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Green Manufacturing in Foundry

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Abstract

In this paper introduce a Green Manufacturing in foundry. A number of initiatives are being taken by companies in India in the areas of regulation and reduction of green house gases, discharge of pollutants and emissions, hazardous waste management, and energy conservation to pave the way for a cleaner and greener environment for sustainable development. Manufacturers are able to save costs on the final product by reducing energy and materials wastes. Beyond good business, a green manufacturing program benefits the environment and creates value for the customer. Three major model of advanced green systems are Green Management System (GMS), Green Waste Reduction Techniques (GWRT) and Green Results (GR). This paper will target reducing traditional lean wastes along with energy and material wastes in metal casing facilities and study was undertaken to estimate the pollutants released from the foundries.

1. INTRODUCTION

Green Manufacturing is generically defined as elimination of waste by re-defining the existing production process or system. We have all come across company examples that take their problem solving approach to the next level and develop innovative techniques towards effective solutions. Such solutions result in cost savings from reduced work handling, effluent control, process automation, etc. All these efforts are applications of green manufacturing.

Green Manufacturing addresses process redundancy, ergonomics and cost implications due to faulty methods of producing goods. Faster and cheaper are no longer the only two criteria in manufacturing a product or evaluating an existing process line. Several other factors such as materials used in manufacture, generation of waste, effluents and their treatment (or possible elimination), life of the product and finally, treatment of the product after its useful life are all important considerations.

Green Manufacturing organizations manufacturing products using materials and processes that minimize negative environmental impact, help in the reduction of green house gases (GHGs), conserve energy and natural resources, improve safety for consumers, communities and employees and at the same time increase profitability of their organizations as a whole.

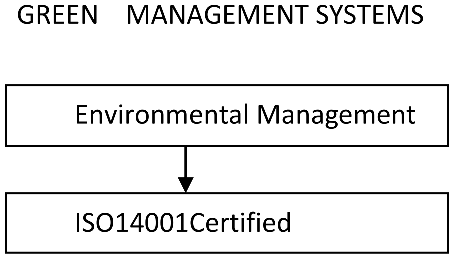
Globalisation impacts and its associated demands in competitive environment have created a need for managers in manufacturing sectors to take decisive actions, responsive to environmental changes, and implement strategies that continually improve quality, capability and process efficiency. The efficiency in continually improving the quality of products and its processes could be seen in term of cost reduction, improvement of customer satisfaction as well as minimize the environmental impacts. One key principle of Lean production is the reduction of wasted materials and labor in a continuously improving culture. To see if Lean companies naturally tend to be Green, known Lean manufacturers were surveyed to determine if they were transcending to a more Green state as a result of their commitment to Lean production. Variables in the study were numerous, including measures of Green Management System, Green Waste Reducing Techniques, and Green Results as first defined by Melnyk, et al. This makes a very powerful statement that Lean companies are embracing Green objectives and suggests that Lean manufacturers are transcending to Green manufacturing as a natural extension of their culture of continuous waste reduction, integral to world class Lean programs.

2. LITERATURE SURVEY

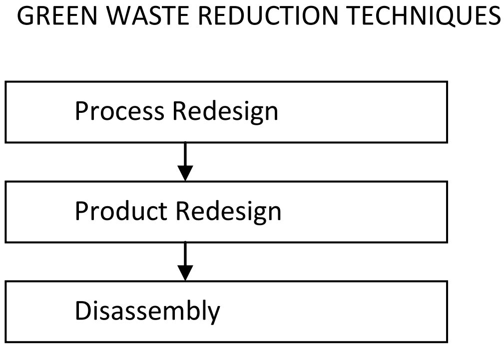
The survey instrument developed and tested by Melnyk, et. al. [5] was adapted for use in this study. Consistent with the three main manufacturing system components, the survey has three sections (GMS, GWRT, and GR). The first section of the survey (GMS) addresses the status and maturity of the plant's environmental management system implementation. The second section (GWRT) is comprised of fourteen questions regarding specific practices the plant undertakes to reduce environmental waste. The third section (GR) is comprised of ten questions that address the process and business results of Green manufacturing efforts in the plant. The survey questions align directly with the Green dependent variables shown in the Advanced Green System Model in Figure 1. Details of the survey construction and validation are beyond the scope of this short paper, but may be found in Bergmiller [1].

3. PROPOSED MODEL OF ADVANCED GREEN SYSTEMS

Significant agreement amongst researchers shows there are three major components to a theoretical model of Green Operations Systems . Top management commitment comes in the form of Green Management Systems (GMS) with policies and procedures empowering employees to make decisions based on reduced environmental impact.This commitment is the beginning point in establishing Green organizations. GMS will support an organizational culture that identifies sources of environmental wastes and implements Green Waste Reduction Techniques (GWRT) designed to reduce the types and amounts of environmental wastes generated by the company's operations. The implementation of GWRTs leads to improvements in business metrics of Green Results (GR). The Advanced Green System Model [3], which is developed from several leading theories, is reproduced here in Figure 1,2 and 3. The figure shows the individual elements comprising the GMS, GWRT, and GR.



" Figure 1: Green Management Systems"



Substitution
↓
Reduce
↓
Recycling
↓
Remanufacturing
↓
Consume Internally
↓
Prolong use
↓
Returnable Packaging
↓
Spreading Risks
↓
Creating Markets
↓
Waste Segregation
↓
Alliances

Figure 2: Green Waste Reduction Techniques"

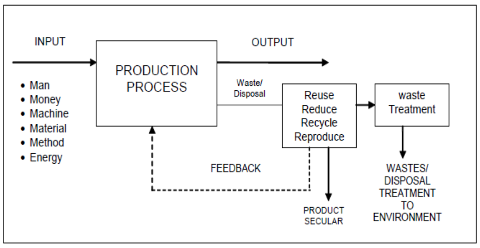
GREEN BUSINESS RESULTS

Costs
↓
Lead Times
↓
Quality
↓
Market Position
↓
Reputation
↓
Product Design
↓
Process Waste
↓
Equipment
↓
Benefits

" Figure 3: Green Business Results"

4. CLEANER PRODUCTION SYSTEM

The Asian Productivity Organisation (APO) had introduced the concept of Cleaner Production (CP). CP is a strategy for enhancing productivity and environmental performance for overall socio-economic developments. Productivity provides the framework for Continuous Improvement (CI), while environmental protection provides the foundation for sustainable development.



"Figure. 4 Cleaner Production System"

The foundation of the CP concepts is to plan, examine, re-evaluate and maintain the production processes to highlight ways of improving productivity, while reducing its environmental impacts through four main activities or also called as 4Rs (Reuse, Reduce, Recycle and Reproduce), or including other one more R (Recovery). CP means persistent used of industrial processes, raw materials and products designed from their inception to prevent pollution of air, water and land; in order to reduce waste, to minimize the risks of environment and human health, and to make efficient use of raw materials, such as energy, water and space.

Implementation of these concepts leads to another cycle of review or evaluation thus promotes continuous improvement (CI) activities (Parasnis, 2003). CI is a win-win approach for simultaneously realizing improvements in productivity and environmental protections. Continuous improvement or kaizen activities on the products and processes create substantial opportunities for pollution prevention and waste minimization, product improvement as well as customer satisfaction (Florida, 1996). CP concepts are considered less costly to implement, operate and maintain over time because the CP activities can reduce costs of raw materials, energy, pollution control, waste treatment and clean-up, and continued regulatory compliance . Until the 1990s, the manufacturing sectors were managing its environmental problems almost exclusively through end-of-pipe solutions. By using the end-of-pipe approach, production departments are discharged from all waste responsibility and they avoided closely monitoring and changing the processing area. This research aims to investigate the level of production practices and its activities and implement cleaner production practices and its activities in the foundries.

5. DATA ANALYSIS

MELT SAVINGS – Never forget that every area of the foundry operation is fertile ground for green savings. Buying the right scrap can net energy savings even before melting materials are received at the foundry. Ferrous foundries have long been comfortable with receiving post consumer steel scrap that contains a moderate amount of surface rust, paint, adhering non-metallics, and other non-steel attachments. Sheared scrap can contain 5 – 8 % by weight of tramp non- metallic materials. Eliminating the non- metallic materials can yield significant savings.

Further melting savings can be achieved by cleaning gates an risers of sand by passing through a properly designed rotary drum, or for very clean returns, a quick sot blasting of the returns.

6.REUSE OF WASTE HEAT Returning to energy savings, one of the most significant areas for achieving energy reductions is in the reuse of waste heat from many foundry processes. The reuse of waste heat can often net energy savings of 15% to 25% or more. Utilize waste heat from melting operations for building heat, core drying, and/or shower water heating. With prober design, these systems can also use heat pump principles to utilize waste heat for air conditioning or chilling, to maximize the year – round benefit of the facility's investment.

SOME BENEFICIAL REUSE OPTIONS

Non-hazardous and non-dangerous spent sand has traditionally been used as "clean fill" in many parts of Washington State. However, "clean fill" opportunities have declined in recent years, making exploration and implementation of other applications essential. Spent foundry sand has been successfully used throughout the United States in various applications. Below are some recycling options for spent sand:

· Asphalt Concrete**:** Substitution of up to 15% spentsand for conventional asphalt concrete fine aggregate.

· Compost Additive**:** Bulking agent for composted yard waste, to produce topsoil or topsoil additive.

· Concrete**:** Substitution for regular sand in structural grade concrete, at low percentages.

· Bricks and Pavers**:** Encapsulation in a proprietary, high pressure, pozzolanic process that can encapsulate and chemically bind various waste materials in C-grade flyash (a fine particulate ash produced by coal-burning electrical power plants). The ambient-temperature process results in bricks that are cost effective and can be shaped to meet end-user requirements.

· Portland Cement**:** Cement kiln feed for Portland cement. A study by the American Foundrymen's Society indicates that portland cement manufactured with up to 13% of spent foundry sand exhibited slightly higher compressive strengths than conventionally produced portland cement, without any degradation of key characteristics such as set time.

Mineral Wool Products: Potential silica source.

Flowable Fill: Substitution for regular sand in flowable fill, a mixture of sand, flyash, and water thatis mixed into a slurry and poured. Flowable fill is aself-leveling and self-compacting mix that hardens anddevelops strength over time, similar to concrete, and is commonly used as backfill for trenches (sewer, conduit, utility).

7. CONCLUSION

Lean system infrastructure serves as a catalyst to the successful implementation of Green best practices and the achievement of corresponding Green Results. The evidence that plants with Lean systems yield higher Green Results. Structural Mortar and concrete can be manufactured with used foundry sand as a partial replacement of natural sand. A suitable recycling of the discarded foundry sand as building construction material could be suggested. The goal is to allow manufacturers to balance environmental concerns with profitability. Attractive incentives to individuals and industries and measures for clean technologies by the government is probably the only way to foster a vibrant green economy.

8. REFERENCES

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