International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 13, Issue 3 [March. 2024] PP: 28-32

Development of a lamp proposal with eco-design characteristics

Claudia Lissete Castrejón Cerro[1], Braulio Gabriel Contreras Galván[1], Johann Mejías Brito[2], Pedro Itzvan Silva Medina[2], Jesús Francisco Tejeda Castrejón[2]

[1]*Departamento de Ciencias Básicas del Instituto Tecnológico de Colima/Tecnológico Nacional de México*
[2]*Departamento de Ingeniería Industrial del Instituto Tecnológico de Colima/Tecnológico Nacional de México*

ABSTRACT: *Eco-design in the manufacturing of parts using 3D printing not only represents a response to growing demands for sustainability, but also offers opportunities to improve the efficiency and competitiveness of companies in an increasingly environmentally conscious world. In this work The proposal to redesign a desk lamp is made under a comprehensive approach oriented to sustainability, addressing multiple key aspects to reduce its environmental impact. The results reveal a significant reduction in the weight of the product without compromising its resistance, as well as improvements in manufacturing time and simplification of components. Furthermore, the introduction of sustainable packaging demonstrates a commitment to reducing environmental impact at all stages of the product life cycle.*

Date of Submission: 01-03-2024 Date of acceptance: 09-03-2024

I. INTRODUCTION

The eco-design approach, which emerged in the 1990s in the Netherlands, has gained prominence as an essential methodology for the implementation of Extended Producer Responsibility, thanks to its rapid adoption and application in various projects and training programs in companies in Germany, Belgium, United Kingdom and Australia.eco-design in 3D printing parts manufacturing has emerged as a key strategy to address environmental challenges and promote sustainability in the manufacturing industry. In a world where environmental awareness is increasingly relevant, designing products that minimize their environmental impact has become a priority for many organizations [1]. 3D printing offers unique opportunities to integrate eco-design principles from the initial stage of product development, enabling the optimization of resource efficiency, waste reduction and minimization of energy consumption throughout the product life cycle [2].

Eco-design is a methodological approach whose main objective is aimed at reducing the environmental impact generated during the life stages of a product, through the application of methods, strategies and techniques in the process of its design or redesign [3].

To achieve sustainability in a product or service, the application of ecodesign is required. This approach primarily involves integrating environmental and sustainability considerations from the initial stages of conception and development of each product.

By carefully considering the materials used, production processes, and part design, companies can significantly reduce their ecological footprint while maintaining standards of quality and functionality [4]. Furthermore, eco-design in 3D printing can foster innovation by promoting creative solutions that balance user needs with environmental considerations [5].

The importance of adopting eco-design approaches in 3D printing lies in its potential to mitigate the negative environmental impacts associated with conventional manufacturing methods. In the field of industrial design and product eco-design, the integration of digital modeling in organizational processes has facilitated the streamlining of 2D and 3D representations for design, analysis of its operation and its improvement. This makes it possible both to generate redesigns from existing products and to create new products. This addition has contributed significantly to a more precise interpretation and the generation of new models.

II. MATERIALS AND METHODS

TheIt is an articulated desk lamp, mainly composed of 3D printed parts. It measures approximately 35 cm tall in its natural position and 50 cm fully stretched. The parts are conceived from their design to achieve a better 3D printing. The base of the lamp is made up of two pieces, the main part that is hollow to

add an element that gives it weight, and a lid that covers it. The lamp hood is separated into two parts and there is a third piece that holds the lamp holder (Fig 1). The materials necessary to complete the product are: LED spotlight (GU10), lamp holder for the spotlight, coated cable approximately 3 meters long, plug, switch, three 5 mm diameter screws and three wing nuts for the screws.

Fig. 1 Desk lamp with LED lighting (Proposed original design).

Design principles

Sustainable Material: Recycled and recyclable materials will be used, prioritizing those with less environmental impact.

Energy Efficiency: Incorporation of latest generation LED technology for greater energy efficiency and lower consumption.

Disassembly and Recycling: Modular design that facilitates disassembly for recycling at the end of useful life.

Eco-friendly Packaging: Use of sustainable packaging materials and reduction to the necessary minimum.

Sustainable Manufacturing Process: Selection of manufacturing processes with a lower carbon footprint and less waste generation.

Durability and Extended Life: Focus on product durability to reduce replacement frequency.

Below is the table of the product components, materials and weight, as well as their typology, of the new redesigned product (Fig. 2).

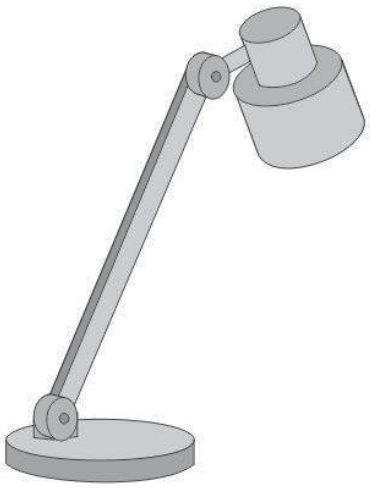


Fig. 2 Desk lamp with LED lighting (Proposed redesign).

Table (1). Product, typology, peculiarities.

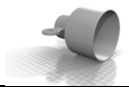
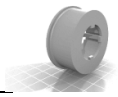
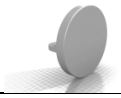
Product	Typology peculiarities	Image
Hood for the spotlight (internal part)	Material:ABS Filament (Acrylonitrile Butadiene Styrene) (Manufactured part) Weight: 63 grams	
Hood for the spotlight (external part)	Material: ABS Filament (Acrylonitrile Butadiene Styrene)(Manufactured part).Weight: 11 grams.	
Support (1 unit)	Material: ABS Filament (Acrylonitrile Butadiene Styrene) (Manufactured part Weight: 36 grams.	
Base	Material: ABS Filament (Acrylonitrile Butadiene Styrene)(Manufactured part).Weight: 85 grams.	
Base Cap	Material: ABS Filament (Acrylonitrile Butadiene Styrene)(Manufactured part).Weight: 85 grams.	
LED spotlight	6W GU10 LED spotlight, neutral white light, GU10 Base, non- dimmable (Standardized part).	
Socket	Socket (Standardized part).	
Screw and wing nut	Set of 2 screw and nut, butterfly. Material: 18-8 Stainless Steel WingNut (Standardized Part).	
10 gauge SPT flexible duplex wire	Material: Wire (Standardized part)	

Table (2). Results of material indicators

Componente	Material	Peso (g)	Indicador	Resultado
Light fixture	Acrylonitrile Butadiene Styrene (ABS)	0.063	400	25.2
Socket Support	Acrylonitrile Butadiene Styrene (ABS)	0.011	400	4.4
Support (2 units)	Acrylonitrile Butadiene Styrene (ABS).	0.036	400	14.4
Base	Acrylonitrile Butadiene Styrene (ABS).	0.085	400	34
Base Cover	Acrylonitrile Butadiene Styrene (ABS).	0.027	400	10.8
			Total	88.8

III. RESULTS

The redesign proposal of the desk lamp demonstrates a sustainable approach in various aspects, reducing the product weight by 11.8% without affecting its strength, decreasing manufacturing time and component quantity. Additionally, it proposes sustainable packaging for the new lamp, reducing the environmental impact associated with conventional packaging and avoiding the use of glues and paints.

The MET Matrix evidences an analysis of the redesigned aspects and the decrease in environmental impacts of the new product, in terms of materials and energy used throughout its lifecycle, thereby reducing the risk of non-compliance with environmental regulations.

Sustainable Material: The new lamp utilizes recycled and recyclable materials, reducing dependence on conventional plastics. In this case, ABS plastic is recyclable, which is excellent news for the environment and sustainability.

Energy Efficiency: Incorporating state-of-the-art LED technology significantly improves energy efficiency compared to the original lamp, enabling energy cost savings without compromising lighting quality.

Disassembly and Recycling: The modular design of the new lamp facilitates disassembly and recycling, addressing end-of-life waste issues, with components and elements made from ABS filament being recyclable.

Eco-Friendly Packaging: Sustainable packaging is used for the new lamp, reducing the environmental impact associated with conventional packaging, specifically utilizing plant fiber wrapping and eco-friendly packing tape made from kraft paper.

Sustainable Manufacturing Process: New manufacturing processes are selected to minimize carbon footprint and waste generation, by reducing the density of component parts in the new design. Components with lower density allow for a more hollow, lighter piece with less material, without compromising the final product's strength. For cases where exceptional strength is not required, a density of 15-50% is recommended. This range balances print time, material consumption, and strength, reducing print time and material usage.

Durability and Extended Lifespan: Attention to durability in the new design contributes to an extended lifespan, reducing the frequency of replacement and, therefore, waste generation.

IV. CONCLUSION

A The redesign proposal for the desk lamp shows a comprehensive approach towards sustainability, addressing multiple key aspects to reduce its environmental impact. The results reveal a significant reduction in the weight of the product without compromising its resistance, as well as improvements in manufacturing time and simplification of components. Furthermore, the introduction of sustainable packaging demonstrates a commitment to reducing environmental impact at all stages of the product life cycle.

The MET Matrix provides a detailed assessment of the redesigned aspects and their reduced environmental impact, which not only ensures compliance with environmental regulations, but also points the way towards more sustainable and responsible manufacturing.

eco-design in 3D printing is emerging as a strategic response to growing demands for sustainability, offering not only a reduction in the ecological footprint, but also opportunities to improve business efficiency and competitiveness. By carefully prioritizing materials, production processes, and part design, companies can achieve a significant reduction in their environmental impact without sacrificing product quality or functionality.

The adoption of eco-design in 3D printing drives innovation by fostering creative solutions that harmonize user needs with environmental considerations, which could mark a turning point in the way products are conceived and developed in an increasingly conscious world. environment.

The benefits of applying eco-design in electrical and electronic devices (EEE) focus mainly on the management of waste generated during their use, known as WEEE. This waste poses significant environmental problems due to the increase in global demand for these devices in recent years. Therefore, it is essential to implement an environmental management system, such as that proposed by the ISO 14000 series of standards, to address these problems. Furthermore, it is relevant to highlight that these standards include ISO 14006, which focuses on the integration of eco-design in the product manufacturing process.

REFRENCES

[1]. Wang, X., & Zhang, X. (2019). Eco-Design in Additive Manufacturing. In Proceedings of the 8th CIRP Conference on Industrial Product-Service Systems (pp. 53-58).Shatat, M., Worall, M. and Riffat, S. [2013] "Opportunities for solar water desalination worldwide: Review" Sustainable Cities and Society, Vol. 9: pp.67–80.

[2]. Gebler, M., Schoenung, J. M., & Gupta, S. K. (2014). Sustainability and additive manufacturing: A proposed framework. Journal of Cleaner Production, 64, 90-98.Sharon, H. and Reddy, K. S. [2015] "A review of solar energy driven desalination technologies" Renewable and Sustainable Energy Reviews, Vol. 41: pp.1080–1118.

[3]. Fuentes, I. A. (2022). La aplicación del ecodiseño. un año de diseñarte, mm1, (24), 24-35..

[4]. Ferreira, J., Marques, A., de Sousa, R. J., & Jorge, J. (2018). Eco-design in the development of additive manufactured products. Procedia CIRP, 72, 1223-1228.

[5]. Bocken, N. M., de Pauw, I., Bakker, C., & van der Grinten, B. (2016). Product design and business model strategies for a circular economy. Journal of Industrial and Production Engineering, 33(5), 308-320.Ghalavand, Y., Hatamipour, M. S. and Rahimi, A. [2014] "Humidification compression desalination" Desalination, Vol. 341: pp.120–125.

[6]. Molina Mata, S. L., García Parra, B., Sahagún Angulo, R., Acosta Fuentes, I., & Ramírez Lozano, A. (2017). Aproximaciones al ecodiseño.

[7]. Rochelle, M. B. (2022). Desarrollo editorial para adultos mayores como sujetos activos en sociedad (Bachelor's thesis).

[8]. Miranda, W. C., de Contreras, M. E. O., de Dios Maza, J., & Owen, A. A. C. (2023). Ecodiseño de bicicletas a partir de residuos urbanos de papel-plástico, bambú y madera. In Actas del X Simposio Iberoamericano de Ingeniería de Residuos: Hacia la circularidad y el residuo cero. Castelló de la Plana, 20, 21 y 22 de junio de 2023 (p. 171). Servei de Comunicació i Publicacions.

[9]. Ramírez Juidías, E., & Galán Ortiz, L. (2006). El ecodiseño como herramienta básica de gestión industrial. In XVIII Congreso Internacional de Ingeniería Gráfica (Vol. 162, pp. 1-6).