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IMPROVING PRODUCTIVITY THROUGH IMPLEMENTATION OF LEAN WITH IN CEMENT PLANT

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ABSTRACT

The Implementation of lean helps many organizations to improve their productivity and efficiency; on the other hand many organizations could not get the benefit of lean. The main objective here is to apply lean manufacturing technique to the eliminate waste in the processes of manufacturing. OEE and TPM are most used lean technics in this paper to improve productivity by reducing wastes. Overall equipment effectiveness (OEE) is important measurement tool for equipment effectiveness. An attempt has been done to measure and analyze existing overall equipment effectiveness of machinery producing Portland cement .Total Protective Maintenance is a strategic tool used to reduce waste and improve the efficiency and competitiveness of an organization.in this paper we are only focus on kiln system because OEE less than the other systems.by using of OEE, root cause analysis and implementation of TPM in kiln system to improve productivity 96 tons per month.

Key words: Lean technology, wastes, OEE, root cause analysis and TPM

I. INTRODUCTION

The cement is mostly found universally in daily life and it is not possible to imagine a society without it. In construction major role of cement is found as it is the basic input in infrastructure. Cement is produced in all over world but about 75 % of it is produced and used in developing country. The cement industry can be a successful sector in the areas where raw materials are available. The main problem with cement industry is to reduce the waiting time to overcome the demand of market and to reduce all other waste to improve the productivity. The cement industry is characterized by intensive energy and raw materials, high breakdowns, large Work-In-Progress inventories, and the need to increase the productivity in order to meet high demands of their customer. The situation of not achieving the expectation of high production rates, low breakdown rates in the cement production line has motivated me to design an implemented lean technique by which the cement production line will be improved

Implementation of lean has helped many organizations to improve their productivity and efficiency. Lean originated in the automobile manufacturing sector and has spread widely within the discrete production industries. The current challenge is to implement the lean philosophy within non-discrete production environments such as continuous manufacturing industries and service industries regardless to the type, size, or mission of the applicant organization. This paper will describe work undertaken investigating the application of lean thinking to a continuous production environment, in this instance exemplified by the cement industry

Effectiveness and efficiency are very important in today's competitive market. Greater the effectiveness and efficiency more productive is the organization. Overall equipment effectiveness is such a performance measure, which indicates current status of production with least calculations. It also helps to measure losses and corrective actions can be taken to reduce it. Effective utilization of all four M's will result into higher productivity.

Overall equipment effectiveness (OEE) is a product of three important parameters, Availability, Performance Rate and Quality Rate. When higher productivity is expected the machine tools which are involved in manufacture of finished goods, must be reliable. Reliability includes availability of machines with least down time. If MTBF (Mean Time between Failures) is more, it indicates machines are available for its desired performance. Attempt must be made to reduce mean time to repair (MTTR) and improve MTBF. It requires failure data analysis and root cause analysis. The failure data collected will help us to calculate availability of equipment

$$\text{OEE} = \text{Availability} \times \text{Performance Rate} \times \text{Quality Rate}$$

$$\text{Availability} = (\text{Loading Time} - \text{Down Time}) / \text{Loading Time}$$

$$\text{Performance Rate} = \text{Operating speed} \times \text{Net operating rate}$$

$$\text{Quality Rate} = \text{Good parts produced} / \text{Total Parts produced}$$

TPM (Total Productive Maintenance) is a holistic approach to equipment maintenance that strives to achieve perfect production:

- No Breakdowns
- No Small Stops or Slow Running
- No Defects
- In addition it values a safe working environment:
- No Accidents

TPM emphasizes proactive and preventative maintenance to maximize the operational efficiency of equipment. It blurs the distinction between the roles of production and maintenance by placing a strong emphasis on empowering operators to help maintain their equipment.

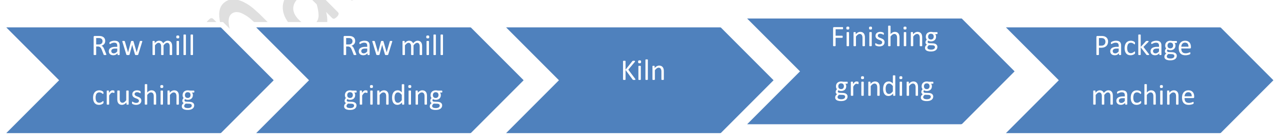
The implementation of a TPM program creates a shared responsibility for equipment that encourages greater involvement by plant floor workers. In the right environment this can be very effective in improving productivity (increasing up time, reducing cycle times, and eliminating defects).

II. METHODOLOGY

The total manufacturing process is divided into 5 stages which are listed below from upstream to downstream sequences

1. Crushing System
2. Raw Grinding System
3. Burning System
4. Finish Grinding System
5. Packing & Dispatch System

FLOW CHART FOR MATERIAL FLOW



Data collection

A systematic approach of collecting true data is given in the table below. Excel tool is used to collect data of all the manufacturing equipment’s. Daily calculation of OEE is possible if given format is used to record data. Following table specify format of true data collection of one month required to calculate OEE.

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Machine name	Available time(min)	Scheduling time(min)	Un scheduling time(min)	Actual time up	Availability%
Raw mill crusher	43200	3500	160	39540	91.52
Raw mill grinder	43200	3950	175	39075	90.45
kiln	43200	5468	302	37432	86.65
Finishing grinding	43200	4155	190	38855	89.94
Package machine	43200	3650	160	39390	91.18

Machine name	Ideal cycle time(min)	Actual cycle time(min)	Performance rate%
Raw mill crusher	1440	1315	91.31
Raw mill grinder	1440	1353	93.95
kiln	1440	1248	86.66
Finishing grinding	1440	1296	90.00
Package machine	1440	1320	91.66

Quality is not a problem for this industry as rejection rate is very low. so Quality rate found to be 97% to 100%.

Machine name	Availability %	Performance rate%	Quality rate%	OEE%
Raw mill crushing	91.52	91.31	98	81.89
Raw mill grinding	90.45	93.95	98	83.27
Kiln	86.65	86.66	98	73.59
Finishing grinding	89.94	90.00	98	79.32
Package machine	91.18	91.66	98	81.90

So as a benchmark, what is considered a “good” OEE score?

- An OEE score of 100% is perfect production: manufacturing only good parts, as fast as possible, with no stop time.
- An OEE score of 75% is considered world class for manufacturers. For many companies, it is a suitable long-term goal.
- An OEE score of 60% is fairly typical for discrete manufacturers, but indicates there is substantial room for improvement.

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- An OEE score of 40% is not at all uncommon for manufacturing companies that are just starting to track and improve their manufacturing performance. It is a low score and in most cases can be easily improved through straightforward measures (e.g. by tracking stop time reasons and addressing the largest sources of downtime – one at a time).

OEE = AVAILABILITY * PERFORMANCE RATE *QUALITY RATE

82.33 % * 86.66 % * 98% =73.59 %

TARGET

75%

We are considering 75% of world class manufacturing plant so all machineries maintains the benchmark but kiln have 73.59% .so we are improve OEE by reducing breakdowns in kiln system

Breakdowns in kiln system

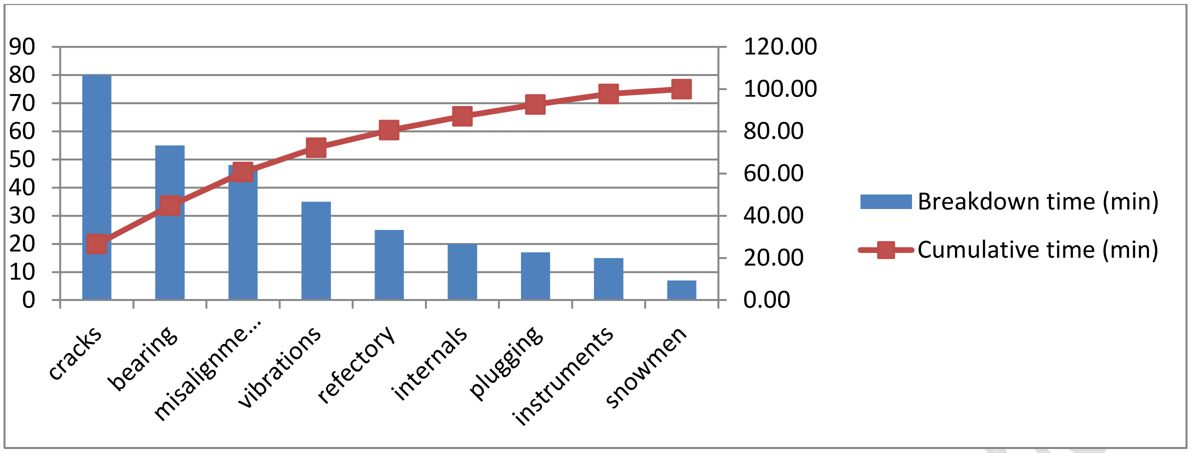
Defects	Breakdown time (min)	Cumulative time (min)
cracks	80	80
bearing	55	135
misalignment	48	183
vibrations	35	218
refectory	25	243
internals	20	263
plugging	17	280
instruments	15	295
snowmen	7	302

Pareto chart

A Pareto chart is a visual tool used to help identify which problems are most significant, so that improvement efforts can be focused where they will have the greatest impact

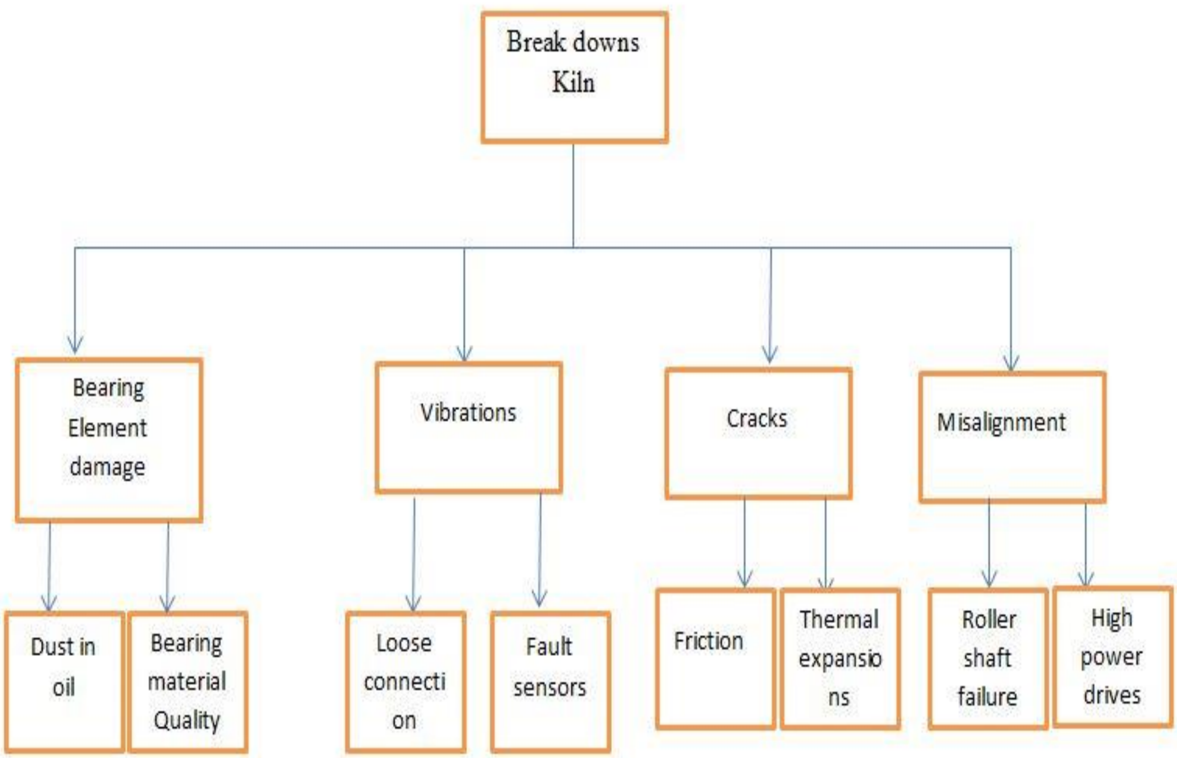
We can use the Pareto chart to focus on the area where we can have the greatest financial impact in the least amount of time, or with the fewest resources

Often we see the “80/20 Rule ”- where the majority of the errors or defects come from only a small fraction of the problems Pareto charts help us focus our limited resources on those areas where we can get the greatest results



Root cause analysis

Root cause analysis (RCA) is a method of problem solving used for identifying the root causes of faults or problems



IMPLEMENTATION TOTAL PRODUCTIVE MAINTANCE

1. **CRACKS**

The severest sign of shell stress is cracks in the steel plate. The shell stresses that lead to cracking are caused by the following factors:

- **Thermal expansion**

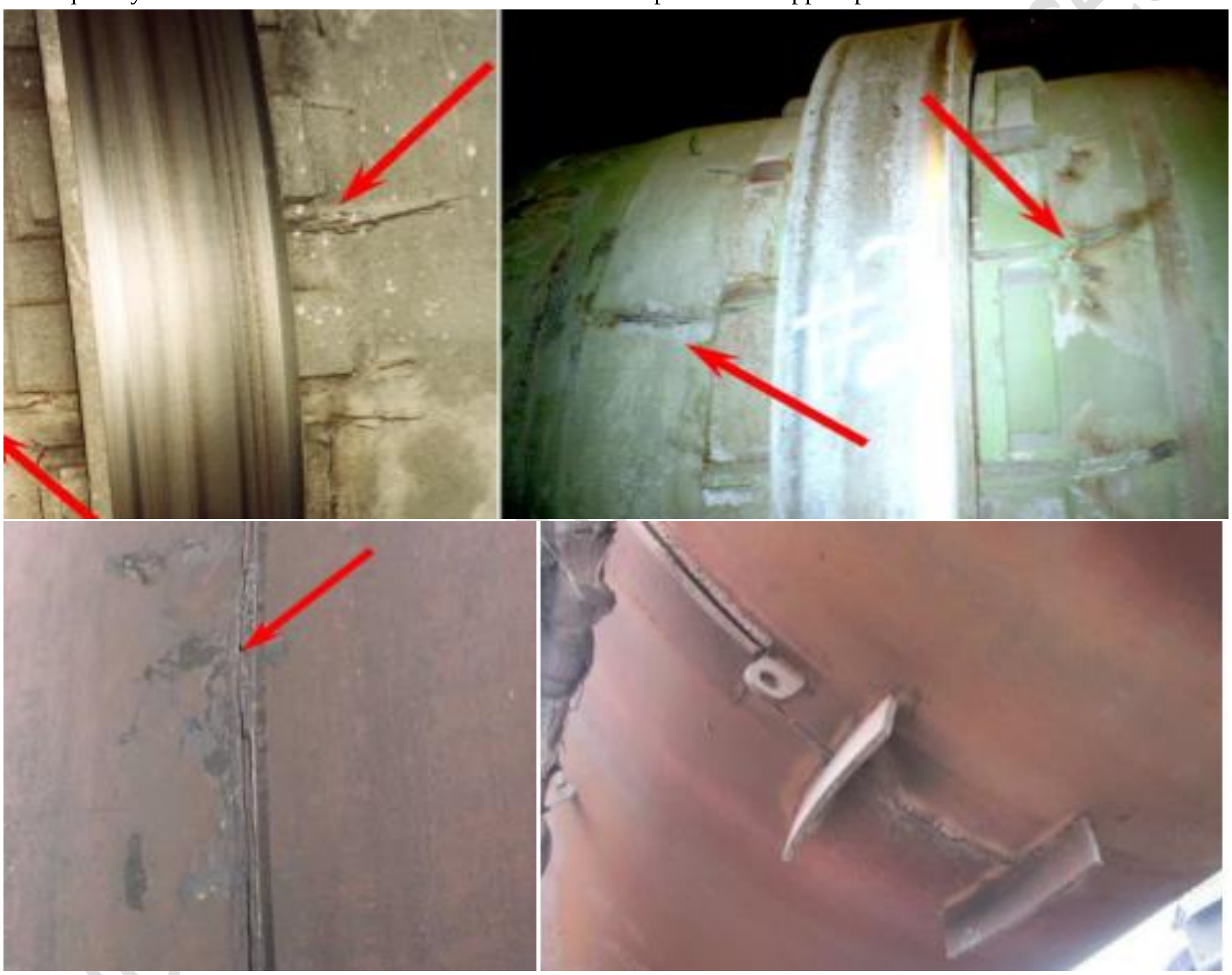
During the normal operation of any kiln shell the temperature fluctuates, causing the shell to expand and contract. The tire support pads expand and contract at a different rate than the shell, creating stresses in the welds used to attach the bars to the shell. These stresses are created from both longitudinal and circumferential forces

- **Friction**

Tires are mounted loosely on the shell to allow for the different rates of thermal expansion of the tire and the shell. As a result, the tire will have circumferential movement relative to the shell. This is referred to as creep or slip. There is generally a sliding component from this action that creates stress in the welds attaching the tire pads to the shell

- **Tire Thrust**

As the unit is moving axially by carrying roller adjustment or thrust roller positioning, a force is transferred from the tire to the shell. This force is applied on the retaining rings or tire stops and consequently causes stress in the welds that attach the tire stops and the support pads to the shell.



NON-DESTRUCTIVETESTS (NDT) FOR SHELL CRACKS

i. ULTRASONIC & X-RAY EXAMINATION

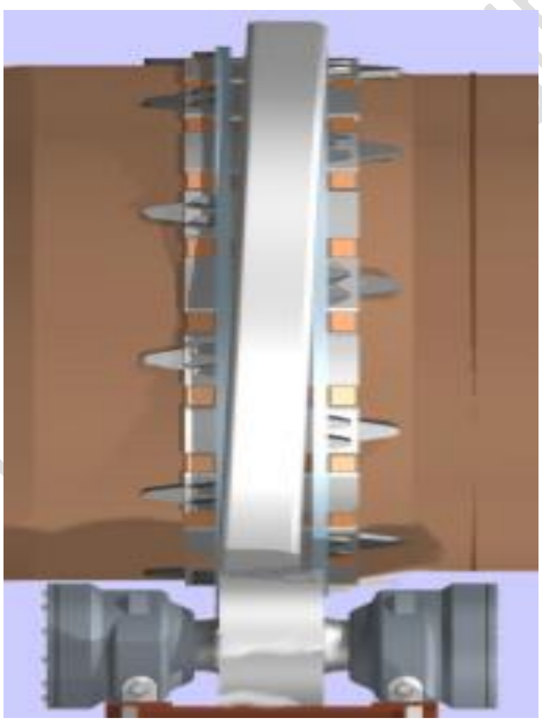
(a) requires experienced technician
(b) shows sub-surface cracks
(c) helps determine exact extent of cracks

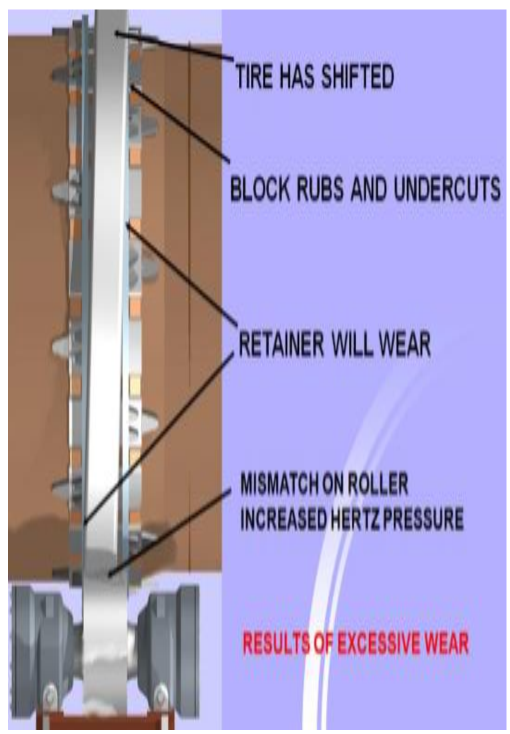
ii. DYE PENETRANT &MAGNETIC PARTICLE INSPECTION

1) easiest to perform
2) limited to surface cracks
3) used primarily during repairs

2. MISALIGNMENT

Misalignment obtain possibilities are
a. Excessive Flexing
b. Refractory Failures
c. Plate Cracking
d. Roller Shaft Failures
e. High Power Drive





CORRECTING PROBLEMS

a. replace tire if damaged beyond repair
b. grind tire and rollers so they are smooth
c. replace filler bars and stop blocks
d. replace shell if collapsed

If the problems you have observed are severe, you may have to replace the tire or roller. A way to solve a problem that has been caught early is to grind the surfaces of the tire smooth. The roller should be ground at the same time. (See "Resurfacing and Grinding" section). A third solution is to replace the worn filler bars and stop blocks. Doing this will not only replace worn out components but rehoming the filler bars will reduce creep.

If the shell has collapsed under the tire and filler bars, a section may have to be replaced. This alone is a very good reason to be aware at all time of the potential problems inherent in the design of rotary equipment

III. VIBRATION

Check to see that the gears are running with proper root clearance or backlash. Too little clearance will cause gear teeth to "jam" together as they mesh causing a vibration problem as the top land of the tooth "pounds" into the bottom land. If you observe a vibration that is intermittent, check first for interference on either end of the kiln end of the gear enclosure. If there are no signs of any rubbing, it is most likely that the shell has a bend that is causing the gear to run out. If this is the case, the vibration will be in a direct relationship with the shell warp. As the bent area of the shell passes across the pinion, the vibration can be felt as the gear teeth "'bottom out". If the vibration is constant throughout the entire rotation, the kiln is acceptably straight but the contact surfaces of the riding rings, support rollers or filler bars have worn enough to lower the kiln to a point of interference of the gear mesh. Too much clearance creates excessive backlash, which under certain conditions also causes a vibration problem. If there is a severe bend in the shell, even though it is not an area that causes gear run out, or perhaps a large uneven buildup of product coating, an unbalanced load is created in the kiln. As the heavy side of the kiln passes over the top center and proceeds on the downward side of rotation, the gear will try to "overrun" the pinion. If excessive backlash exists, intermittent vibration will appear at a frequency equal to gear tooth engagement frequency.

Problem solving suggestions

- Clean & measure amount of wear to teeth.
- Fix leaking seals.
- Check teeth for abnormal wear.
- Change gear lubrication.
- Clean bottom of gear guard.

IV. RESULT

Table for breakdown before and after TPM

Defects	Breakdown times (mints) before TPM	Break down times(mints) after TPM
cracks	80	14
bearing	55	11
misalignment	48	8
vibrations	35	6
refectory	25	5
internals	20	7
plugging	17	3
instruments	15	4
snowmen	7	3

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OEE of kiln before TPM =availability * performance rate * quality rate

86.65 % * 86.66 % * 98% =73.59 %

OEE of kiln after TPM = availability * performance rate * quality rate

87.20% * 87.9% *98% = 75.11%

$$\text{Throughput} = \frac{\text{SRT – break downs}}{\text{CT}}$$

SRT = scheduled run time

CT =cycle time

Cycle time of kiln in the plant=2.5 tons/min

Throughput before TPM = (37732-302)/2.5

=14972 tons

Throughput after TPM = (37732-60)/2.5

=15068 tons

productivity = Throughput after TPM- Throughput before TPM

=15068-14972

=96 tons

	Before TPM	After TPM
availability	86.65 %	87.20%
performance rate	86.66 %	87.9%
quality rate	89%	89%
OEE	73.59 %	75.11%

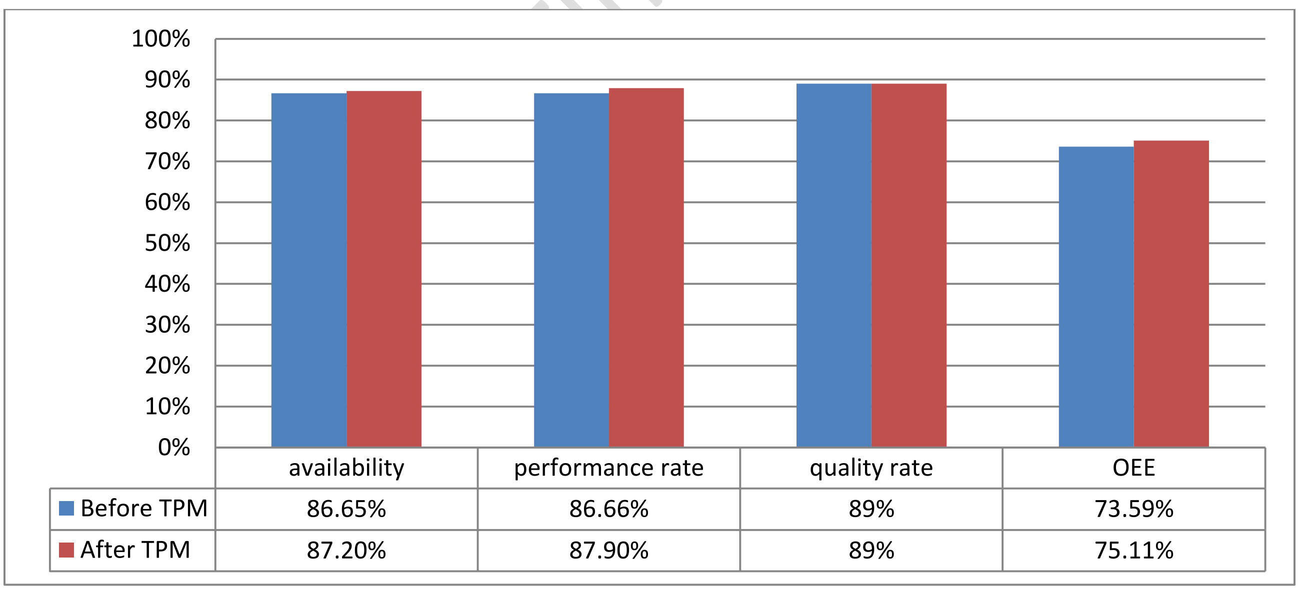

Fig: Analysis of OEE

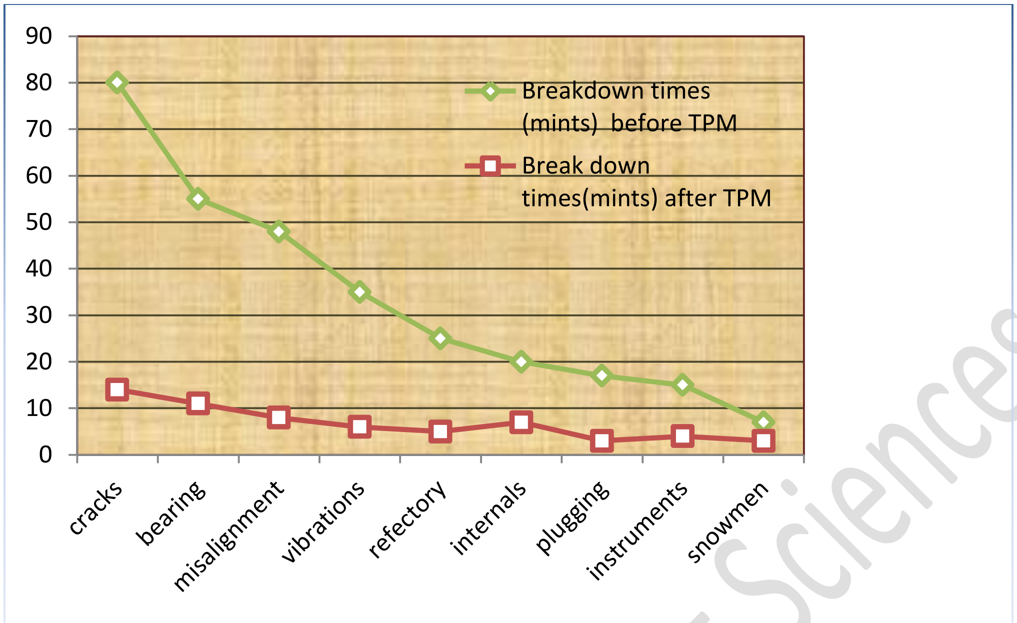

Fig: Analysis of break down times

Suggestions of implementation TPM

- Perform Initial Cleaning
  - Eliminate dust and dirt from main body of equipment
  - Expose irregularities such as slight defects, contamination sources, inaccessible places,
  - Sources of quality defects o Eliminate unnecessary and seldom-used items, and simplify equipment
- Establish cleaning and checking standard
  - Formulate work standards that help maintain cleaning, lubricating, and tightening levels with minimal time and effort
  - Improve the efficiency of checking work introducing visual controls
- Conduct general equipment inspection
  - Provide inspection skills training based on inspection manuals
  - Get individual equipment items into peak condition by subjecting them to general inspection
  - Modify equipment to facilitate checking. Make extensive use of visual controls
- Perform general process inspection
  - Provide instruction in process performance, operation, and adjustment and in methods of handling abnormalities in order to improve operational reliability by developing process competent operators
  - Prevent inspection duplications and omissions by incorporating provisional cleaning and inspection standards for individual equipment items into periodic inspection and replacement standards for entire processes or systems
- Systematic autonomous maintenance
  - Achieve quality maintenance and safety by establishing clear procedures and standards for dependable autonomous maintenance
  - Improve setup procedures and reduce work-in-process

- Establish a system of self-management for workplace flow, spares, tools, work-in-process, final products, data, et

➢ Practice full self-management

- Evolve activities and standardize improvements in line with company and plant policies and objectives, and reduce costs by eliminating workplace waste
- Improve equipment further by keeping accurate maintenance records (ex, MTBF) and analyzing the data in them

V. CONCLUSION

Lean manufacturing technique are used to find waste (break downs and waiting times) in cement industry .through root cause the main significant causes that effects the OEE at kiln system are identified and reduced by implementing total productive maintenance.

After implementation of TPM

1) The break down times at kiln system decreased from 302 mints to 60 mints
2) Through put was increased from 14972 tons to 15068 tons.
3) Through put was increased 0.64% (i.e.5,36,000 INR per month)

References

1) C.J. Bamber, P.Castka, J.M.Sharp, & Y.Motara, 2003 “Cross Functional team Working for Overall Equipment Effectiveness”, Journal of Quality in Maintenance engineering, Vol 9 No.3, pp. 223-238
2) F. T. S. Chan, H. C. W. Lau, R. W. L. Ip, H. K. Chan & S. Kong, 2005 “Implementation of total productive maintenance: A case study”, Int. J. Production Economics, Vol. 95, p. 71-94
3) I. P. S. Ahuja & J. S. Khamba, 2008, “Total productive maintenance: literature review and directions”, International Journal of Quality & Reliability Management, Vol. 25 No. 7, p. 709-756
4) M.C. Eti, S.O.T. Ogaji, & S.D. Probert, 2004 “Implementing total productive maintenance in Nigerian manufacturing industries”, Applied Energy, Vol.79, p. 385-401
5) Orjan Ljungberg, 1998 “Measurement of Overall Equipment Effectiveness as a basis for TPM activities”, International Journal of Operations & Production Management, Vol 18 No.5, pp 495-507.