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PRODUCTIVITY IMPROVEMENT IN MANUFACTURING OF A GRINDING WHEEL

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Abstract- *Grinding wheels are made of natural or synthetic abrasive minerals bonded together in a matrix to form a wheel. For manufacturers, grinding wheels provide an efficient way to shape and finish metals and other materials. Abrasives are often the only way to create parts with precision dimensions and high-quality surface finishes. At this time, grinding wheels are used in almost every industry. Manufacturing of a grinding wheel consist of mixing abrasive grains, binders and bonding materials. Two important components, abrasive grains and bonding materials, make up any grinding wheel. Often, additives are blended to create a wheel with the properties necessary to shape a particular material in the manner desired. Abrasive grains constitute the central component of any grinding wheel, and the hardness and friability of the grinding materials will significantly affect the behavior of a given wheel. In the next step the ingredient mix is poured into the mold and compressed by a hydraulic press. Most grinding wheels are manufactured by the cold-press method, in which a mixture of components is pressed into shape at room temperature. The wheel is then fired at 200 ^0C – 1260 ^0C depending upon the type of the bond. The purposes of the firing are to melt the binder around the abrasives and to convert it to a form that will resist the heat and solvents encountered during grinding. A wide range of furnaces and kilns are used to fire grinding wheels. After firing, wheels are moved to a finishing area, where arbor holes are reamed or cast to the specified size and the wheel circumference is made concentric with the center. Steps may be necessary to correct thickness or parallelism of wheel sides, or to create special contours on the side or circumference of the wheel. Manufacturers also balance large wheels to reduce the vibration that will be generated when the wheel is spun on a grinding machine.*

Keywords-*Abrasives, surface finish, cold press method, arbour holes, etc*

I. INTRODUCTION

Grinding wheels have been important for more than 150 years. Today, grinding wheels appear in nearly every manufacturing company, where they are used to cut steel and masonry block; to sharpen knives, drill bits, and many other tools; or to clean and prepare surfaces for painting or plating. More specifically, the precision of automobile camshafts and jet engine rotors rests upon the use of grinding wheels. Sandstone, an organic abrasive made of quartz grains held together in natural cement, was probably the earliest abrasive; it was used to smooth and sharpen the flint on axes.

By the early nineteenth century, emery (a natural mineral containing iron and corundum) was used to cut and shape metals. By the 1890s, the search had yielded silicon carbide, a synthetic mineral harder than corundum. Research into synthetic minerals also led to production of the so-called super abrasives. Foremost in this category are synthetic diamonds and a mineral known as cubic boron nitride (CBN), second in hardness only to the synthetic diamond. Today, development continues, and a seeded-gel aluminum oxide has just been introduced.

Figure: Grinding wheels

There are no clear performance standards for grinding wheels. With the exception of those containing expensive abrasives such as diamonds, grinding wheels are consumable items, and the rates of consumption vary considerably depending on application. However, a number of domestic and global standards are accepted, voluntarily, by manufacturers. Trade organizations, which represent some manufacturers in the highly competitive U.S. market, have developed standards covering such matters as sizing of abrasive grains, labeling of abrasive products, and the safe use of grinding wheels. The extent to which grinding wheel quality is checked depends upon the size, cost, and eventual use of the wheels. Typically, wheel manufacturers monitor the quality of incoming raw materials and their production processes to assure product consistency. Each large vitrified wheel is examined to determine the strength and integrity of the bonding system as well as the uniformity of grain through every wheel. Acoustical tests measure wheel stiffness; hardness tests assure correct hardness of bonds; and spin tests assure adequate strength.

II. PROBLEM DEFINITION

In the industries, if we want to increase the production rate in same premises and also same man power. This is the new innovative task. There are three solutions to this said problem.

Apply the Management rule: TQM, Lean Manufacturing, TPM, etc
Increase the Machine Capacity
Apply Automation / Semi Automation

III. METHODOLOGY

In methodology to implement lean manufacturing in industry there are mainly 7 steps as under (Value Stream Mapping).

1. **Select Product or product family.**
2. **Study of manufacturing method and sequence of operation.**
3. **Data collection by time study and motion study.**
4. **Study of layout.**
5. **Construction of current state value stream map.**
6. **Identification of waste after the value stream map analysis.**
7. **Procedure to eliminate waste and continues improvement.**

IV. EXPERIMENTATION

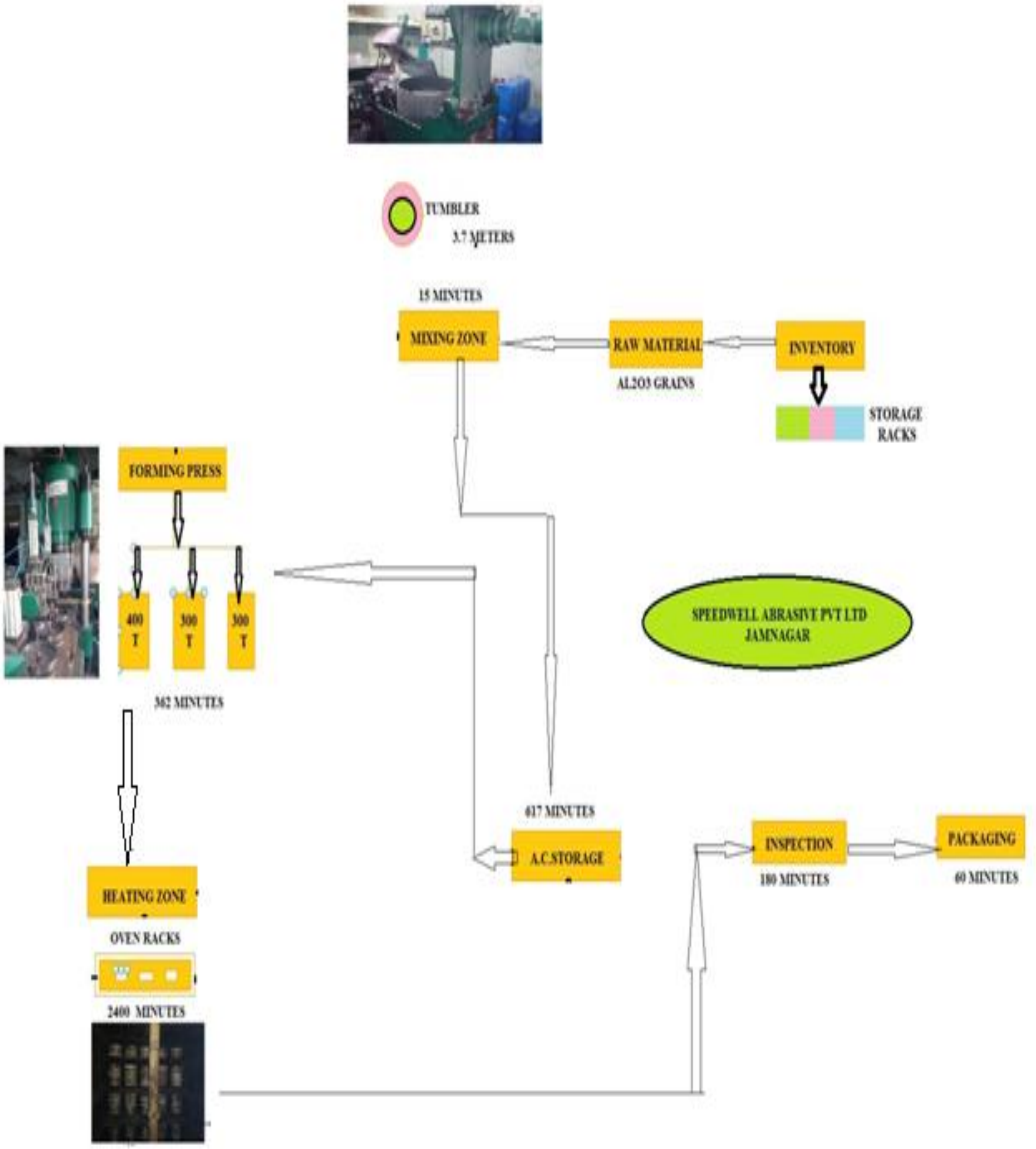
Time Study Table

Plant/Machine: Speedwell abrasives pvt. Ltd					
Customer : Overseas casting pvt ltd					
Product/Part : Grinding Wheel					
DWG No.: 790-30-32					
Material: Al2O3 + PF resin Oil					
Sr. no	Element Description	W.R			
		L.T	O.T	U.T	T.W.R
1	Mixing of raw materials	10	15	12	37
2	Cooling of mixture	21	617	24	662
4	Forming of wheel	38	362	27	427
5	Heating of wheels in an oven	120	2160	138	2418
6	Inspection of wheels	7	183	5	195
7	Packaging	0	62	0	62
Note: L.T = Loading Time O.P = Operation time					
U.T = Unloading time T.W.R = Total watch reading					

Flow Process chart as per the existing Layout of Industries

Sr. No.	Description	Distance In (m)	Time in Min.	○	⇨	D	□	▽
1	Raw Material in storage	8.3	7.8					•
2	Mixing of raw materials	10.4	9.2	•				
3	Move to Cooling of mixture	14.8	6.4		•			
4	Move to Forming of wheel	16.4	17.2		•			
5	Heating of wheels in an oven	12.3	9.2	•				
6	Move to Inspection of wheels	15.9	16.4		•			
7	Packaging	5.7	6.3	•				
Total		83.8	72.5	3	0	0	1	1

Existing Layout of Industry


TUMBLER
3.7 METERS
15 MINUTES
MIXING ZONE
RAW MATERIAL
INVENTORY
AL2O3 GRAINS
STORAGE
RACKS
FORMING PRESS
400
T
300
T
300
T
302 MINUTES
SPEEDWELL ABRASIVE PVT LTD
JAMNAGAR
617 MINUTES
A.C.STORAGE
INSPECTION
PACKAGING
180 MINUTES
60 MINUTES
HEATING ZONE
OVEN RACKS
2400 MINUTES

V. RESULTS & FUTURE SCOPE

Future state map

Step 1: Calculate Takt Time

Starting to draw the future state map know takt time.

$$\text{Takt Time} = \frac{\text{Net Available Time}}{\text{Customer Demand}} = \frac{600 * 26}{65000} = 14.4 \text{ Second}$$

The net available time is the total operational time during a specific period of time, meaning the total amount of time.

Step 2: Understand customer Demand.

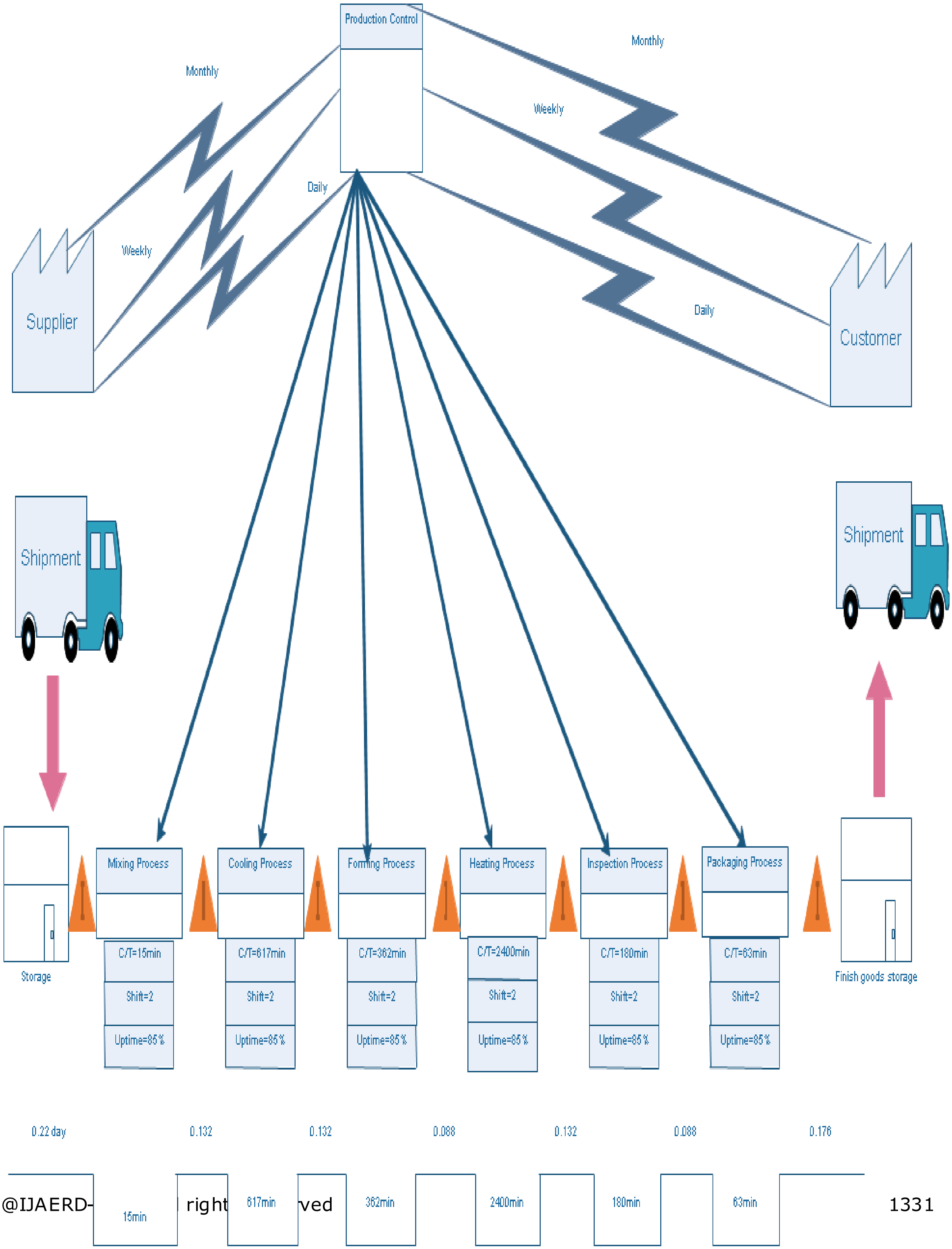
Step 3: Map the process flow.

Step 4: Map the material flow.

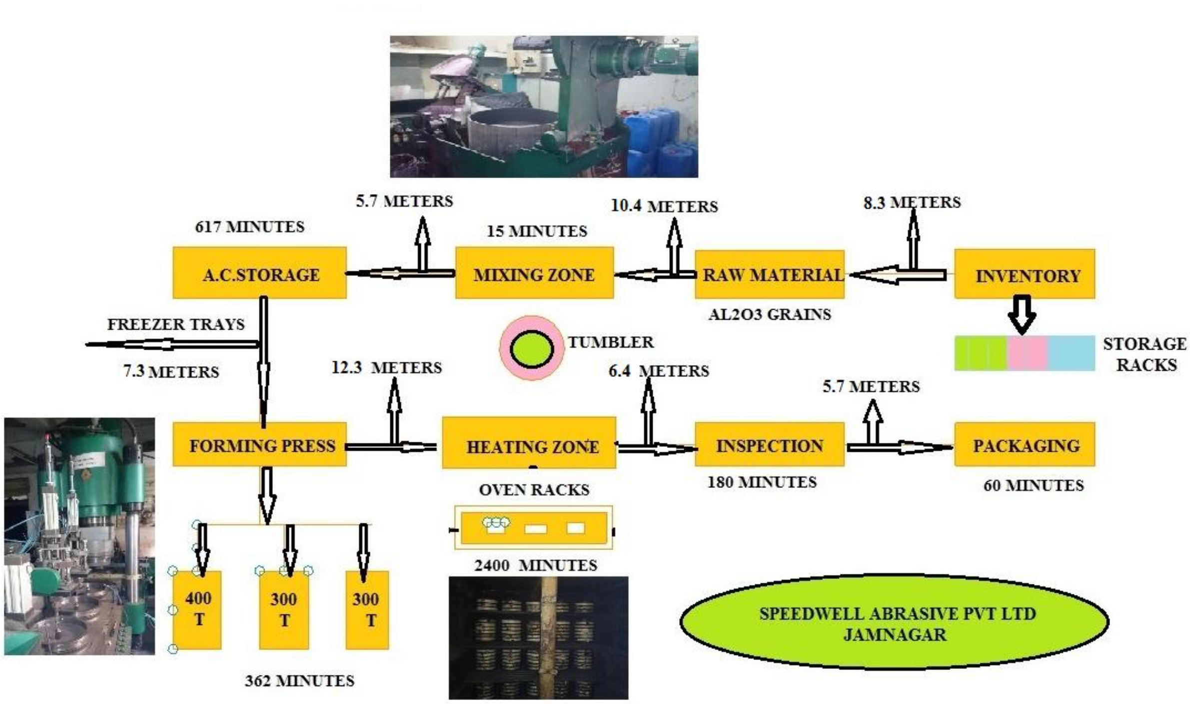
Step 5: Map the information flow.

Step 6: Level the production Volume

Step 7: Develop the ability to make "every part every day" (then every shift,


Production Control
Monthly
Weekly
Daily
Monthly
Weekly
Daily
Supplier
Customer
Shipment
Shipment
Storage
Mixing Process
C/T=15min
Shift=2
Uptime=85%
Cooling Process
C/T=617min
Shift=2
Uptime=85%
Forming Process
C/T=362min
Shift=2
Uptime=85%
Heating Process
C/T=2400min
Shift=2
Uptime=85%
Inspection Process
C/T=180min
Shift=2
Uptime=85%
Packaging Process
C/T=63min
Shift=2
Uptime=85%
Finish goods storage
0.22 day
0.132
0.132
0.088
0.132
0.088
0.176
15min
617min
362min
2400min
180min
63min

Modified Layout of Industry



VII. CONCLUSION

From review of above literature we can conclude the following points:

1. Not only hard and strong wheels, but also elastic wheels were obtained by the selection of resins with a proper bending strength and when elastic modulus is used as a grinding wheel.
2. An increase of geometrical accuracy of profiles of the grinding wheels can be obtained using plain water jets.
3. It has been shown that the development of vitrified CBN grinding technology is a collaborative partnership between end user, machine tool builder, and abrasive supplier Continued collaboration in addition to new developments in materials technology associated with abrasive products and camshafts will reduce grinding costs even further.
4. Reconfigurable machine tools system would enable the system to adjust functionality and capacity according to feedback from demand and market fluctuations. The performance measures of the Reconfigurable manufacturing system gives an indication to choose the configuration in each stage.

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