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Study on the Impact of Plastic Materials and Sustainability Issues for Car Manufacturers

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Abstract – Recent literature in automotive research indicates that studies of the environmental impact mostly concerns with metal-based components. Environmental effects are mainly analysed using "environmental performance indicators" and "life cycle assessment" techniques. Therefore a knowledge gap in the field of studying automotive plastic components should be conducted based on analysing material and manufacturing processes selection at the design stage. The research was focused on a plastic component previously unexplored and analyses it using tools that have not been employed for this application. A computer-aided tool was used to model the part and its associated sustainability function was used to analyse its environmental impact. The component was analysed using different materials and manufacturing processes, then redesigned to be more ergonomic. The improved component design was manufactured using rapid prototyping and a consumer preference survey was conducted to determine which component was preferred. The research found that by changing the material to high density polyethylene there would be approximately a 30% reduction in carbon footprint, 24% reduction in air acidification, 26% reduction in water eutrophication and 15% reduction in total energy consumption. Injection moulding was found to be the most sustainable manufacturing process

Keywords – Automotive Component Design, Sustainable Design, Environment Impact

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INTRODUCTION

Single Minute Exchange of Dies: Customarily, SMED is changed for each model. The stamps are intended for each model. However, it takes a few times and burns-through more energy. At whatever point the machine changes the devices, the machine should stop and kicks the bucket are adjusted, it requires 10 hours to 2 days (Moreira et al. 2011).

Presently the different passes on are planned all the while and masterminded in precise, when one group of works are done, they are changed for the following various tasks. There are 2 exercises, named as inside and outer. In Internal exercises kicks the bucket are changed and the machines are halted. In External exercises regardless of whether there is change of passes on, the machines are not halted (Worley et al. 2006).

The overall activities of SMED are noted in Figure 1.4. First discrete the inward and outside activities. The inner activities are changed over in to outer activities (for example preheating of the apparatuses). At last the outside activities are major and decrease the arrangement time. The arrangement time is decreased under 9 minutes (single minutes= 0 to 9 mins).

Just in Time: JIT is a concept used to reduce the inventory. There is no storage cost. It is only, whenever the materials required, then only supplied. The kanban card is used to indicate the material requirement position (Nour A et al. 1998). JIT technology is a pull-method and not a push method. When the material is required the kanban arrival card indicates the proper requirement of the material, then dispatching conveyor or automatic hook is used to supply the material. When the material is supplied, then the new kanbansignalling card indicates that the material requirements are surplus. The material supply is regularised with updated kanbansignalling method (Tahat et al. 2006) .

The toyota production house is shown in Figure 1.5. The JIT, jidoka, heijunka and kaizen are noted in that figure. The main goal is to increase the quality and reduce the lead time.

OBJECTIVE OF THIS STUDY

1. To study the effects of plastic on leans applications.

2. To study the sustainability issues on value stream mapping of plastic automotive.

DEFINITION OF TERMS

Non Value Added Time

NVAT is measure of the creation process duration that doesn't straightforwardly deliver merchandise or administrations. At the end of the day, this is the measure of time that merchandise are not effectively being dealt with. The NVAT condition figures the all-out time by adding development time, investigation time and holding up time (Evans et al. 2005).

Lead Time

LT is the time between the initiation and completion of production and the process is referred to as lead time. The following are relevant concepts concerning lead time.

- Preprocessing lead time: The mandatory chance to release a request for the buy or produce some work on schedule or after the time.

- Handling lead time: The mandatory opportunity to create a piece.

- Post-handling lead time: It compares to the time a gained piece is made available in stock from the period just as takes conveyance of it.

- Request lead time – Time beginning when client demand was set up to that when the client order is given over.

- Request taking care of time - Time starting when a client

- Order is recognized to the making of deals game plan.

LEAN TOOLS

The following are the lean tools,

Bottleneck analysis: It identifies the manufacturing process limits and improves the performance of the process.

Continuous flow: The working processes have continually a smooth flow out and there are no buffers. It eradicates several appearances of waste such as transport, inventory and waiting time (Haque et al. 2012).

Gemba: This is the real place for products to be placed correctly.

Heijunka-It reduces lead-time and inventory.

Jidoka - It implies autorotation. Labor force is equipped for noticing various posts and a great deal of value matters which are being found immediately.

LEAN MANUFACTURING APPLICATIONS

Lean manufacturing concepts are applied to all type of industries.

- Automobile industry

- Food and refreshment industry

- Process industry

- Tyre manufacturing industry

- Software industry

- Production industry

- Medical hardware, drug businesses, and so on…

PLASTICS AND PLASTIC WASTES

History of Plastics

History has it that, the advancement of plastics is viewed as one of the significant specialized accomplishment of the 20th century by humanity.

Since, the improvement of the plastic, it has been considered as the least expensive materials utilized instead of different materials like metal, wood and glass. The mission for plastic items in our regular daily existence required for new advancement to improve the quality and the strength of plastic. As the plastic material have some novel properties equivalent to different materials with respect to capacity of framing into any attractive shapes, protection from dampness, protection from malleable pressure and so forth The disclosure of plastic began sometime in the past. It was in the last part of the 1850s when the main manufactured plastic was made by an English creator called Alexander Parkesine. This accomplishment was displayed in 1862 at Great International Exhibition in London. It was named after Parkesineand this natural material was gotten from cellulose. Alexander Parkesine saw

that when the material was warmed and chilled off it held its shape.

Between1930-1934, witness the gigantic advancement of the most widely recognized thermoplastics utilized today by manufacturing enterprises. These normal thermoplastics for instance are polystyrene, polyvinyl chloride, polyolefins and polymethyl methacrylate. The improvement of plastics didn't stopped around then rather lead to ceaseless examination into plastics till date.

What are Plastics?

Plastics are engineered or fake materials produced using the utilized of unrefined petroleum and flammable gas as the crude material. The crude material contains polymer atoms that are partitioned into straightforward individual substance constituents of a polymer. Plastics comprise of a few monomers that are connected together in a chain-like structure. Plastic material can exist as lin-ear or extended ploymers. Plastics are delivered by a cycle of going along with at least one monomers like ethylene, styrene vinyl chloride together and this is called polymerisation. During the time spent polymerisation of polymers like ethylene, vinyl chloride and styrene prompted polyethylene (PE), polyvinyl chloride(PVC) and polystyrene(PS) There are two different ways that plastics can be gathered relying upon their synthetic and phys-ical properties. Plastic can be either thermosets or thermoplastics. With the thermosets, they are plastic that are solidify by compound cross-connecting response including polymer atoms. The synthetic properties of thermosets separate after warming and consequently debilitate the connections between the polymers atoms. This debilitate of the bonds is irreversible.

TYPES OF PLASTICS

There a couple of kinds of plastics been conveyed by plastics manufacturing associations all through the planet including the customary plastics and changed plastics. In the make ing countries in any case, the standard plastics are created for use. In this assessment the creator is focusing in on the going with five plastics, PET, PE, PVC, PS and PP.

These plastics are used in our regular day to day existence in habits, for instance, food squeezing, amassing contain-ers, food compartments, etc coming up next is the quickly portrayal of all of the above sort of plastics agreeing their properties, pattern of manufacturing and livelihoods.

Polyethylene: Low thickness polyethylene (LDPE), Linear Low Density Polyethylene (LLDPE) and High thickness Polyethylene (HDPE) are the three kinds of Polyethylene plastic. Polyeth-ylene has a thickness scope of 918-965kg/m3 relying upon the kind. It is a delicate, intense and adaptable and straightforward material. LDPE is utilized in the utilization of making bottles, bowls, pails, film plastic packs, tubing or lines, electric or phone encasings and so on with respect to HDPE, it is marginally harder and stiffer than LDPE. It is utilized in manufacturing of dustbins, bottles cases, lines and liquid holders.

Polystyrene: Polystyrene (PS) is a thermoplastic material that is gotten by polymerisation of mon-omer styrene separated as fluid from oil. It is a fragile, straightforward material and it is strong at room temperature and mollify to fluid at temperature above 100oc. Polystyrene is delivered as either as strong or frothed plastic and use in the application like electrical warm protection, window boards, food cutlery, battery case, food box and so on It is impervious to warm, oil, acids, alcohols and so forth.

Polypropylene: Polypropylene (PP) is a thermoplastic material produced using monomer propylene and properties like unbending nature, compound obstruction, solidness and amazing weariness. As far as its applications, it is utilized to make pipes, cases, seats, device handles, TV cupboards, machine parts, floor coverings, bottles and so on.

AUTOMOBILE INDUSTRY IN THE WORLD

The car business is supposed to be the biggest manufacturing area in the World and is quite possibly the most asset concentrated of all major modern frameworks (Mildenberger and Khare, 2000). As per the 2006 yearly report of ANFAVEA, World vehicle creation was 64,272,000 out of 2004 and the World armada had 837,184,000 vehicles in 2003. In created nations like the USA, Italy, Japan, Germany, France and UK, the pace of vehicle per 100 head of populace is higher than 55 (Anfavea, 2006).

It is normal that agricultural nations, mostly those, which are filling quicker in the 21st century and with huge populaces like China, India, Indonesia, Brazil, and Russia, will in general build their paces of vehicles per head of populace to numbers like created nations. Tragically, there are different negative ramifications for the climate that happened in created nations and are going to be imitated in the agricultural nations like: air contamination in metropolitan community, blockages, and so on Seeking after changes in this industry is indeed muddled because of its monetary and social impact. In reality, the effect of the auto area on a country's economy is huge whether or not it is an arising or created country. For instance in 2002, China had 33.5 million individuals utilized in the auto business and straightforwardly related areas; one out of 22 Chinese specialists had a place with these areas (Zhu, Sarkis and Lai, 2006). In the USA, the Alliance of Automobile

Manufacturers guarantees that 1 out of each 10 positions is reliant upon the car business (new vehicle creation, deals and other related positions) (Alliance of Automobile Manufacturers, 2007).

SUSTAINABILITY ISSUES FOR CAR MANUFACTURERS

The advantages of vehicles are clear: they give a house to house transportation framework, the way to accessing life's necessities and work, and a wellspring of delight and economic wellbeing. Nonetheless, in spite of these advantages there are ecological weights also: neighborhood air contamination, ozone depleting substance discharges, street blockage, commotion, mortality and bleakness from mishaps, and loss of open space to streets, vehicle leaves and endless suburbia (Vergragt, 2006). The auto business has had not many extremist changes in the course of the most recent 30 years. In any case, these couple of changes were regularly noteworthy and altogether affected practice and the scholarly world. The Toyota Production System – "In the nick of time" - and the secluded consortium are significant developments from the creation framework point of view. Additionally, the exchange of the get together plants to non-industrial nations and worldwide re-appropriating are apparent changes in the's business and tasks system. All things considered, these progressions have been inadequate to make the area more maintainable. As proof of this the auto business is as yet battling against financial, natural and social difficulties. Orsato and Wells (2006) bring up the numerous monetary difficulties presently confronting the business: strikingly over-limit; immersed and dividing markets; capital force; and diligent issues with accomplishing sufficient benefit. Solid reliance on non-renewable energy sources and huge utilization of crude material lead the natural issues.

PLASTICS: THE DRIVING FORCES FOR THE CAR OF TOMORROW

The requests on the advanced auto industry are truly difficult – drivers need elite vehicles and yet they are searching for improved unwavering quality and security, more prominent solace, eco-friendliness, style, serious estimating and, progressively, consolation about ecological effect. There is one group of materials that is adapting to the situation of these conceivably clashing requests: plastics. With their one of a kind mix of properties they are vital to furnishing mechanical development considering cost-productivity and maintainability.

Numerous discussions at European level are affecting vehicle plan, from cleaner air to the administration of vehicles toward the finish of their valuable life. It is a test to all players – lawmakers, producers and buyers – to guarantee that all exercises are attempted in cooperative energy in the general drive for better wellbeing and ecological assurance.

This report investigates the part of present day materials and the improvements that are molding vehicles and the auto business in the 21st century. It additionally inspects the most recent car improvements dependent on new examination into plastics' utilization in cars1. Specifically, the report investigates the patterns which are bringing about truly expanding requests for plastics in vehicles and the difficulties in adjusting wellbeing, cost and ecological prerequisites. It additionally gives information on the utilization and recuperation of plastics and features the impact that the rule of manageable advancement is having on vehicle plan. The ends help figure out where future accentuation ought to be coordinated for most noteworthy ecological addition and advancement.

CONCLUSION

Lean manufacturing methodologies have been implemented by the companies who intend to achieve competitive advantage and business sustainability (Pavnaskar, Gershenson, and Jambekar 2003). The implementation of the lean tool VSM in the company studied aimed at reducing waste and thus increasing both the quality and efficiency of a production process. The production process of the part considered in this case study was firstly studied through data collection and analysis. The resulting information led to the definition of the initial state as well as to the identification of the critical points. Afterwards, a future state was mapped representing a balanced production process with a considerable waste reduction. A financial analysis was also performed, pointing out the expected profit of the proposed changes. Lean wastes have been identified and fourteen solutions were proposed to eliminate them, of which eleven were implemented. As a result, the Cycle Time on the assembly sub-process was reduced from 370 to 140 s, the number of operators was reduced from four to three, and the inventory level of the unfinished product has also decreased by 25%, and one of the major bottlenecks was eliminated by changing a 95 s operation into a 1 s one. The financial analysis was essential for the decision-making process and provided better results than expected by the decision-makers. Ultimately, by implementing the action plan, the resulting production system became more functional and effective.

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