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SIMULATION AND ANALYSIS OF PLANT LAYOUT IN THE ZINC PHOSPHATING PLANT

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ABSTRACT

The objective of this research is to lead time reduction in the inventory control. Growth of business world these days created tighter market competition, because the existing industrial market become more global and have penetrated the inter-states boundary. Their goal is to satisfy the customer with the exact product, quality, quantity and price in the shortest amount of time. By analyzing according to the layout concept, types and calculating the manufacturing lead time in the company, design of the plant layout is modified.

KEYWORDS
Inventory control, Lean Manufacturing, Manufacturing Lead Time. Stack.

1.1 Introduction

Hitech Arai is the leading Manufacturing company of producing oil seals. They are producing 40 barrel of oil seals per shift. The company was founded by Mr.R.Lakshmi Narayanan, with the capital of Rs.4.5 lakhs and with the manpower of 75 as a family owned concern.

This paper will show how the Manufacturing Lead Time can be reduced by changing the Process layout of the company. It analyse the processes involved in the manufacturing, plant layout and the manufacturing lead time for the process taken in the company.

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Phosphating is a conversion coating treatment largely used in many industries as a surface preparation for coating by paints and to increase corrosion resistance. Phosphating is the metal pre-treatment process for the surface treatment and finishing of ferrous and non-ferrous metals. Due to its economy, speed of operation and ability to afford excellent corrosion resistance, wear resistance, adhesion and lubricate properties, it plays a significant role in the automobile, process and appliance industries. Phosphate coatings serves as a conversioncoating in which a dilute solution of phosphoric acid and phosphate salts is applied via spraying or immersion and chemically reacts with the surface of the part being coated to form a layer of insoluble, crystalline phosphates.

DATA COLLECTION AND ANALYSIS

The figure 1 is the zinc Phosphating layout followed by the Hitech Arai Company. At first the oil seals were loaded in the barrel. Here the oil seals are loaded manually only. The carriage is moved from one place to another with the help of the Material Handling System. A chain is used to move the Material Handling System. It is controlled by an operator.

After the oil seals are loaded, the barrel is placed in Degreasing bath for 8 mins. When the dipping time finished, the barrel is removed from it and placed in the Rinsing I bath for 1 min. Next it is placed in the Rinsing II bath for 1 min. After Rinsing I and II it is placed in the Surface Conditioning bath for 4 min. When finished, it is placed in the Phosphating bath for 7 mins. Now, the barrel is dipped in the Rinsing III bath for 1 min. After finishing the barrel is dipped in the Rinsing IV bath for 1 min. By doing all the above process, the oil seals are unloaded in the unloading station. Here the unloading is done manually. Also in the unloading stage the barrel is not removed from the material handling system in the station.

In the same plant, they are doing both the Acid Pickling process and Parkerizing process. For Parkerizing process, the above process will be done. While for the Acid

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Pickling Process, after loading the oil seals in the barrel it is directly dipped in the Rinsing II bath by neglecting the Degreasing and Rinsing I bath.

With the help of Manufacturing Lead Time (MLT) concept, the MLT is found from the timings taken from the company. It is shown in the table 1. The average MLT is found from the MLT calculation table. The average MLT is 37 mins and 30 secs. The Standard Timings also calculated manually. It is shown in the table 2.

A Fish Bone Diagram has been drawn by analysing the layout, comparing the MLT for standard timings and the company timings. It is shown in the figure 2. From the Fishbone diagram the causes and their effects were found.

Different causes occur in zinc phosphating:

Loading:

Loading the work pieces to the barrel manually take long time. When increase in process time, the loaded work parts in the barrel are placed in the loading station even after loading.

Unloading:

Unloading the work pieces manually from the barrel takes long time. Up to unload all the work parts from the barrel all the running process are stopped. When drier is full, unloading is stopped and placed in the unloading station and the barrel is also fixed in material handling system.

Material Handling:

Only one material handling system is used cause so many effects.In unloading station, material handling system carries the barrel and stop in the station.Material handling is working manually not automated.

Process:

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All the cells are not in active and also not use for the correct process.All the cells are not working in proper time. Different types of process working in same working station.

Worker:

Some workers even not having the phosphatingknowledge.All the workers having different working skill.Workers having different problems from environment.Some workers having home problems.

Different effects occur in zinc phosphating:

Loading:

Decrease in production rate and process stopped until the loading the work parts in the barrel manually. Reduce in production rate due to the loaded barrels are stopped in the loading station.

Unloading:

Increase in time taken for all the process and reduce in production rate by stopping the barrel in the unloading station. Dispatching time increased when unloading the work parts time increased.

Dipping time increased due to the barrel stopped in the unloading station. Reduction in quality and production rate due to the time taken for the unloading process increased.

Material Handling:

Reduction in quality, production rate and increase in process time due to single material handling system.

Due to material handling system stopped in unloading station all the above effects also occurred here.

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Manual controlling Material Handling System leads to decrease in production rate, quality and increase in process time.

Process:

Processing time increased due to the cells is not in active for the correct process.

Reduction in quality due to more dipping in surface conditioning and Phosphating solution.

Giving importance to acid pickling materials leads to more dipping time for Parkerizing in current process which leads to reduce in quality.

Worker:

Having individual problems for some workers, time management is not proper which leads to reduce in quality, production rate and also increase or decrease in dipping time.

Due to no knowledge in Phosphating for workers, dipping time increase in surface conditioning and Phosphating which leads to quality reduction.

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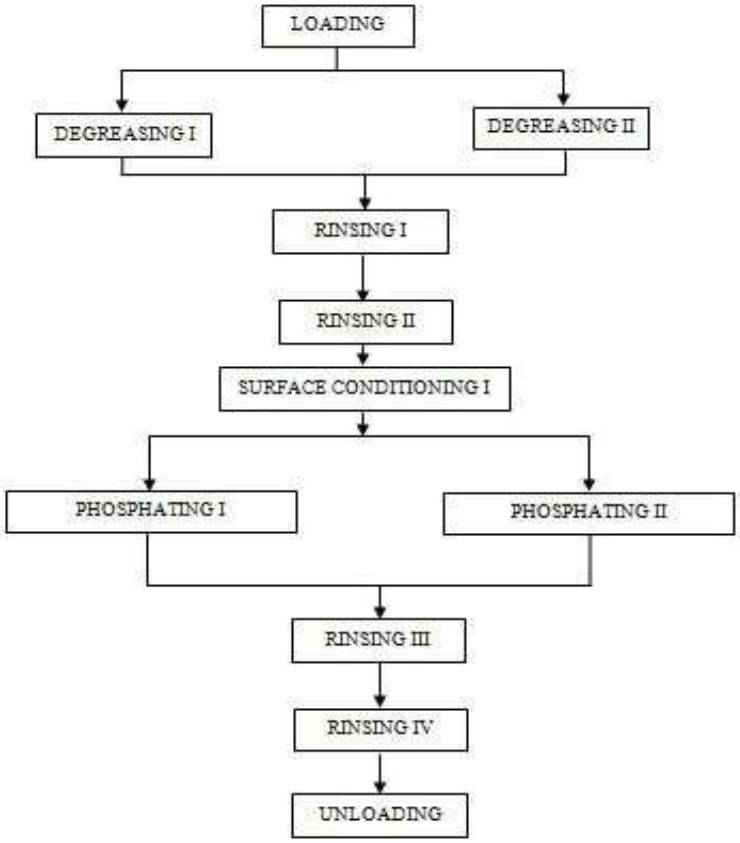

Figure 1 Product Layout of the company

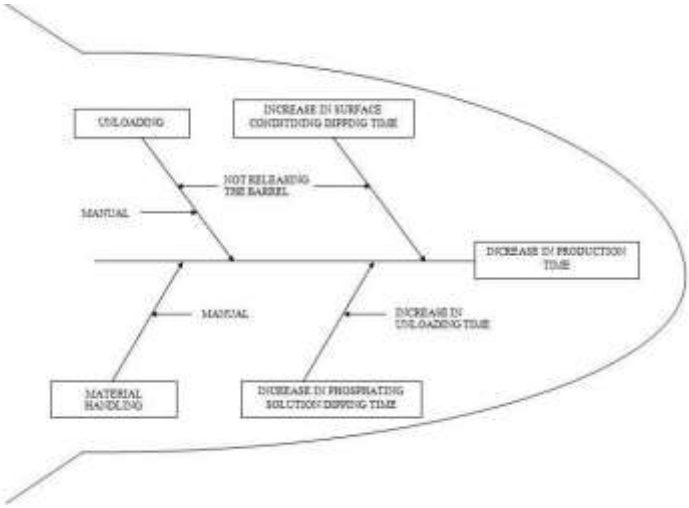

Figure 2 FishBone Diagram

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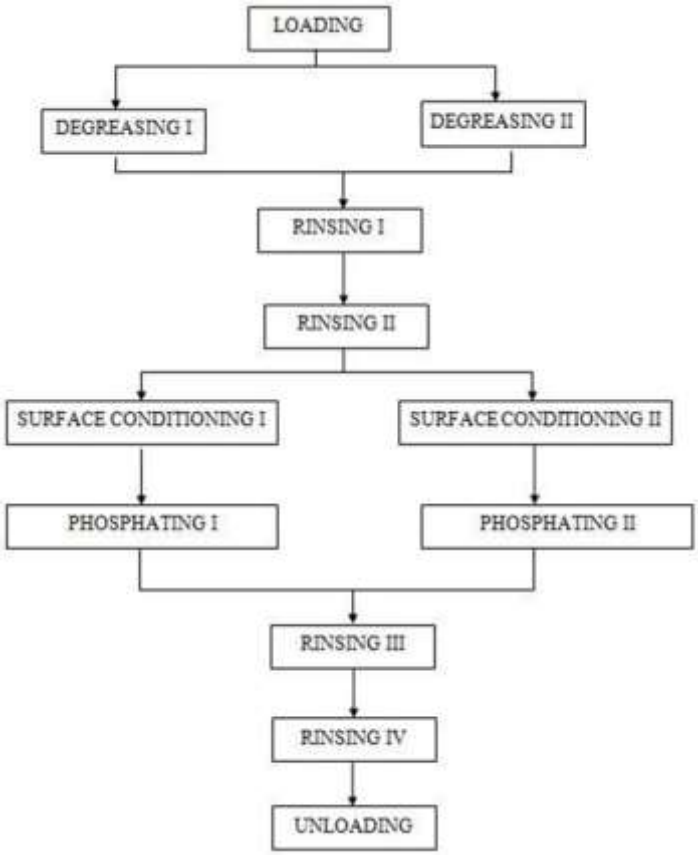

Figure 3 ModifiedLayout

Table 1 MLTcalculationforcompanylayout

PROCESS	NOTE	BATCH NO 1 2															
	BARRAL	1		2		3		4		1		2		3		4	
		min	sec	min	Sec	min	sec	min	sec	min	Sec	min	sec	min	Sec	Min	Sec
LOADING		1	00	1	00	1	00	1	00	1	00	1	00	1	00	1	00
TRANSFER TIME		0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
DECREASING I		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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DECREASI NG II	8	00	8	17	8	02	8	05	7	58	9	05	8	02	8	03
TRANSFER TIME	0	15	0	15	0	18	0	14	0	21	0	15	0	13	0	18
RINSING I	1	15	1	01	1	32	1	06	1	36	0	40	1	10	1	10
TRANSFER TIME	0	05	0	14	0	20	0	12	0	20	0	20	0	10	0	14
RINSING II	0	58	1	05	1	05	1	03	1	05	1	05	1	03	2	12
TRANSFER TIME	0	12	0	14	0	15	0	15	0	11	0	12	0	14	0	12
SURFACE CONDITION ING	5	10	4	06	7	58	6	30	8	55	8	03	8	18	8	49
TRANSFER TIME	0	05	0	15	0	32	0	15	0	10	0	20	0	15	0	20
PHOSPHATI NG I	7	07	-	-	10	40	-	-	10	05	-	-	12	05	-	-
PHOSPHATI NG II	-	-	14	45	-	-	12	45	-	-	11	37	-	-	8	50
TRANSFER TIME	0	18	0	10	0	15	0	30	0	20	0	23	0	15	0	25
RINSING III	1	10	1	15	1	05	1	07	1	05	1	16	1	15	0	50
TRANSFER TIME	0	13	0	10	0	13	0	13	0	35	0	14	0	15	0	12
RINSING IV	5	17	1	10	1	02	1	04	1	10	1	20	1	05	1	18
TRANSFER TIME	0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
UNLOADIN G	4	10	3	00	3	36	2	48	3	00	3	25	2	20	3	59
MANUFAC TURING LEAD TIME	35	45	37	27	38	23	37	37	38	21	39	45	38	10	38	22

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PROCESS	BARRAL	BATCH NO.															
		1								2							
		1		2		3		4		1		2		3		4	
		h	Sec	Min	Sec	Min	Sec	Min	Sec	Min	Sec	Min	Sec	Min	Sec	Min	Sec
LOADING		1	00	1	00	1	00	1	00	1	00	1	00	1	00	1	00
TRANSFER TIME		0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
DECREASING I		8	00	8	00	8	00	8	00	8	00	8	00	8	00	8	00
TRANSFER TIME		0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
DECREASING II		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANSFER TIME		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RINSING I		1	00	1	00	1	00	1	00	1	00	1	00	1	00	1	0
TRANSFER TIME		0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
RINSING II		1	00	1	00	1	00	1	00	1	00	1	00	1	00	1	00
TRANSFER TIME		0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
SURFACE CONDITIONING		4	00	4	00	4	00	4	00	4	00	4	00	4	00	4	00
TRANSFER TIME		0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
PHOSPHATING		7	0	-	-	7	0	-	-	7	00	-	-	7	00	-	-

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I		0														
TRANSFER TIME	0	15	-	-	0	15	-	-	0	15	-	-	0	15	-	-
PHOSPHATING II	-	-	7	0	-	-	7	0	-	-	7	00	-	-	7	0
TRANSFER TIME	-	-	0	15	-	-	0	15	-	-	0	15	-	-	0	15
RINSING III	1	00	1	00	1	00	1	00	1	00	1	00	1	00	1	00
TRANSFER TIME	0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
RINSING IV	1	00	1	00	1	00	1	00	1	00	1	00	1	00	1	00
TRANSFER TIME	0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
UNLOADING	1	00	1	00	1	00	1	00	1	00	1	00	1	00	1	00
TRANSFER TIME	0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
MANUFACTURING LEAD TIME	27	15	27	15	27	15	27	15	27	15	27	15	27	15	27	15

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Table 2. MLT calculation according to company standard timings

PROCESS	BARR AL	BATCH NO.															
		1								2							
		1		2		3		4		1		2		3		4	
		Min	Sec	Min	SeC	Min	Sec	Min	Sec	Min	Sec	Min	Sec	Min	Sec	Min	Sec
LOADING		1	00	1	00	1	00	1	00	2	00	2	00	2	15	2	15
TRANSFER TIME		0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
DECREASIN G I		8	00	-	-	8	15	-	-	8	15	-	-	8	15	-	-
TRANSFER TIME		0	15	-	-	0	15	-	-	0	15	-	-	0	15	-	-
DECREASIN G II		-	-	9	15	-	-	8	15	-	-	8	00	-	-	8	00
TRANSFER TIME		-	-	0	15	-	-	0	15	-	-	0	15	-	-	0	15
RINSING I		1	00	1	00	1	00	1	00	1	00	1	00	0	45	1	0
TRANSFER TIME		0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
RINSING II		1	00	1	00	1	00	1	00	1	15	1	00	1	00	1	00
TRANSFER TIME		0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
SURFACE CONDITIONI NG I		4	00	-	-	4	30	-	-	4	0	-	-	4	45	-	-
TRANSFER TIME		0	15	-	-	0	15	-	-	0	15	-	-	0	15	-	-

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SURFACE CONDITIONING II	-	-	4	0	-	-	5	0	-	-	4	0	-	-	4	0
TRANSFER TIME	-	-	0	15	-	-	0	15	-	-	0	15	-	-	0	15
PHOSPHATING I	7	00	-	-	7	0	-	-	7	00	-	-	7	00	-	-
TRANSFER TIME	0	15	-	-	0	15	-	-	0	15	-	-	0	15	-	-
PHOSPHATING II	-	-	7	0	-	-	7	0	-	-	7	00	-	-	7	0
TRANSFER TIME	-	-	0	15	-	-	0	15	-	-	0	15	-	-	0	15
RINSING III	1	00	1	00	1	00	1	00	1	00	1	00	1	15	1	00
TRANSFER TIME	0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
RINSING IV	1	15	2	00	1	00	1	00	1	00	1	00	1	00	1	00
TRANSFER TIME	0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
UNLOADING	1	00	1	15	1	15	1	00	1	00	1	00	1	00	1	00
TRANSFER TIME	0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15
MANUFACTURING LEAD TIME	27	30	29	45	27	45	28	30	28	45	28	15	29	45	28	30

Table 3. MLT calculation according to the Modified Layout

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Conclusions

According to the modified layout and standard timings the MLT is calculated theoretically. It is shown in the table 3. The average MLT for the standard timing is 28 mins and 35 secs. The following are the advantages of the modified layout:

- By adding the surface conditioning bath, the manufacturing lead time will be decreased.
- Using of both the degreasing bath will increase the production rate.
- Releasing the barrel in the unloading stage will decrease the Manufacturing Lead Time.
- Making the Material Handling System as an automated one will lead to increase in production rate.
- Giving proper training to the workers leads to increase in production rate.

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