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Application of Kaizen Principles to a Small Scale Industry in India

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ABSTRACT

This case-study presents the application of Kaizen concept to Chempromech Engineers Pvt. Ltd. in Butribori, Maharashtra, India. The work carried out focuses on Kaizen approach to the Plant Layout of the industry to make it more efficient and desirable to work in as well as gives a formula to the industry to calculate its production in kg/hr theoretically. Chempromech Engineers Pvt. Ltd. Is a small scale industry present in the Butibori MIDC area in Nagpur, Maharashtra which specializes in manufacturing of circlip washer wires and washers. Being a small-scale industry, it is faced with problems pertaining to limited workspace, so a new layout is designed which helps groups machines based in their product type and thus freeing out space for future expansion. Product Based Plant Layout is preferred for this industry as its products vary in size and weight.
Key words:- Kaizen, Plant Layout, Product Based Plant Layout, Washers and Washer wire.

1.Introduction

Manufacturers today have a lot of obstacles to overcome, such as the need to improve customer service, optimize processes for efficiency, and cut expenses to stay competitive in the global market. In the face of these expectations, a lot of Indian businesses are actively looking for methods to strengthen their competitive edge. A significant factor driving up production costs is the growing waste that occurs in the manufacturing process, which is linked to changing consumer demands.

Many methods for improving performance and reducing waste have been developed to solve these issues. These methods include Kaizen, Total Productive Maintenance (TPM), Just In Time (JIT), and Total Quality Management (TQM). For example, Just-In-Time (JIT) inventory management maximizes stockpiling by guaranteeing that components and raw materials arrive exactly when needed. TQM, however, encourages a comprehensive strategy for quality enhancement minimizing unnecessary stockpiling when necessary. Conversely, Total Quality Management (TQM) encourages a comprehensive strategy for quality enhancement, incorporating all relevant parties in the pursuit of better products and procedures. By enabling machine operators to do routine inspections and maintenance, TPM systematically addresses equipment-related inefficiencies. This minimizes downtime and maximizes machine utilization.

Kaizen, which is based on the idea of continual improvement, is very important and is best represented by the Toyota Production System. This method promotes a culture of continuous improvement by empowering frontline staff to actively discover and correct anomalies in the production process. Kaizen is cyclical in that it entails standardizing processes, gauging performance, coming up with new ideas to increase productivity, and then sustaining these advancements through standardization, which feeds back into the cycle of improvement. Beyond just improving processes, kaizen also provides real benefits like less labor required, more output, less operator fatigue, lower production costs, and better-quality products. However, addressing organizational factors and behavioral changes within the corporation is just as important to the success of kaizen implementation as technology advancements.

2.Background of the Study

The Japanese word "kaizen"—which means "continuous improvement" in work processes—has found its way into the operations of many Western businesses. Combining the Japanese terms "Kai" (changing) and "Zen" (better), it represents a way of thinking about organizational operations that is always being improved. Continuous Improvement, also known as Gemba Kaizen or CI, is a fundamental approach to attaining industrial excellence. It is especially important in the extremely competitive market of today.

The fundamental principle of Kaizen is that all members of the organisation must be involved in ongoing attempts to improve. Wickens (1990) emphasizes the critical role that supervisors play as leaders within their teams and highlights the significance of teamwork in defining the notion. This focus on teamwork is evident at the Nissan Motor Plant in the UK.
The Kaizen technique is used by Radharamanan et al. (1996) to address problems in a small-scale bespoke furniture industry. These problems include antiquated machinery, disorganized workspaces, and quality assurance procedures. Their objective is to meet customer expectations by improving product quality, cutting expenses, and increasing productivity through the proposal of solutions to these challenges.

Balakrishnan et al. (1996) examined the effects of JIT production adoption and discovered that JIT firms had better inventory utilization after adoption; however, these improvements did not translate into appreciable changes in Return on Asset (ROA). The transformational potential of Just-In-Time (JIT) systems is highlighted by Kochan (1997), who notes that these systems can reduce lead times, improve product quality, and save operating and inventory expenses. Employee empowerment is emphasized by Bowen (1998) as a way to promote flexibility, efficiency, and quality in industrial operations. Doolen et al. (2003) investigate factors including attitude, skill acquisition, and overall event success in their measurement of the effects of Kaizen activities on human resources.

Granja et al. (2005) support the combination of target and Kaizen costing in construction firms, utilizing an ongoing sequence of activities for improvement to improve product performance and cut expenses. Comparing CI practices in China and Pakistan, Malik et al. (2007) find that there are differences in the extent to which these strategies are used in different businesses in both nations.
Autodesk AutoCAD 2024 software is used to produce the CAD drawings for the existing and new plant layout.

3. Some important terms:-

1. Kaizen:- The Japanese word "kaizen," which means "improvement" or "change for the better," describes a way of thinking and doing business that emphasizes constant process improvement in engineering, production, and management.
2. Plant Layout:- Plant layout is a business structure in which the resources such as materials, equipment and workforce are properly placed and organized within the selected site. It is the planning to ensure that the available space is utilized to the maximum capacity.
3. Product Based Plant Layout:- Production procedures are arranged in a manufacturing facility type known as a "product-based plant layout" in accordance with the particular items being produced. The machines, equipment, workstations, and other resources are arranged in this architecture according to the kind of product they are meant to manufacture.

4.Case Study:-

Chempromech Engineers is a small scale industry based in Butibori MIDC in Nagpur, Maharashtra. Founded in 1983, Chempromech Engineers Pvt. Ltd. Is a company specializing in the manufacturing of spring washers according to the need of their clients. Alongwith spring washers, the other products that the company supplies are: Annealed MS Wire, Washer Wire, Circlip Wire. Their raw materials include MS and 72B High Carbon steel. The monthly dispatching capacity of the plant is 150-200 ton. The USP of the company is that it can manufacture washers in more than 100 different sizes while having minimum to no material wastage. The number of employees of the company is around 30-35 which do the job of operators as well as maintenance technicians. Main clients include Karamtara Engineering Pvt Ltd., KEC Ltd., PowerGrid corporation of India.

Photo 1:- Circlip washer wires produced by the company

Photo 2:- Washers manufactured by the company

Plant Layout of the company:-

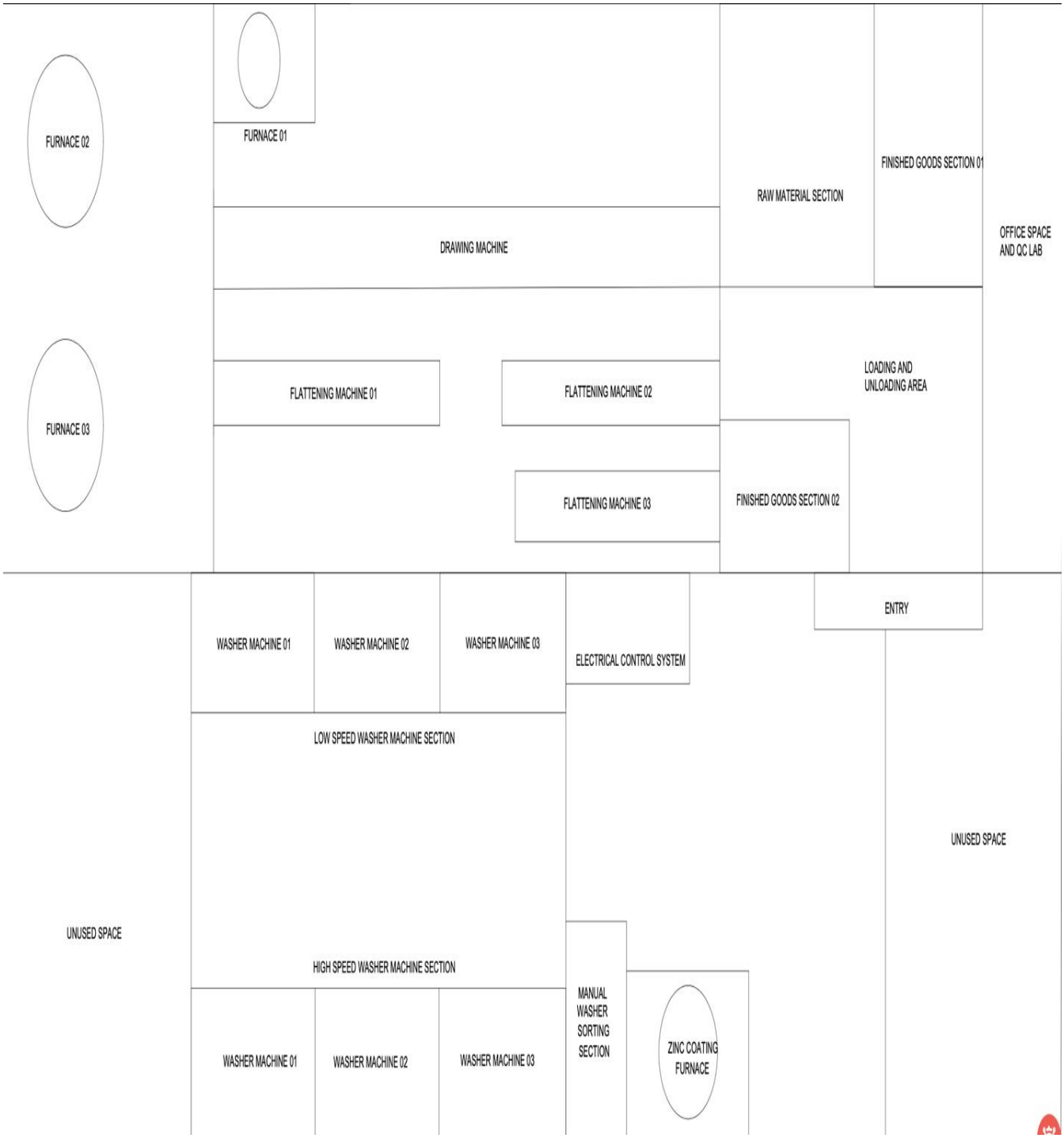

Fig 1:- CAD drawing of existing plant layout of the company

Sr.No.	Name of the Machine	Qty.
1.	Drawing Machine	1
2.	Flattening Machine	3
3.	Furnace	3
4.	Washer Machine (Low Speed)	3
5.	Washer Machine (High Speed)	3
6.	Zinc Coating furnace	1
7.	Overhead motorized Crane	1

Table 1:- Equipment present in the industry

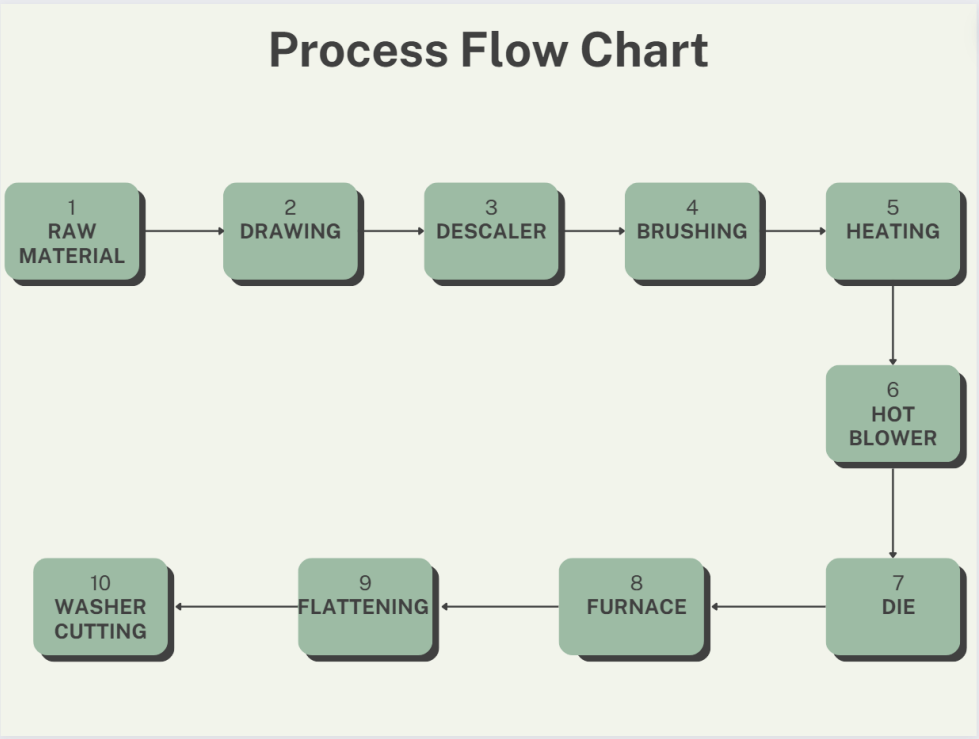

Fig 2:- Process Flow Chart of the company

In this industry, there is one drawing machine present which draws the raw material wire of 5.5 mm diameter into a wire of 2.2 mm diameter which goes through the processes of drawing, descaling, brushing, heating and hot blowing before going into the die to reduce its diameter to 2.2 mm. This is done in order to bring the wire into the favorable temperature zone before it is drawn. After drawing, this wire is then sent to furnace number 2&3 to get heat treated where it sits for about 8 to 12 hours depending on its volume and then sent to furnace number 01 which is right beside the drawing machine where it is kept to slowly cool down for up to 10 hours. This process is called a Spheroidization. After this process is completed, the cooled down wire is taken to the flattening machines where it gets flattened and bundled and bunched up into coils of weight 220-250 kgs per bundle. This is known as Circlip washer wire which the company either exports as is to its customers or uses it to manufacture circlip washers of size M3 to M30 depending on the order quantity. To manufacture washers there are 6 washer manufacturing machines present (3 Low speed and 3 High speed). After manufacturing of washers, manual sorting is done and the goods are dispatched. An overhead crane is used for material handling purposes.

Following are the Problems faced by the company:-

1) Limited movement of operators on the workshop floor.
2) Calculation of its circlip wire production in kg/hr.
3) Unused space laying in 2 different corners of the plant.
4) QC issues in sorting the washers.

5.Implementation:-

After discussing these issues with managers, engineers, and operators at various levels and taking into account a variety of circumstances, it was discovered that kaizen may improve the situation. Reaching a company-wide goal is one of the main goals of the Kaizen System implementation.

Problem 1:-

As shown the company has 1 drawing machine which can draw the wire of 5.5mm diameter to 2.2 mm diameter which is then used to manufacture the circlip washer wire. The company has 3 flattening machines where the wire earlier reduced to 2.2mm is made in form of circlip washer wire. This wire is then either exported as it is or used to manufacture washers in the industry itself. But the way in which the machines are laid out in the plant pose a challenge for the operators to move around freely. Therefore it is suggested that the arrangement of the flattening machines should be changed in a way that these 3 machines lay parallel to each other.

Now, in the washer manufacturing area of the industry, the 3 low speed and 3 high speed washer machines are in front of each other as seen in Fig. 1 which means that when the high-speed ones are being operated, which the industry chooses to operate all the 3 at one time the low speed ones are set idle leading to higher manufacturing times as the washer sizes needed from the low speed ones cannot be manufactured at the same time. Therefore, to overcome this, it is suggested that two separate sections to be made in order to separate the high speed and low speed washer machine areas so that operators can work separately and focus on the particular task at hand without worrying about the order fulfillment time.

It was also observed that the washer sorting was done manually and lots of QC issues were generated due to that because in a batch of thousands of washers it becomes nearly impossible to sperate the faulty ones. Therefore, a suggestion to implement an automated sorting machine to reduce the number of errors found in washer sorting.

And as the company had shut down its zinc coating process for the washer it was suggested to remove the zinc coating furnace.

The layout was changed accordingly and a CAD Drawing was made.

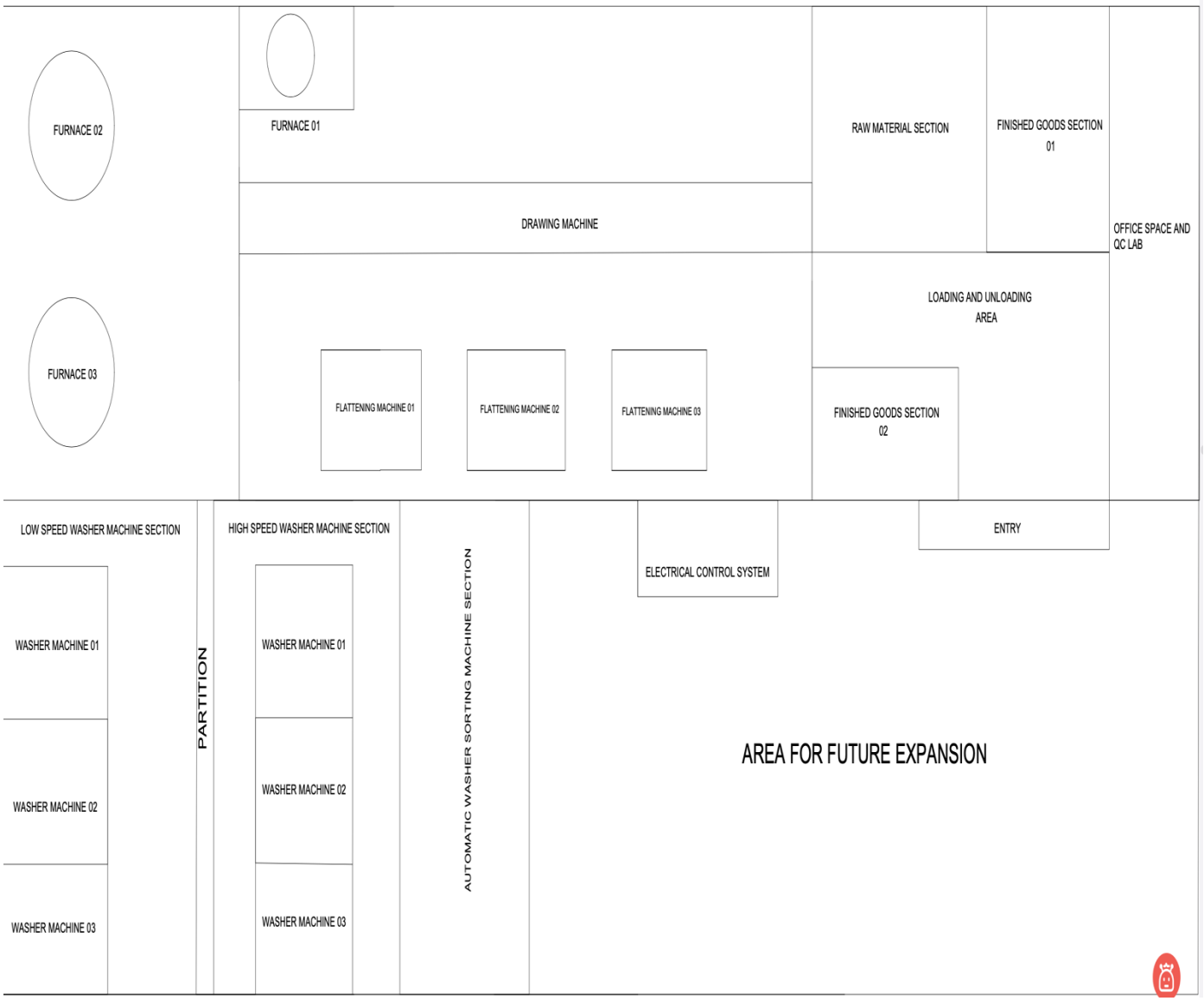

Fig 3:- New plant layout

➔ In this layout the previously unused space is allocated for the low speed washer machine section and the two sections are separated by a partition. Alongside these stations is an automated sorting area. The zinc coting furnace is removed and the remaining space is kept for future expansion.
The 3 flattening machines are placed side by side and parallel to each other which makes for easier maneuverability and efficient use of space.

Sr. No.	Problems faced	Changes suggested
1.	Difficulty in maneuvering between flattening machines.	Re-arranging the machines side by side and parallel to each other.
2.	Unable to use high speed and low speed washers manufacturing machines at the same time	To separate the manufacturing machines into high speed and low speed cells and divide them via a partition.
3.	QC issues in manual sorting	Automated sorting machines to be installed.
4.	Unused zinc coating furnace	Removal of the furnace.

Table 2:- Problems faced vs Changes suggested

➔ As the machines were moved to the previously unused area and the zinc coating furnace now removed, the area of future expansion increased. (Considering that the unused space in the existing layout was to be used for future expansion).

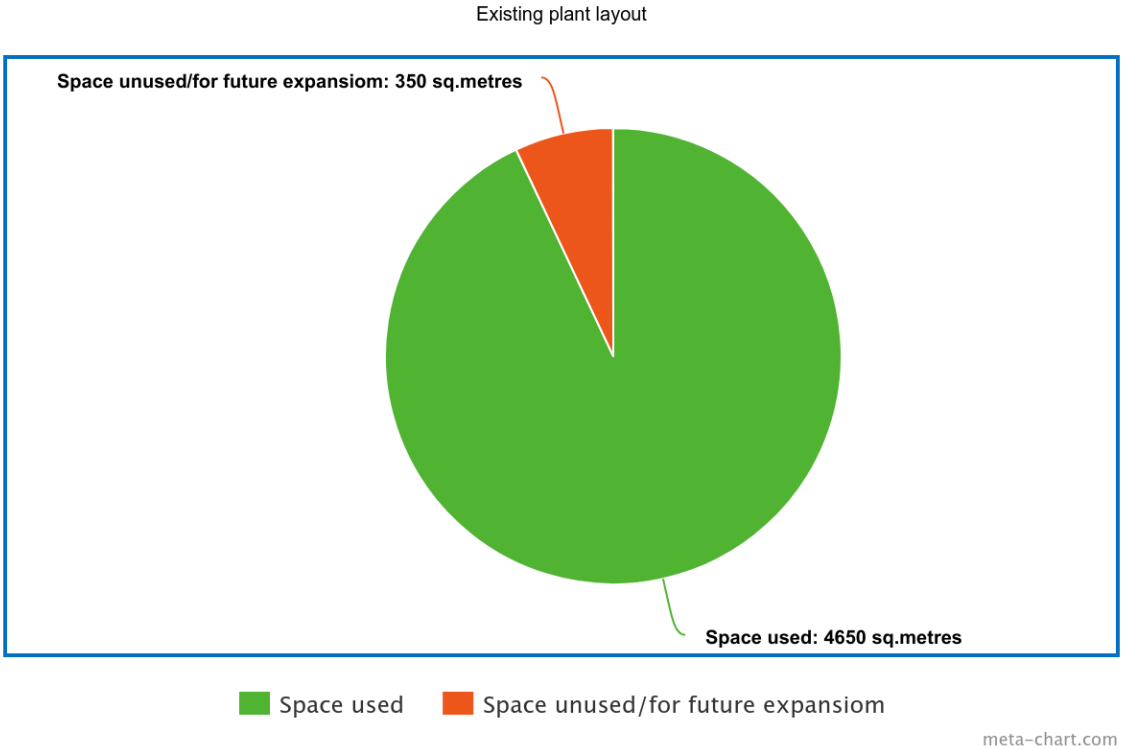

Fig 4:- Pie-chart depicting used vs unused area in sq.metres for the existing plant layout.

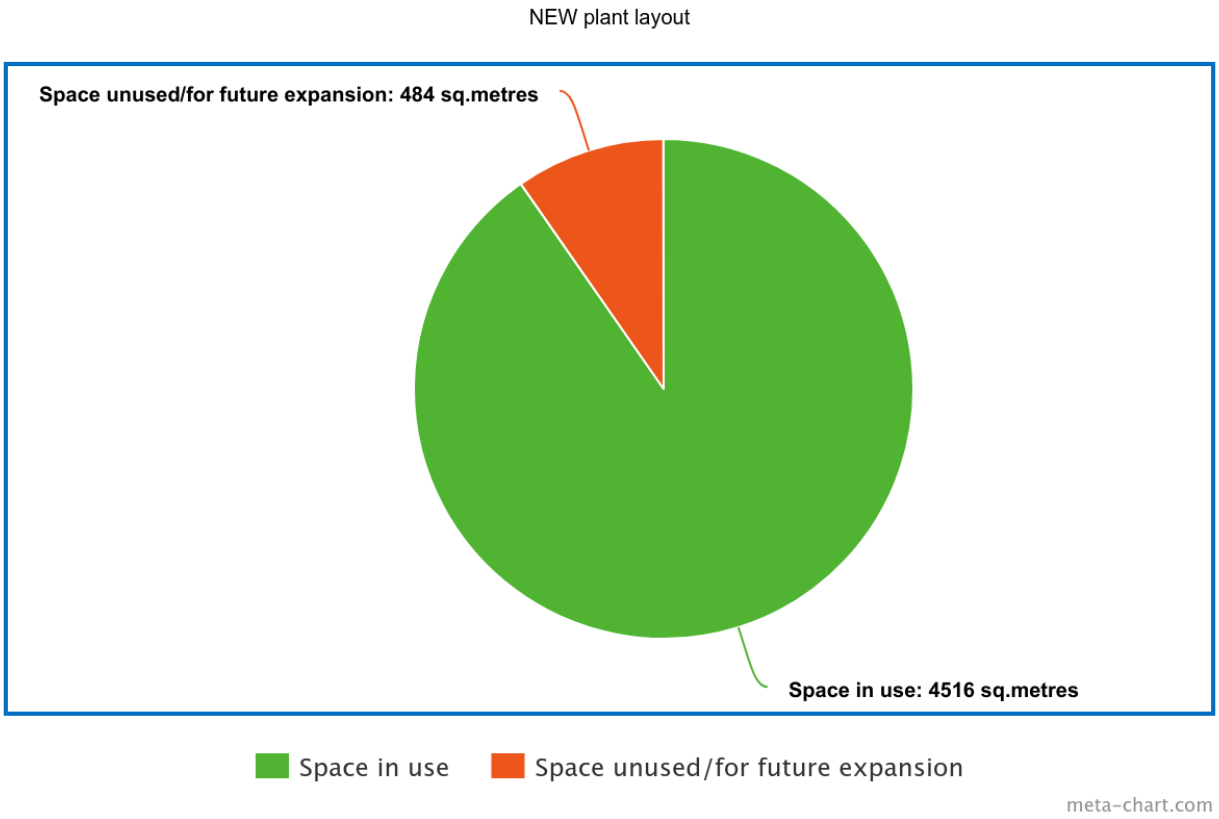

Fig 4:- Pie-chart depicting used vs unused area in sq.metres for the new plant layout.

Problem 2:-

The company wanted to know its production capacity in kg/hr for one flattening machine considering the I.D. of the wire 0.5 m and O.D. to be 0.8 m (avg of I.D. and O.D.= 0.65m= D).
It was observed with the help of a stopwatch that the machine has 29 revolutions per minute.

Solution:- The capacity in kg/hr can be calculated by;

1) Calculating the area of the wire by taking diameter "D". (π*D^2)
2) Calculating the circumference of the wire. (π*D)
3) Calculating the speed by π*D*N where N is the RPM. This will give answer in meter/min, so converting meter/hr.
4) To calculate the volume by multiplying circumference by the area.
5) To calculate the weight by multiplying the volume by the density of the material. (7.8 kg/m^3).
6) Now the volume is known, speed of rotation is known and the number of revolutions of the machine per minute is known, therefore by multiplying these 3 parameters together we can find out the production capacity in kg/hr.

6.Results and Conclusion:-

1) It was observed that the grouping of flattening machines and the separation of low speed and high speed machines into cells by using the concept of product based plant layout.
2) The grouping of machines into cells provided for a increase in space for future expansion by 38%.
3) A formula for easy calculation of the capacity of the flattening machine in lg/hr was provided.

7.References:-

[1] Wickens P. D.,"Production Management: Japanese and British
Approaches", IEE Proceedings Science, Measurement and Technology, Vol. 137, No. 1, 1990, pp. 52-54.
[2] Dean M, Robinson A,"America's Most Successful Export
to Japan: Continuous Improvement Programs", Sloan Management Review, Vol. 3, 1991,
pp. 67-74.
[3] Bassant J, Caffyn S,"Rediscovering Continuous Improvement", Technovation, Vol. 14, No. 1, 1994,
pp. 17-29.
[4] M. Huson, D. Nanda,"The impact of just-in-time manufacturing on firm performance", Journal of Operations Management,
Vol. 12, 1995,
pp. 297-310.
[5] R. Balakrishnan, T.J. Linsmeier, M. Venkatachalam,"Financial benefits of JIT adoption: E!ects of customer concentration and cost structure", The Accounting Review,
1996,
pp. 71-83.
[6] Radharamanan R, Godoy L P and Watanabe K I,"Quality and Productivity Improvement in a Custom-Made Furniture Industry Using Kaizen", Computer and Industrial Engineering,
Vol. 31, Nos. 1/2, 1996,
pp. 471-474.
[7] Gunasekaran A. and Lyu J.,"Implementation of Just in time in a small company: A case study", Production Planning and control, Vol. 4, 1997, pp. 406-412.
[8] Vrat P, Mittal S, Tyagi K,"Implementation of JIT in Indian environment: A Delphy Study", Productivity, Vol. 38, 1997,
pp. 312-321.
[9] Burns A.,"Choosing the Right Tool from the Tool Box: Some Examples of Gemba Kaizen Practice". IEE Seminar, Kaizen: From Understanding to Action (Ref. No. 2000/035), Vol. 6,
2000, London, UK
pp. 1- 10.
[10] Chen J C, Dugger J., Hammer B, "A Kaizen Based Approach for Cellular Manufacturing Design: A Case Study", The Journal of Technology Studies, Vol. 27, No. 2, 2000, pp.
19-27.
[11] White RE, Prybutok V.,"The relationship between JIT practices and type of production system Omega", International Journal of Management & Science, Vol. 29(2), 2001,
pp.113–124
[12] Palmer V S.,"Inventory Management Kaizen", Proceedings of 2nd International Workshop on Engineering Management for Applied Technology, 2001, Austin, USA.
pp. 55-56.

[13] Doolen T L, June W Q, Akan V, Eileen M., Jennifer F, "Development of an Assessment Approach for Kaizen Events", Proceedings of the 2003 Industrial Engineering and Research Conference, 2003, CD-ROM.
[14] Granja D A., Picchi F. A., Robert G T.,"Target and Kaizen Costing in Construction", Proceedings IGLC-13, 2005,
Sydney, Australia. pp. 227-233.
[15] Malik S A., YeZhuang T,"Execution of Continuous Improvement Practices in Spanish and Pakistani Industry: A Comparative Analysis", IEEE International Conference on
Management of Innovation and Technology, Vol. 2, 2006,
Singapore.
pp. 761-765.
[16] Malik S A, Li-bin L, YeZhuang T., Xiao-Lin S, "Continuous Improvement Practices in Asian Developing Countries: A Comparative Analysis between Chinese and Pakistani Manufacturing Industry", 14th International Conference on Management Science and Engineering, 2007,
pp. 692-697.
[17] Singh Jagdeep, Harwinder,"Kaizen Philosophy: A Review of Literature", The ICFAI University Journal of OperationsManagement, Vol. VIII, No. 2, 2009.