The current scenario of environmental degradation has raised an alarming signal of what the world awaits in a few years if this is not controlled or sustainable practices not adapted. All manufacturing sectors have started to implement strategies to curtail practices which create pollution or gradual destruction of the environment. One such need of the hour is the end-of-life practices which are the disposal of the product after its useful shelf life. The characteristics that influence the end-of-life outcomes the most are product material, technology cycle, aesthetics, life cycle, design cycle and reason for redesign. In considering the methodology for safe elimination of many consumer products after its lifetime, two major criteria are to be analysed. Te foremost is the identification of what end-of-life strategy is possible according to the technical characteristics of the product. The second part is to compare the proposed end-of-life measures with current design practice. This paper projects the methodology for sustainable practices in the use of consumer product where proposal for change in materials or change in design of the product are analysed to specify appropriate end-of-life strategies. The use, the collection of the product after use, and finally the re-use or recycling and final disposal can be effectively made sustainable and environment friendly if these proposals are implemented in future in design of one of the most widely used keyboard the integral part of the computer. The paper depicts a case study of sustainable keyboard design using appropriate materials which help to adapt the concept of sustainability.

Keywords: Environmental impact, Sustainability, Product life cycle, Product development

INTRODUCTION

Sustainability in environmental practices has become predominant all over the world. Governments, communities and industries are all adapting policies, regulations and enforcing stringent laws to prevent pollution as overconsumption of power, unsafe disposal method is slowly degrading the planet and depleting the natural resources we all rely on. There is an urgent need to make all industrial products and processes ‘sustainable’. The application of smart materials, with novel interlocking abilities, reduces manufacturing and disassembly costs. The development of software has given designers more tools, such as Computer Aided Design (CAD), Finite Element Analysis (FEA), and Virtual Reality, to help expedite the detail design stage, reducing the development costs of products. The Design for Environment (DFE) is a concept gaining widespread attention as decisions made by designers have a direct effect on the amount of raw material used, the amount of energy consumed lifetime. It is important that design engineers are provided with the appropriate tools to enable the minimization of the effect their products create on the environment. A balance of various factors such as the economy, environment, and society are necessitated to accomplish sustainable development in human society. Since the issues of global warming and climatic change become important, manufacturing sectors value the importance of green manufacturing to provide measures of environmental protection.

PRODUCT DESIGN

Products are the source of all environmental problems. Major issues such as pollution, deforestation, species loss and global warming are all side-effects of the activities that provide consumers with endless consumer goods on the market today. Product design is a complex process that requires design engineers taking into consideration a number of factors simultaneously. The properties of the materials used in the manufacturing process, such as their recycling and reuse capabilities and long-term impact on the environment, must all be considered. Other important considerations are the energy consumption and efficiency of the manufacturing process and ease of both assembly and disassembly.

SUSTAINABLE PRODUCT DESIGN

The basic considerations of Sustainable product design are development procedures, material selection, assembly, transportation, dismantle and recycling. The product designer should try to acquire a balance in sustainable development in order to intensify corporate image in the global competitive market after product sustainable development. For successful achievement of sustainable development on the decision making stage, the designer always consider the impact on the environment, the focus after greener product manufacturing, and minimizing reduction of waste. The sustainable development, in addition to the sustainable view, the designer should consider the important issues and future trends, including societal functions and possible alternatives. Therefore, Industries, the end users, and social environments will be sustainable and developed by mutual dependency.

CASE STUDY

Methodology of sustainability analysis

In this paper the literature review suggests that products be developed that are more sustainable and support the environment. The literature survey helped to understand various products that have undergone minor or major changes in terms of design, material etc, for sustainable development in design. After an analysis, one of the most important commercial products in the Universal power consuming device of keyboard in computer was selected. The existing product has been
selected and carefully followed by design procedures. The new models are designed in order to maintain the functions. A case study of a computer keyboard of base Figure 1 and proposed models Figure 2-3 has been carried out for minimizing environmental impact analysis by using sustainability express software. The sustainability analysis has been conducted to determine environmental impact in terms of carbon footprint, energy, air acidification and water eutrophication.

Environmental factors

The environmental factors that play a major role in study of design of consumer products are Carbon footprint, Air acidification; Water eutrophication and energy consumption are taken as the parameters to achieve better design of the product by change of design and alternative materials. The creation of CAD models of both baseline and proposed models has been done using SOLIDWORKS software. This software being widely used for design and analysis in all manufacturing concerns are readily available and the implementation can be made easily in manufacturing units. Design using SOLIDWORKS can enable various features to be represented in terms of parametric design that helps easy manipulation and change of various proposed models.

Table 1 Sustainability analyses for base and proposed models

<table>
<thead>
<tr>
<th>Parameters</th>
<th>CAD Model</th>
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<tbody>
<tr>
<td></td>
<td>Base model</td>
</tr>
<tr>
<td>Carbon Footprint (kg CO₂e)</td>
<td>0.159</td>
</tr>
<tr>
<td>Total Energy Consumed (MJ)</td>
<td>2.6</td>
</tr>
<tr>
<td>Air Acidification (kg SO₂e)</td>
<td>7.8E-4</td>
</tr>
<tr>
<td>Water Eutrophication (kg PO₄e)</td>
<td>8.4E-5</td>
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RESULTS AND DISCUSSIONS:

The analysis has been carried out in Figure 4 it can be seen that the reduction of parameters in proposed model2 are agreeable and considerable when compared to the base model and the agility of design can create a sustainable process of the product. From Figure 5 and 6 for varying weights of the identical materials and alternative materials are tabulated. The parameters as already discussed are Carbon Footprint, Total Energy Consumed, Air Acidification, and Water Eutrophication. The Table 1, where variation in material has been proposed shows that use of less polluting materials can be used for the production of keyboards which can make sustainable manufacturing of the widely used consumer product and minimize environmental impact. The analysis using software, considering the four parameters which are widely used to measure a product’s sustainability also shows that the carbon footprint of the proposed models are less than the base model and can reduce environmental degradation. Likewise, the other parameters of Total Energy Consumed, Air Acidification, Water Eutrophication when compared with the baseline models shows that the proposed models can significantly reduce their implications and create a sustainable design and development process.

Figure 5 Minimisation of Environmental Impact on Base and Proposed models
CONCLUSIONS

The growing concern on various environmental issues has forced organizations in manufacturing to produce products that are eco-friendly and have less impact on the environment. This case study has suggested a means to improve the manufacturing strategy in terms of design and material for one of the most widely used consumer product, the computer keyboard which today creates a reasonable impact on the environment after its useful life, on disposal. As proposed by the models and validation of the software, this on implementation can create sustainable manufacturing and provide minimal environmental impact.

REFERENCES


