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LEAN PROCESS MANAGEMENT IMPLEMENTATION IN CERAMIC INDUSTRY

K. ANUJ BABU*, A. THIRUGNANAM and S. P. SUNDAR SINGH SIVAM

Department of Mechanical Engineering, SRM University, Dist.: Kancheepuram, KATTANKULATHUR – 603203 (T.N.) INDIA

ABSTRACT

Lean manufacturing is one of the most powerful systems in the world. The idea of lean manufacturing has continued to get use and visibility on a figure of fronts. Lean is frequently heralded as manufacturers' best hope for critical cost and retrieval their original edge. Implementation a lean manufacturing works is vital in the ceramic industry manufacturing tiles. Most would agree with the Lean manufacturing is the core idea of "maximizing customer price while minimizing waste" and "creating more value for clients with fewer assets. Several plants around the world have attempt to execute lean manufacturing to abolish Non value added processes and wastes. When it comes to a ceramic industry manufacturing tiles, by the very nature of its process manufacturing, the material flow is both continuous and non continuous. Continuous and non continuous processes mixed in a ceramic industry has their own set of major wastes caused by downtime, miscommunication and mishandling .To eliminate such wastes this study implementation of lean tools such as Root cause analysis, visual factory and multi functional employee to eliminate downtime, miscommunication and mishandling for three unit such as Hydraulic press, Bearing failure in drier and kiln Owen. This study was conducted in a ceramic tile industry manufacturing polished glaze vitrified tile (PGVT) for a time-span of six months. This study concludes that by using lean tool Root Cause Analysis can keep the downtime at minimum by eliminating the source of the problem in Bearing failure in drier, Hydraulic press and Owen resulting in non repetition of the same problem, using visual factory miscommunications are kept at minimum and by using multi functional employee mishandlings errors can be reduced. After performance of *lean tools* reduced the discards and breakdown by an average of 40% and also cost. This also reduces the dissipate disposal problem and energy expenditure thereby falling ecological, collective and cost-effective burden. Multi functional remuneration have also been experiential in term of skill up-gradation, team service, multi talents and improved confidence of the workers.

Key words: Ceramic tile industry, Lean process management implementation.

*Author for correspondence; E-mail: legendsundar2k6@gmail.com

INTRODUCTION

In today's competitive market, where profit margins are small and resources costly, manufacturing industry has on purpose started looking for customs to improve the efficiency of production. In this context, implementation of a manufacturing strategy which focuses on reduction of waste during production, and promotes reuse and recycling of finished products has a great impact on product quality, tools accessibility, surroundings, and overall efficiency [1]. In India, the ceramic industry has witnessed fast growth in demand primarily due to growth in construction and housing sector. This has led to burgeoning demand for sanitary ware, floor and wall tiles [2]. Ongoing reforms in the power sector and expansion of distribution of infrastructure has resulted in demand for insulators, especially high tension insulators (33kVA and above). This is likely to represent a captive market that is expected to grow steadily for at least 5-10 years [3, 4]. The major problems faced by these labour intensive industries are irrational industrial structure, over volume of low class products and large rejections. Similar results were obtained in a research related to the Chinese ceramic industry taken up by Li [1]. Li [1] also mentions that the concentration extent of the ceramic industry in China is low, and competition is fierce, so profitable capability of the enterprise holds key importance for the development of companies. Some of the problems faced by the ceramic industry may be sorted by reducing rejections. The making of ceramic products can be in-between in to three individual phase - pre-kiln, kiln and post-kiln operations. Defects and resultant rejects in the pre-kiln operation can be pressed back and recycled as the material is in semi-solid state. However, post-kiln rejections of ceramic cause sustainability issues because (i) the post-kiln ceramic cannot be worked upon to remove the defect, (ii) post-kiln ceramic are non-recyclable, (iii) more than 90% of method energy is consumed in pre-kiln and kiln operations which gets wasted. This causes waste removal problems as well as the surroundings problems as most of the energy is spent in pre-kiln and kiln operation. This provides the stimulus for the study to condense the post-kiln rejection by discovery the root causes and applying the kaizens to remove the causes of the rejections.

Need for study

The dynamics of markets, expertise, and struggle have made administration to establish new goods extremely often, and if the same has been well accepted by the market organisations should torrent goods before the involve cultivate of inferior quality. While ramping up the ability organisations should keep. The study was carried out in a ceramic tile manufacturing company such as Flooring tiles, wall tiles etc. The process was analysed and here the main scope is Increasing Production and Eliminating Waste through Lean Tools and Techniques for this ceramic manufacturing industry in such departments like Kilin Owen Hydraulic press and bearing failure in drier.

Ceramic manufacturing industry case study

The XXX group is a foremost unit in the field of industrial soaring voltage and added soaring voltage alumina porcelain insulators vital for broadcast lines, sharing out lines, sub-stations, railway electrification, Electrical switch gears, etc. It was set up in 1985 and presently company is producing 1550 metric tonnes (MT) per month of insulators with annual earnings of 400 Cores and 1500 employees. It was fully capable of recent plant with initial install capability of 4000MT per annum Company is struggling to fulfil the demands of the customers due to high rejection rate in the post-kiln operations. It has started many manufacturing strategies/tools and techniques to control the rejection rates. A cross-functional team was formed to analyse the processes, to find the main rejections, to suggest the root causes of rejections and to implement the kaizens to reduce the main rejections. The team includes Production Planning Control (PPC) personnel, champion, managers, supervisors, quality inspectors, and operators. The members of the team were drawn from various functions at different hierarchy. The team coined a goal "increase productivity, quality and decrease the defects to meet fluctuating customer demand".

Tile production flow

Here there are 10 steps in the ceramic tile manufacturing process listed in below the stages.

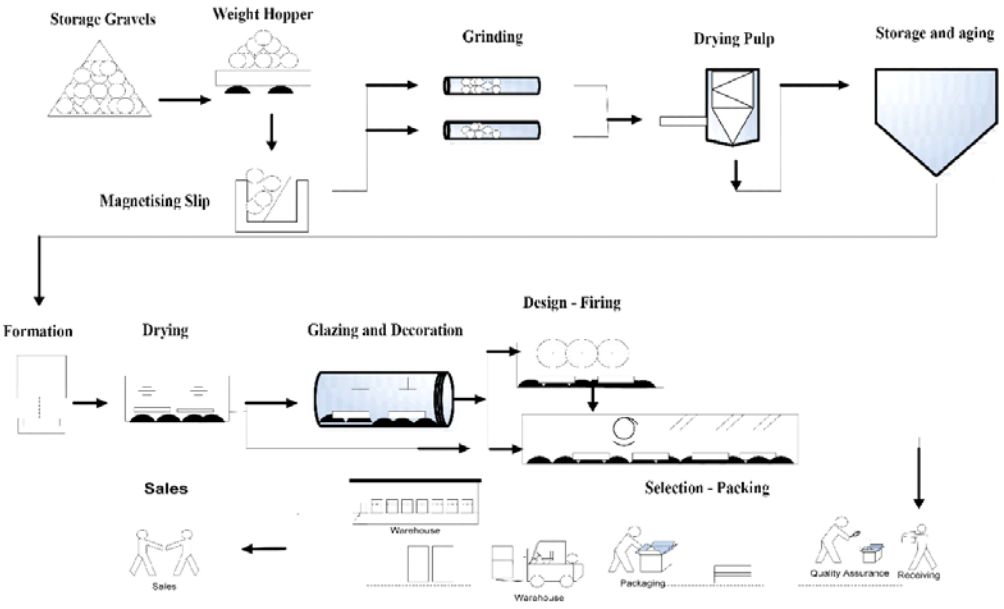


Fig. 1: Tile production flow

The Fig. 1 shows the tile production flow in that the initial step would be strorage gravels followed by weight Hopper, grinding, Drying soft tissue, Storage and aging, Formation, Drying and decoration, Glazing, Design – Firing/Oven last Selection – Packing).

Ishikawa/Fishbone diagrams/Cause and effect diagrams

The Ishikawa diagrams, also known as the Fishbone diagrams or the Cause and Effect diagrams, are diagrams that show the causes of a certain result. Common uses of the fishbone diagram are product design and quality defect prevention, to identify potential factors causing an overall effect. Each cause or reason for imperfection is a source of variation. Causes are usually grouped into major categories to indentify these sources of variation. The Categories typically include materials, man, machine, methods and the environment (Tague, 2004). The ceramic tile manufacturing plant focusing further on achieving the desired cost, the avoidance of carelessness, the acquisition of knowledge and the correct operation it will succeed perfectly the proper adoption of creations methods a good quality Ceramic tile.

Go lean – Visual factory

Lean Manufacturing Visual Factory refers to lean manufacturing theory. It describes visual methods a factory or any manufacturing plant can use to communicate information about a process to everyone who needs to understand it as they work.

A visual factory uses a collection of conceptual tools that will convey information in a clear, accurate, efficient, and organized way to those who need to know it. Since this visual information is easier to comprehend then verbal or mathematical symbols, information is conveyed via signs, graphics, photographs and charts. This information is quickly comprehensible and easily accessible to those who need to understand the status of a process. Moreover, this way of communication becomes even more valuable when processes evolve and become increasing complex. Using this method, even complex information can still be quickly grasped and put to use.

Data collection and analysis

In this chapter the data collection and analysis for bearing failure in kiln, Hydraulic press and oven has been analysed by fishbone diagram and rectified.

Bearing failure modes

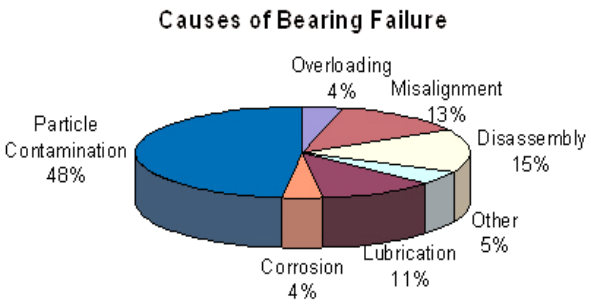


Fig. 2: Bearing failure

Root cause analysis for bearing failure

S. No.	Main cause	Why-Why analysis (1st)	Why-Why analysis (2nd)
1	Misalignment	Alignment does not take process conditions	Improper skill or knowledge on hot service
		Excessive piping strain	Improper piping/Support installation
		Erratic instrument reading	Absence of instrument calibration
2	Wrong mechanical seal assembly	Improper personnel skill	Lack of awareness or focused training
		Use of non-standard Materials	Not adhering to standard procedure /Spare parts
3	Damage to bearings during installation	Improper use of tools and tackles	Not adhering to standard procedure
		Use of defective bearing	Use of non-inspected (by SKF) bearing
4	Bearing failure while in operation	Improper lube oil level	Defective bearing isolator/Leveler
		Improper lube oil quality	Use of contaminated oil/Handling issue
		Excessive cooling or Heating of housing	Improper cooling system/Choice of lubricant/Defective oil ring or splasher

Cont…

S. No.	Main cause	Why-Why analysis (1st)	Why-Why analysis (2nd)
5	Suction pressure variations/Low flow/ Pump cavitations	Operation outside acceptable range	Absence of suction surge vessel
		Operation much lesser than design point	Pump too big to handle lower throughput
		Deviation in operating parameter/Cavitations	Process upset
6	Improper flushing of seal	Connected piping is chocked	Not adhering to procedure/Checklist
		Improper piping orientation	Ignorance or insufficient knowledge
7	Frequent changeover of the pump	Plant follows 15 day cycle it is too frequent to adopt	No defined practice available

Fish bone diagram for bearing failure

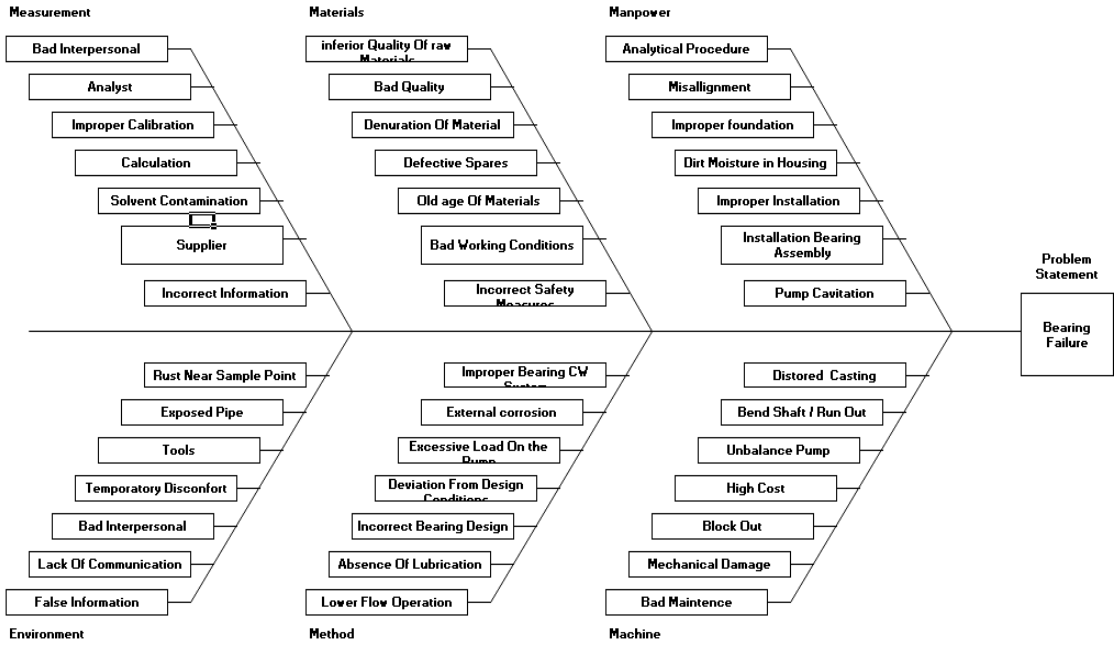


Fig. 3: Fish bone diagram for bearing failure

Fish bone diagram for hydraulic press

In Fig. 4, the promising causes for happening problems of press are recognized. It is obvious that a quantity of potential causes which can found as the major cause of challenging operation of Press and hence the making of a non-conformation manufactured goods is the bad planning, the unsuitable direction, the low act evaluation of the worker and the shocking assistance. These are the fields were the company should be purposeful and fixed to preventative and remedial actions. In addition possible causes of failure of a ceramic tile may be the incomplete education, the small budget, the unawareness and the reduced purchase of raw materials which finally indicate that the equipment are a possible main cause. Thus, the company must be careful and continue with corrective actions. Furthermore, the careful collection of manufacturer machinery, the detection of finance and low maintenance cost of the machine as the use of the machine as regards the time if they will be in concentration from the company they will not establish as main cause of breakdown of a ceramic tile the machine. Similarly, through inferior costs, proper management, a good production planning and a good division of labour means that the company follow appropriate methods that donate to product agreement to requirements. A better product, a good environment and sufficient equipment of environmental protection are important for a Good surroundings that will not cause a problem in the press and in the making of non-quality manufactured goods.

Fig. 4: Fish bone diagram for hydraulic press

Data collection and analysis for hydraulic press

For the current study furnished below are the data collected to understand the current status of the problem.

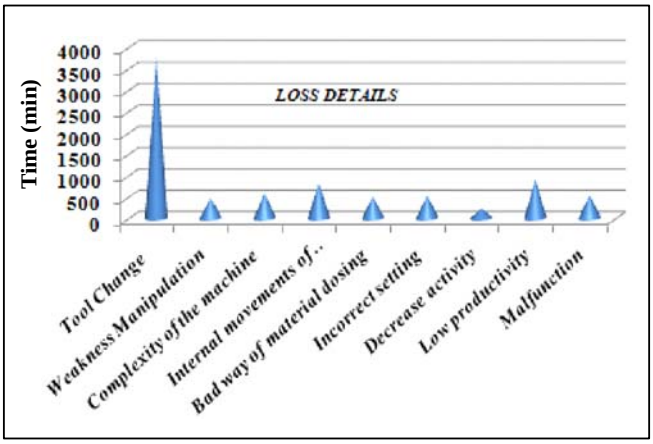


Fig. 5: Data collection and analysis for hydraulic oven before lean implementation

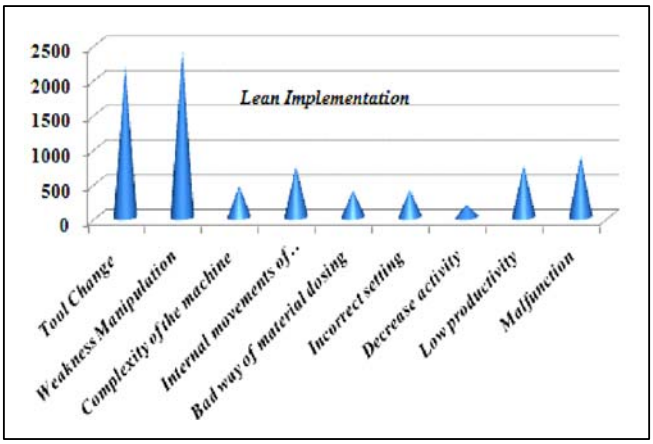


Fig. 6: Data collection and analysis for hydraulic oven after lean implementation

Before implementation of tools, there were no standards of the performed work. Machine operators were unable to perform the planned standards of quantity. Due to absence of planning, the work performed by the employees was ineffective. Raw materials were placed several dozen meters away from the workstation. In order to retool the machine, a worker had to switch it off go to the storehouse to collect moulds as well as the necessary tools and components. The tools were not kept in one place and each time the operators had

to look for the necessary accessories all over the production hall. Time was wasted on processing the waste mass. After implementing lean tools and visual factory the following results of tests and taken measurements are shown in Fig. 5 & 6 obtained data was averaged. Seconds were used as units of measurement of individual steps taken by the operators, and the total time was given in minutes. The Table shows the time of Tool Change & Weakness manipulation as the process enquiring 22 steps. On average, there is one retooling taking place during one week.

Data collection and analysis for owen in klin

For the current study furnished below are the data collected to understand the current status of the problem.

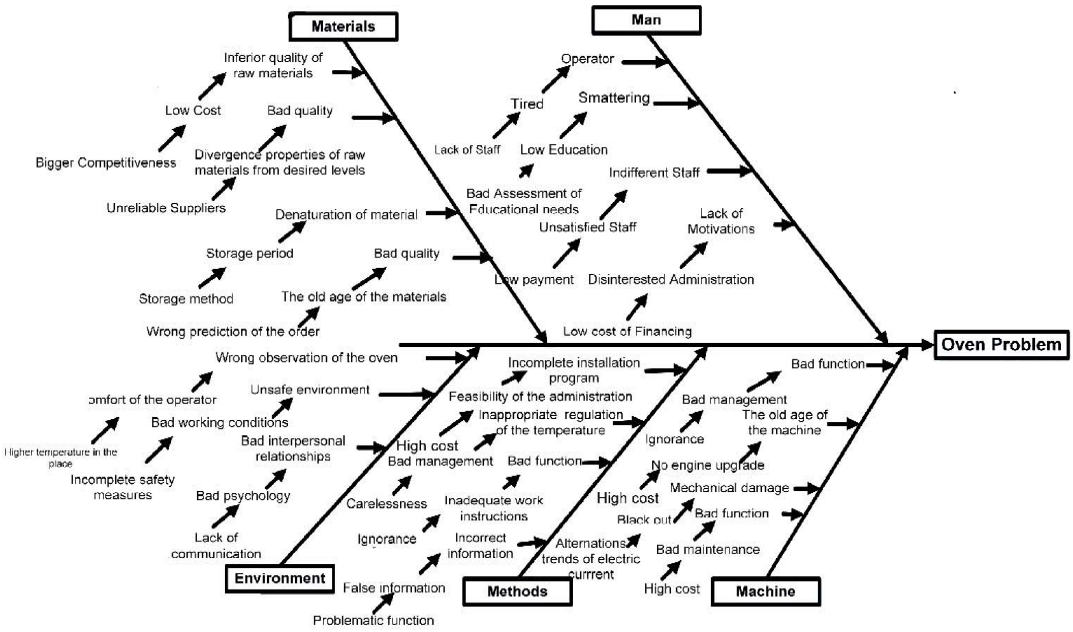


Fig. 7: Fish bone diagram for Klin Oven

The ceramic tile manufacturing plant focusing extra on achieve the required cost, the prevention of negligence, the achievement of information and the correct process it will succeed completely the appropriate acceptance of creation methods a good quality Ceramic tile. Furthermore, as shown in Fig. 7, some other possible causes that may establish the environment as the main reason of malfunction, is notice to the evaluate temperature in the ecological place for oven, the acceptance of suitable protection measures and enhanced statement.

Data collection and analysis for oven in Klin

For the current study furnished below are the data collected to understand the current status of the problem.

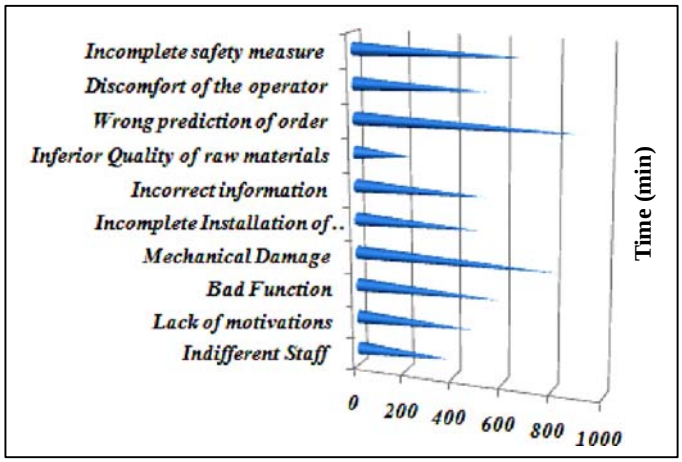


Fig. 8: Data collection and analysis for Klin oven before lean implementation

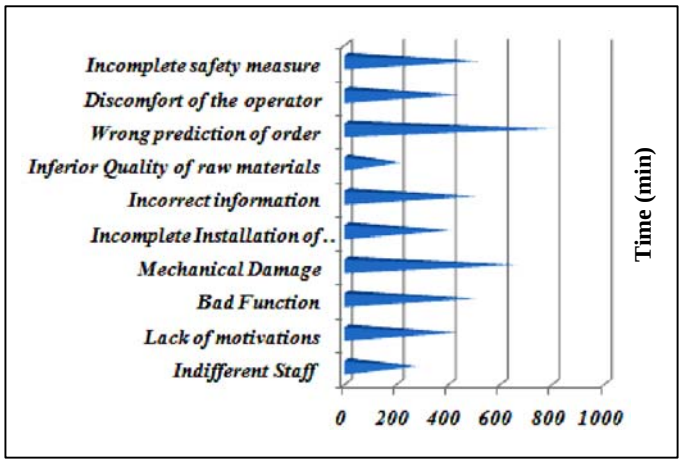


Fig. 9: Data collection and analysis for Klin oven after lean implementation

Before implementation of lean tools and visual factory, there were no standards of the performed work. It is obvious that some possible causes, which shows as the main cause the man for the problematic operation of the Oven and especially for the non-conformation of the ceramic tile are the lack of the staff, the bad assessment of educational needs, the low payment and the low cost of financing, which should be resolved by the ceramic tile

manufacturing plant and corrected to let it to produce a conformal product. By the observation of the competition for lower prices of better quality materials, with the selection reliable Suppliers, with the appropriate choice of storage and with the correct prediction order where the materials will not be stored for a long time of period, and as a result they will have a good quality. Respectively, the knowledge, the cost, the alternations trends of electric current can introduce even the equipment as the main cause of bad usage of the machine and non-conformation of the products which must be in attention in order the Manufacturing plant to produce qualitative product.

Visual factory implementation

S1 – Sort

Sort refers to the tradition of leaving through all the tools, materials, etc., in the work area and keeping only essential items. Everything else is either stored offsite or unused.

Action Steps	Resources
1. Identify a 5S-project area and take "before" pictures 2. Review sorting criteria for ceramic industry 3. Create a local red tag area for department 4. Tag, record, and move red tagged items 5. Take "after" pictures 6. After target time, move unclaimed items to the central red tag area	1. Red tags 2. Red tag record forms in ceramic industry 3. Camera for “before” and “after” pictures Some companies create a central storage area for 5S supplies and designate a 5S coordinator to Manage supply stock in ceramic industry

Here red tags used to identify the unused items

Items to be discarded are placed in a local tag area for removal

S2 – Shine

The S2-Shine movement include three primary activities which consist of getting the workplace clean, maintaining its Appearance, and using preventative measures to keep it clean.

Action Steps	Resources
1. Define "clean" for ceramic industry 2. Get cleaning supplies 3. Take "before" pictures 4. Clean the work area 5. Fix small imperfections 6. Identify contamination sources 7. Take "after" pictures	1. Cleaning supplies such as brooms, dust pans, rags, degreasers, and floor cleaner for ceramic industry 2. Personal protective equipment such as gloves and eye protection. Do not wear jewelry that can get caught in the equipment

S3 – Set in order

In S3 Set in Order, team members join and share the insights they have gained during S1 and S2. They analyze the work area for additional development opportunities and look for ways to reduce sources of waste and error as well as to make the workplace more visually informative.

Action Steps	Resources
1. Take “before” pictures in ceramic industry 2. Implement workplace changes	1. Existing plant standards for labeling, marking, and colour-coding 2. Labelling supplies

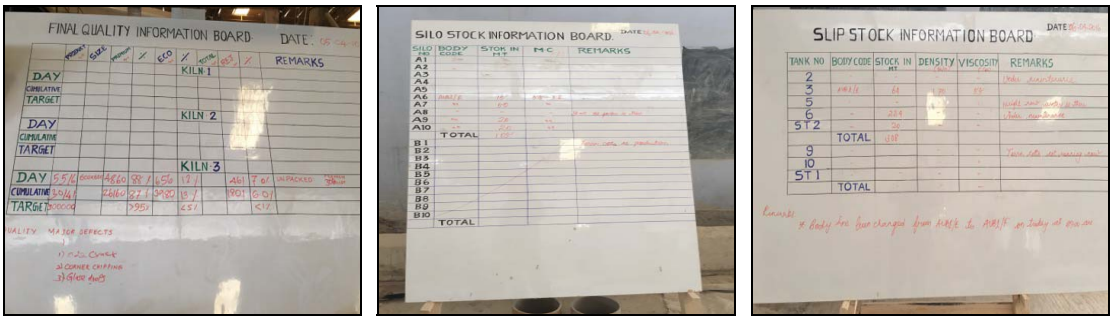
Cont…

Action Steps	Resources
3. Mark locations by creating addresses and applying labeling, marking, and color-coding 4. Take “after” pictures	3. Tape for creating borders on work surfaces and floors 4. Paint and painting supplies

S4 – Standardize

During this stage of performance, the team identifies ways to establish the enhanced workplace practices as a standard. The goal of standardization is to create best practices and to get each team member to use the established best practices the same way.

Action Steps	Resources
1. Brainstorm ideas for making the 5S changes standard operating procedure for tile industry 2. Update documentation to reflect changes 3. Make sure all stakeholders are aware of the new standards - inform and educate for tile industry	1. Support from those who can create documentation, job aids, and visual aids for tile industry 2. Information and approval from those responsible for maintaining company procedures for tile industry 3. Poster-making supplies for posting new standards in work areas for tile industry



S5 – Sustain

The purpose of S5-Sustain is to continue the drive generated during the initial event or project. A management auditing process should be put into practice to ensure that employees understand that maintaining the level of workplace organization is a top priority.

Action Steps	Resources
1. Monitor processes established during S4 -Standardize	1. Management audit forms
2. Expand 5S efforts to other work areas	2. Resources for communication and recognizing successes (newsletters, displays, awards)
3. Evaluate 5S effectiveness and continuously improve	3. Presentation tools for sharing best practices with other work areas
4. Recognize and reward strong efforts	4. Management commitment and focus on maintaining the new standards

The visual factory implementation influence is

To eliminate miscommunication the tile manufacturing contains both continuous stream of production and non continuous stream of production where non continuous stream of process require work in process storage. There are these storage tanks were the work in process materials are stored.

The process flow of the non continuous process starts with weighing the raw material and mixing it in the ball mill with water, after six hours of ball milling we get the output as slip which is slurry material, then stored in tanks after discharge from ball mill.

Later the discharged slip is then extracted from the tanks and they are used in spray dryer which results in removing the moisture content from the slip which becomes powder. These powders are stored in silo tanks and after that it acts as the input for the hydraulic press and from there on it is a continuous process.

In this process there are two works in process materials to store where there were several errors occurring during using the stored materials in the next department. All the errors were related to miscommunication.

When the operator uses different material from wrong tank than the right one then we has a production loss with cannot be reversed. So installing a communication medium between the two departments can reduce the miss communicational error occurrence.

These mediums were placed in three places were one is in the slip house where the medium contains the data of the stored slip in the slip tanks.

Another place where it was implemented is near the silo tanks where there were power stored in the silo tanks .and a final medium was put up in the dispatch area where it requires showcasing the quality details to know the production performance.

CONCLUSION

The concluded study reveals that of the lean concept in ceramic industry is recommended for Hydraulic Press, kiln oven and Bearing failure in drier for that visual factory and multi functional employee. A lean Tool procedure was implemented, which saves the time of looking for tools. Standardisation was implemented in performing individual tasks, which is one of the bases of constant development for company vison. Extravagance of material, time, and money was minimized. The inference of the problem for Hydraulic Press, oven and Bearing failures the Ishikawa diagrams were showed. In that the overall loss 60% of loss is contributed by tool change for hydraulic press. In that the overall loss 35% of loss is contributed by Mechanical Damage for Oven. In that the overall loss 54% of loss is contributed by Particle contamination for bearing failure. The visual factory prevents errors arising from miscommunication as makes employees feel more competent and reduces friction due to misunderstanding about what needed to be done to run a process effectively also with It improves the way machines are used, improving up-time and increasing run rates. Multi functional remuneration have also been experiential in term of skill up-gradation, team service, multi talents and improved confidence of the workers.

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