11.1 |

Table 3.1 Motor specification

Step 2: calculation of electrical consumption per day
Running of liquid filling line: 5 hours per shift

Power consumption per day

\[
\text{Power consumption per day} = \frac{1}{\text{amp}} \times \text{power in watts} \times 1.732 \times \text{power factor} \times E (\text{Volts}) \\
\text{Power in watts (per hour)} = 1.732 \times 0.82 \times 415 \times 11.1 \times \frac{1}{\text{amp}} \times 1.732 = 6542 \text{ watts} \times \frac{6.542}{\text{amp}} = 6.542 \text{ kW} \\
\text{Power consumption per shift} = 6.542 \times 5 = 33 \text{ KWh} \\
\text{Power consumption per day} = 33 \text{ KWh} \times 15 = 495 \text{ KWh}
Step 3: If spillage occurs within line & if it is taking 30 minutes to clear
Power loss in watts (per 30 minute) : 1.732 x 0.82 x 415 x 11.1
Due to unnecessary movement Of can & intermediate feeder : 6542 watts / 2
: 3.271 Kw ---- (B)

Estimated result: we have saved the power lost in spillage after modification

Step 4 : Pneumatic calculation used of existing system
Calculation of air consumption: per day machine use time:15 hrs.
Formula:
Q= pi/4 * (d1²-d2²)*h*(P+1)*10⁻⁶
Q= Air consumption per cm stroke (l)
d1= piston diameter (mm)
d2= piston rod diameter (mm)
h= stroke (mm)
p= operating pressure, relative (bar)

For cylinder: DZF-25-25 for size 25 mm & stroke length

<table>
<thead>
<tr>
<th>Size</th>
<th>Stroke/Length</th>
<th>Op. Mode</th>
<th>Piston Rod (mm)</th>
<th>Pressure</th>
<th>Cycles</th>
<th>Air Consumption per Cycle</th>
<th>Air Consumption lit per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 mm</td>
<td>25 mm</td>
<td>double</td>
<td>10</td>
<td>6.00 bar</td>
<td>60.00/min</td>
<td>0.16</td>
<td>9.48</td>
</tr>
<tr>
<td>40 mm</td>
<td>50 mm</td>
<td>double</td>
<td>16</td>
<td>6.00 bar</td>
<td>60.00/min</td>
<td>0.81</td>
<td>48.56</td>
</tr>
<tr>
<td>20 mm</td>
<td>200 mm</td>
<td>double</td>
<td>8</td>
<td>6.00 bar</td>
<td>1.00/min</td>
<td>0.81</td>
<td>0.81</td>
</tr>
<tr>
<td>25 mm</td>
<td>200 mm</td>
<td>double</td>
<td>10</td>
<td>6.00 bar</td>
<td>30.00/min</td>
<td>1.26</td>
<td>37.93</td>
</tr>
<tr>
<td>40 mm</td>
<td>25 mm</td>
<td>double</td>
<td>16</td>
<td>6.00 bar</td>
<td>60.00/min</td>
<td>0.40</td>
<td>24.28</td>
</tr>
<tr>
<td>100 mm</td>
<td>150 mm</td>
<td>double</td>
<td>25</td>
<td>6.00 bar</td>
<td>60.00/min</td>
<td>15.98</td>
<td>958.68</td>
</tr>
<tr>
<td>25 mm</td>
<td>5 mm</td>
<td>double</td>
<td>10</td>
<td>6.00 bar</td>
<td>30.00/min</td>
<td>0.03</td>
<td>0.95</td>
</tr>
<tr>
<td>18 mm</td>
<td>10 mm</td>
<td>double</td>
<td>8</td>
<td>6.00 bar</td>
<td>60.00/min</td>
<td>0.03</td>
<td>1.93</td>
</tr>
<tr>
<td>18 mm</td>
<td>10 mm</td>
<td>double</td>
<td>8</td>
<td>6.00 bar</td>
<td>60.00/min</td>
<td>0.03</td>
<td>1.93</td>
</tr>
<tr>
<td>25 mm</td>
<td>40 mm</td>
<td>double</td>
<td>10</td>
<td>6.00 bar</td>
<td>30.00/min</td>
<td>0.25</td>
<td>7.59</td>
</tr>
<tr>
<td>32 mm</td>
<td>100 mm</td>
<td>double</td>
<td>12</td>
<td>6.00 bar</td>
<td>30.00/min</td>
<td>1.05</td>
<td>31.40</td>
</tr>
<tr>
<td>100 mm</td>
<td>25 mm</td>
<td>double</td>
<td>25</td>
<td>6.00 bar</td>
<td>30.00/min</td>
<td>2.66</td>
<td>79.89</td>
</tr>
<tr>
<td>63 mm</td>
<td>10 mm</td>
<td>double</td>
<td>20</td>
<td>6.00 bar</td>
<td>0.07/min</td>
<td>0.41</td>
<td>0.03</td>
</tr>
<tr>
<td>32 mm</td>
<td>100 mm</td>
<td>double</td>
<td>12</td>
<td>6.00 bar</td>
<td>30.00/min</td>
<td>1.05</td>
<td>31.40</td>
</tr>
<tr>
<td>40 mm</td>
<td>320 mm</td>
<td>double</td>
<td>16</td>
<td>6.00 bar</td>
<td>0.15/min</td>
<td>5.18</td>
<td>0.78</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total</td>
<td>1235.68</td>
</tr>
</tbody>
</table>

Table 3.2 Air consumption by cylinders

Forward stroke:
Q= pi/4 * (d1²-d2²)*h*(P+1)*10⁻⁶
= 3.14/4 * 25²-25*(6+1)*10⁻⁶
Q = 85859.375*10^{-6} = 0.085859 ltr

Reverse stroke:
Q = \pi/4 \times (d_1^2 - d_2^2) \times h \times (P+1) \times 10^{-6}
= 3.14/4 \times (25^2 - 10^2) \times 25 \times (6+1) \times 10^{-6}
Q = 72121.875*10^{-6} = 0.072121875 ltr

Air consumption per cycle = 0.085859 + 0.072121875 = 0.158 ltr
Air consumption per minute for 60 cycles = 60*0.158 = 9.48 ltr
As per above calculation rest of cylinders we have calculated the air consumption

Calculation of Power consumption for compressor
Compressor capacity: 225 liters
Motor power: 7.5 kW
Air used in volumetric filling of pressure: 6 kg/cm^2
Time req to fill the air = 2 min 40 sec

Flow rate through compressor (CFM):
Tank capacity (gallon) x 0.536 (formula factor) x gauge reading (psi)
-------------------------------------------------------------
= 60.81 x 0.536 x 86.55
= 17.6314 CFM
1 lit /min = 0.0353 CFM
For 17 CFM flow rate of air we have required 7.5 kwh electrical consumption
Hence per day for 15 hrs total power consumption is 113 kwh = 113 units

Total air consumption of entire system in CFM = 1235.68 x 0.0353
= 43.61 CFM

Total power consumption will be for entire system is = 20kwh
Hence per day for 15 hrs total power consumption is 300 kwh = 300 units …… (C)
In volumetric filling arrangement we need cylinder of size 100 mm and stroke length where the air consumption is high 958 lit /min approx 34 CFM
Total Power loss = 14 kwh
Hence per day for 15 hrs total power consumption is 210 kWh = 210 units …… (D)

Total power consumption per day = (A) + (C)
= 495 + 300 Units
= 795 units
Total power saving per day = (B) + (D)
= 3.271 + 210 Units
= 213.271 units

IV. NEED AND OBJECTIVES

India needs huge amount of energy to grow in coming years. To push the recent government Make in India initiative will need more power sources. As we know we may try the option of energy production along with this we have to be conscious related to energy conservation & energy efficiency. Main objective of this project is to reduce the electrical consumption in manufacturing line. If we conserve & invent the energy conservation option in the existing system then ultimately we can reduce the energy production requirement and it help us achieve following.
This result of detailed analysis of paint manufacturing line were addressed to many leading paint industries which are using the paint filling lines form the local manufacturers & it is describes the potential in saving electricity. This result will address with the help of continuous improvement m,we can designed the energy efficient of equipment. In current scenario to fulfill demand of electricity this energy efficient approach in the manufacturing sector will play important role.

ACKNOWLEDGEMENT

I express my gratitude to Four’s Engineers for providing me kind support & co-operation during the visit to carry out inspection in their manufacturing unit. I would also like to thank Principal & professors of ARMIET college for their valuable support.

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