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A Brief Review of Lean Manufacturing and Indian Fertilizer Companies

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Abstract: *Lean manufacturing system has comprised of different tools and technique which provide basis for Improvement in Fertilizer Company. All small &medium scale fertilizer industries have facing certain problem resulting in shortage of production & quality issues. Instead of all demand is too much in India. Correct application of right tool at right time and at right place creates wonder in many industries. Starting with lean tools and techniques such as, TPM is one of most useful tool which improves effectiveness and efficiency of equipment. 5S and Kaizen are commonly used technique collaboration with TPM, which provide ground level improvements. Collective application of these discussed tool help organization to achieve better position in competitive market where main focus is on reduction of lead time and improving quality.*

Keywords - *Lean tools, Time and motion study, TPM, 5's, Kaizen, SMED*

INTRODUCTION

In Today's Industrial Environment huge losses/wastage occur in the manufacturing shop floor. This waste is due to operators, maintenance problem, Tooling problems and non-availability of components in time, non-value added activity in manufacturing processes etc. Other forms of waste includes idle machines, labour absenteeism, break down machine, rejected parts etc. are all examples of waste. The qualities related to waste are of significant importance as to the company in terms of time, material and the reputation of the company in the market. There are different techniques of waste reduction and performance enhancement like Just in Time (JIT), Total Quality Management (TQM), Total Productive Maintenance (TPM), Kaizen etc. JIT is a strategy for manage the inventory in which raw materials and components are delivered from the vendor or supplier immediately before they are needed in the manufacturing plant. Kaizen is Japanese technique for "improvement" or "change for the better" refers to philosophy or practices that focus upon continuous improvement of processes in manufacturing, engineering and business management (Rajesh Gautam et al, 2012).

Zero oriented concepts such as zero tolerance for waste, defects, break down and zero accidents become a pre-requisite in the manufacturing and assembly industry (Christie, 2007). In this situation, a revolutionary concept of TPM has been adopted in many industries across the world to address the above said problems (Ranteshwar Singh et al, 2012). An efficient layout may also contribute in the cycle time reduction in production, work-in-progress, idle times, number of bottlenecks or material handling times and to the increase in the production output, with obvious implications on productivity (R. D. Vaidya et al, 2013). Globally, the efficiency of use of resources (particularly energy, water and nutrients) and the impacts of food production on the environment are seen as critical issues for future sustainability. Pastoral agriculture is a significant contributor to this, particularly for greenhouse gas (GHG) emissions (e.g. FAO 2006). This has led to a drive by overseas customers (such as supermarket chains) for information on the carbon footprint (i.e. total GHG emissions through the life cycle) of agricultural products and in some cases to the use in eco-labeling. Determination of resource and environmental efficiency of products is best carried out using a Life Cycle Assessment (LCA) approach in order to capture all contributing sources through the life cycle of a product. In India there have been a series of Fertilizer Company which produces different kinds of fertilizer. Figure 1 is represented in terms of different techniques which are being widely used in process industry such as Fertilizer Company.

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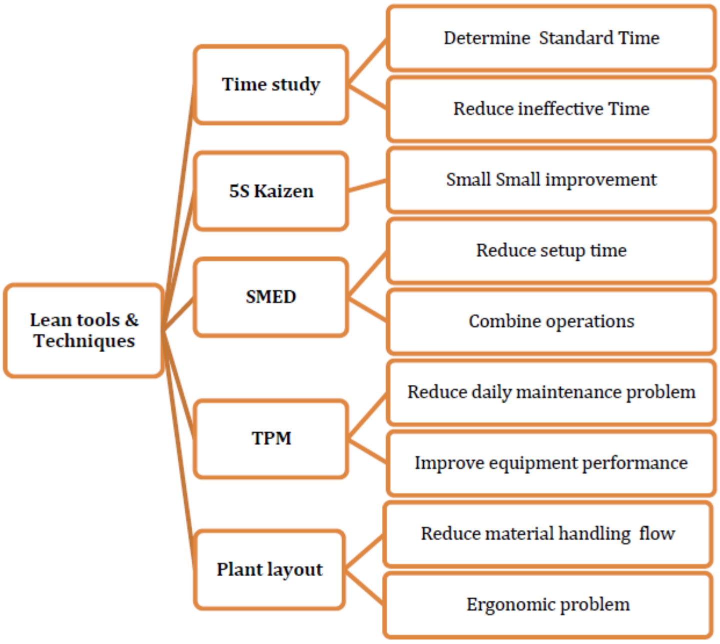

Fig 1: Different Lean Tools & its applications

DIFFERENT TOOLS & TECHNIQUES

SINGLE MINUTE EXCHANGE DIE [SMED]: The need of SMED is mandatory due to increased demand for variable products and reduced product life cycles. SMED also known as "quick changeover," or "rapid changeover", this method can be applied any time equipment is "changed" from one physical state to another It helps the company to keep reduced inventory and effective utilization of the equipment. SMED analysis has to be started up with detailed process map and time study. It needs analyzing everything that happens during the changeover to understand the possibilities of activities that can be moved outside the changeover window (Arun Abraham et al, 2012).

MOTION STUDY

Motion study, according to Ralph M. Barnes (2001) Frank and Lillian M. Gilbreth are known as the parents of motion study. Gilbreth begin investigation to find the "best way" of performing a given task trough analyzing the motions used by his workmen and he easily saw, how to make improvements. He also possessed for analyzing work motion situations to enhance their ability for shorter or less fatiguing motions to improve the work environment. The research included the elimination of all useless motions and the reduction of those remaining motions. The elimination of this unwanted waste known as work simplification. (Nirav Patel et al, 2015)

5S- KAIZEN

Kaizen is a Japanese word that has become common in many western companies. The word says that small improvement of process in a continuous way of the standard flow of process & work. Kai means change and Zen means for the better "change for the better" (Rajesh Gautam et al, 2012). The cycle of kaizen activity can be defined as

- Standardize an operation and activities.
- Measure the standardized operation (find cycle time and amount of in-process inventory)
- Innovate to meet requirements and increase productivity
- Standardize the new, improved operations
- Continue cycle

TOTAL PRODUCTIVE MAINTENANCE [TPM]

Total Productive Maintenance (TPM) is an alternative approach to equipment maintenance that seeks to achieve zero breakdowns and zero defects. TPM is a unique Japanese philosophy, which has been developed based on the Productive Maintenance concepts and methodologies. According to Angeles (2009), TPM can be described as a plant improvement methodology which enables continuous and rapid improvement of the manufacturing process through the use of employee involvement, employee empowerment and closed-loop measurement of results. It is a production driven improvement methodology that is designed to optimize equipment's reliability and ensure efficient management of plant assets. TPM also aims on building up a corporate culture that thoroughly pursues production systems efficiency improvement and Overall Equipment Efficiency (OEE). From both definition, it can be seen that they both describes a synergistic relationship among all organizational functions, but particularly between production and maintenance, for continuous improvement of product quality, operational efficiency, capacity assurance, safety and enhancement of the people who work within the company. It emphasizes maximizing Overall Equipment Effectiveness (OEE) through employee involvement. TPM activities involved all employees, starting from top management till ground floor

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operators. TPM program is marked to increase production while at the same time, increase employee morale and job satisfaction. In order to set up Total Productive Maintenance (TPM) framework, the understanding of it must be total. According to Nakajima (1989), the goal of Total Productive Maintenance (TPM) is continuously improve all operational conditions, within a production system by motivating the daily understanding of all employees.
TPM as the name suggests consists of three words:
(1) Total- This signifies to consider every aspect and involving everybody from top to bottom.
(2) Productive- Emphasis on trying to do it while production goes on and minimize troubles for production.
(3) Maintenance- Means keeping equipment autonomously by production operators in good condition – repair, clean, grease, and accept to spend necessary time on it.

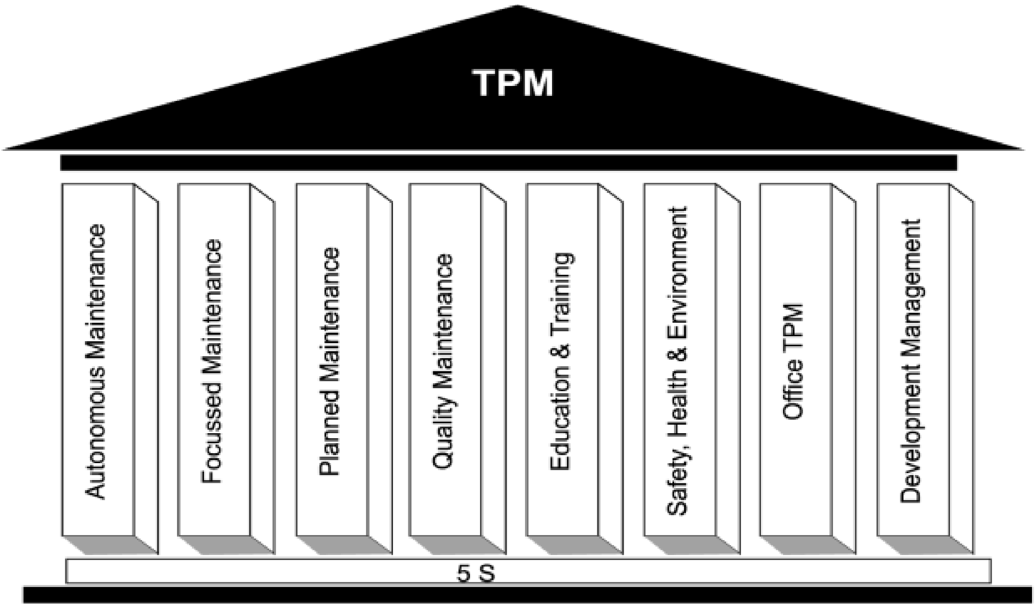

Figure 2: TPM Pillars

A Brief Introduction to Fertilizers

Fertilizers customer representatives have often recommended product blends to reduce the number of fertiliser applications and deliver a proprietary nutrient mix that meets the needs of their customers. Their arable customers have continued to purchase these mixes and when spread at the correct settings to achieve a 30m tramline have experienced striping which previously at narrower tram lines has not occurred. Striping is a real economic issue as it is only visible at in- field coefficient of variation (CV) of around 40%, giving a yield reduction of at least 20%, (Mersmann et al, 2013) and (Yule and Grafton, 2013). This reduction in yield and economic impact on the fertiliser end user has resulted in the complaints, media coverage and the attention of the Fertiliser Quality Council. Both fertiliser N and naturally fixed N are likely to be required for future food production. But how essential in reality is the industrial production of 'reactive' N from the unlimited supply of unreactive (inert) di-nitrogen gas (N2) in the atmosphere? Some claim that natural fixation, such as that effected by Rhizobium bacteria in association with leguminous plants, can yield sufficient N to feed the current global population (e.g. Badgley et al., 2007; but see Goulding et al., 2009). Others have calculated the carbohydrate and protein requirements of the global population and conclude that natural N fixation on the current cropped land generates about half the food required (Smil, 1999, 2001; Erisman et al., 2008).
At present, many parts of the N cycle result in a net loss from the food production and use continuum. Maximising the quantity of N retained involves minimising N losses but also maximizing the efficiency of reuse of N contained in residues and 'waste' products, including human excreta. Agriculturally these two objectives are combined in 'best practice' (for UK example: Defra, 2010), optimizing nitrogen use efficiency (NUE). NUE seeks to minimise losses to air and water, and to maximise returns from using farm-generated manures and N-containing 'waste' brought onto farm. The subject of N conservation has been widely studied and needs no further attention here. But there are opportunities for optimization in the N production-consumption cycle.
Ammonia synthesis requires the production of hydrogen which is then reacted with atmospheric N2. While unreactive N2 in the atmosphere is effectively limitless, supplies of energy and feedstock sources for ammonia production are not. Looking forward, what possibilities can be envisaged for the use of alternative less- or non-limited sources? Are there alternatives to the use of methane, currently the most efficient hydrogen feedstock? Can the efficiency of ammonia synthesis be improved?
Nitrogen and Phosphorus (P) are both essential to the life of all higher plants and animals, and neither is substitutable. They exhibit, however, two significant differences. First, the supply of N is effectively unlimited, while P reserves are relatively very limited. Secondly, the life cycle of N can be measured in years, or at most a century or two, whereas that of P is measured in millennia. A major review of the global resources of PR and phosphate ore was undertaken by the International Fertilizer Development Center (IFDC) and published in September 2010 (IFDC, 2010).
Balmér (2006) identified a number of commercially viable processes for the precipitation of P from effluent water streams. The current requirement in Europe to remove P from effluent water is to prevent the P from entering watercourses for environmental

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reasons. The need to conserve and to recycle resources P to achieve sustainability targets was not a factor in creating these regulations, but now there is an urgent need to update this legislation to ensure that P is recovered in a form suitable for use as a fertiliser, such as struvite (Ostara, 2010). The P in struvite has been shown to be as available to plants as from triple superphosphate (Johnston and Richards, 2003). Overall, the outcome must be industrial-scale recovery of P from both solidand liquid sewage phases to be used onland as equivalents to mineral fertiliser. Such processes are logistically and commercially challenging, but will have to be widely introduced (Defra, 2008). Several pilot and commercial systems are reported (IWAR, 2010), particularly in the Scope newsletters of CEEP (Centre Europeen Etudess Polyphosphates), a sector group of CEFIC (European Chemical Industry Council) (for example: Scope, 2003, 2009). The wastewater industry has to dispose of the treated liquid fraction of sewerage waste it collects, which is typically discharged to watercourses. In the EU the P content of this effluent is controlled by the Urban Waste Water Treatment regulations which limit the amounts by varying groups of Member States. There have been a number of case studies undertaken which demonstrate splitting of fertilizer blends resulting in uneven spread, of which (Miserque et al, 2008) and (Yule and Pemberton 2009) are examples. Whilst the elements which lead to separation are identified by (Miserque et al, 2008) and (Yule, 2011) to be particle or specific density, particle size and particle shape in that order of effect on the distance particles spread.

INDIAN FERTILISER SECTOR

Indian Agriculture sector remains an important element for overall economic growth. However, there has been continues decline in the share of agriculture and allied sectors in India's GDP (13.7% in 2012 - 13 from 51.9% in 1950 - 51). This was largely due to shift from traditional agrarian economy to industry and service sectors. The govt. has been increasing the focus in improving the agriculture share in total GDP. We believe Fertilizers; "an integral part of the Agriculture", needs to be strengthened by bringing reforms in the sector. The Fertiliser sector has witnessed few positives like new fertilizer policy, easing of channel inventory into the system, softening of raw material prices globally and expectations of higher urea subsidy. This has led Fertiliser Sector to witness major out-performance vis-à-vis the broader indices. Over the last one year, S&P BSE Sensex gained 42.3% YoY while Fertiliser stocks gained by an average of ~64% YoY. We remain long term positive on the sector due to stable demand for fertilizer, govt.'s positive stance on the agriculture and reasonable valuations.

Further, New fertiliser policy to reduce to the urea import dependency: While urea consumption in India grew steadily at a CAGR of 4.1% between 2005 – 2014, production has remained stagnant with CAGR of 1.4% in the same period. The lower production is a result of lack of capacity addition due to various bottlenecks and limited availability of raw materials to some extent. In order to boost the urea production in the domestic market, the Fertilizer Ministry has approved a new fertiliser policy. The policy talks about maximizing urea production from the urea units including through conversion of non-gas based units to gas, incentivizing additional urea production and encourage investment in joint venture projects abroad. It is also aimed at establishing a more efficient urea distribution system in order to ensure availability of urea in the remotest corners of the country. We think that this may help in bridging the widening demand-supply gap to large extent and reduce dependence on the imports of the urea. Fall in the key raw material prices to improve the profitability: Globally, the fertiliser raw material prices have been on a declining trend over the last one year. The fall in the prices has been largely on the back of global capacity addition in the fertilizer raw materials. According to the International Fertilizer Industry Association (IFA), close to 200 expansion projects for fertiliser raw materials at an investment of about $110 bn, are at an advanced stage of development. These projects, coming up in Morocco, Saudi Arabia, China, Brazil, Canada and Russia, are expected to become operational in the next four-five years. Amongst the imported raw materials, India imports the entire potash demand, 90% of its requirement of phosphates and 25% of its requirement of urea. Hence, the fall in the prices is likely to benefit India significantly. Also, the stability in INR against USD throughout the year has prevented companies from any fluctuation in the forex market. We think that the fall in the fertiliser raw material prices along with stable currency, is likely to help domestic fertiliser manufacturers (Complex fertiliser manufacturers in specific) to reduce the operating cost and improve the profitability.

Removal of restriction on neem-coated urea production to improve the margin: The govt. has taken steps to encourage production and availability of coated urea in the country. In this regard, the cap to produce neem-coated Urea has been removed. According to Chemicals and Fertilizers Minister Ananth Kumar, India is presently using only 60 lakh metric tons of neem-coated urea which can be increased to full demand of 310 lakh metric tons in the country. The application of neem-coated urea would help in increasing the yield with its minimum use, which would benefit the farmers. The neem-coated urea is costly by 5% compared to plain urea, but it reduces nitrogen loss by more than 10%, thereby incurring savings and improving EBITDA margin of the manufacturers. Govt.'s policies led to major pricing difference between Urea and Complex fertilisers: Domestic consumption of Di-ammonium phosphate (DAP) is much lower as compared to urea, indicating imbalanced application of nutrients in India. Farmers are using excessive urea as it is cheaper than decontrolled Phosphatic (P) & Potassic (K) fertilisers such as DAP and MOP (Muriate of Potash). According to Department of Fertilisers, GoI, the ratio of NPK for Indian soil has worsened as it has increased from 4:2:1 in FY10 to 8.2:3.2:1 in FY14, which adversely impacts the soil health. The govt. policies can also be attributed to large difference between the price of urea and non-urea fertilisers. Urea is highly subsidised and is sold at Rs 5,360 per tonne as against the average production cost of over Rs 20,000 per tonne in 2013-14. Govt. pays 70-75% of total cost of production per tonne as subsidy, while in P and K fertilizers the central govt. pays 25-40% of total cost of production as subsidy. Hence, increasing imbalanced use of nutrients has made it imperative for the govt. to take measures to promote balanced use of fertilisers by bringing down urea consumption that has resulted in a huge subsidy bill and affected soil health. Trend in Prices of Di-ammonium phosphate (DAP) and Urea (Rs. per tonne basis) Source: Department of Fertilisers, GoI Soil Health Cards – to improve the agricultural productivity: With imbalanced usage of fertilisers, the soil health has witnessed a major deterioration. In

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order to improve the soil health, the govt. has launched a scheme to provide every farmer a Soil Health Card. The card will carry crop wise recommendations of nutrients/fertilizers required for farms. We believe this will help farmers to review the soil health and increase the adoption of non-urea fertilisers to improve the productivity. Also to encourage Soil Health Cards initiative, the govt. has increased the budgetary allocation (for FY16) by ~30% to Rs.2.00 bn from Rs.1.56 bn in FY15 which is likely to benefit the agriculture sector.

Allocation of gas to fertiliser sector remains key monitorable: The govt. is in the process of revising its priorities in allocation of natural gas after it ordered GAIL India Ltd to supply natural gas to city gas retailers (City Gas Distribution companies) by cutting supplies of non-priority sectors like steel and petrochemicals. According to the new policy, the existing fertiliser plants which are operational will continue to remain at the top in the priority list and accordingly receive the gas supply. However, for new incremental fertiliser capacities, the fertiliser sector has been brought down to third rank in the priority list which may hamper the capacity addition.

CONCLUSION

An exhaustive review of literature indicates the involved process in manufacturing of fertilizer is tedious. It requires man power and more attention on safety also. Lean manufacturing is supposed to reduces the various typed of waste especially on quality based. Further the Indian fertilizer industries are also lacking in the lean implementation and further its proper execution. There no problem of demand and sustainability of company. From the brief review it is being suggested that the fertilizer companies should implement the lean tools and techniques for the productivity and performance improvement.

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