



# Mix Sustentável

## **Sustainable Innovation: the use of recycled PLA as a substitute for natural gemstones**

Inovação Sustentável: o uso de PLA reciclado como substituto para gemas naturais

Innovación Sostenible: el uso de PLA reciclado como sustituto de gemas naturales

**Laura de Menezes Pacheco David**<sup>1</sup> 

**Janaíne Taiane Perini**<sup>2</sup> 

**Felipe Luis Palombini**<sup>3</sup> 

**Mariana Kuhl Cidade**<sup>4</sup> 

<sup>1</sup> Bacharela, DI/UFSM – Desenho Industrial, Universidade Federal de Santa Maria, Santa Maria, Rio Grande do Sul, Brasil

<sup>2</sup> Mestranda, PPGAUP – Programa de Pós-graduação em Arquitetura, Urbanismo e Paisagismo, NOVA Lab – Laboratório de Inovação e Sustentabilidade em Design, Universidade Federal de Santa Maria, Santa Maria, Rio Grande do Sul, Brasil

<sup>3</sup> NOVA Lab – Laboratório de Inovação e Sustentabilidade em Design – Departamento de Desenho Industrial, PPGAUP – Programa de Pós-graduação em Arquitetura, Urbanismo e Paisagismo, Universidade Federal de Santa Maria, Santa Maria, Rio Grande do Sul, Brasil

<sup>4</sup> NOVA Lab – Laboratório de Inovação e Sustentabilidade em Design – Departamento de Desenho Industrial, PPGAUP – Programa de Pós-graduação em

**ORIGINAL ARTICLE –  
SCIENTIFIC SECTION  
RESPONSIBLE EDI-  
TORS:** Lisiane Ilha  
Librelotto, Dr. Eng., Paulo  
Cesar Machado Ferroli, Dr.  
Eng.

**SUBMITTED ON**

12/01/2026

**ACCEPTED ON**

30/01/2026

**PUBLISHED ON**

02/03/2026

**PID**

10.29183/2447-

3073.MIX2026.v2.n2.IV-VIII



### **Standard License Text**

This work is licensed under a Creative Commons Attribution 4.0 International License.

### **Copyright Statement**

Authors retain the copyright and grant the journal the right of first publication, with the work simultaneously licensed under a Creative Commons Attribution

Arquitetura, Urbanismo e Paisagismo, Universidade Federal de Santa Maria, Santa Maria, Rio Grande do Sul, Brasil

**Correspondência para:** mariana.cidade@ufsm.br

**Resumo:** A joalheria contemporânea destaca-se pela inovação em seus processos e pela adoção de materiais distintos, frequentemente incorporando insumos reciclados. Nesse contexto, este artigo descreve o emprego do ácido polilático (PLA) reciclado, proveniente de resíduos de impressão 3D, como substituto para gemas naturais. O objetivo é reaproveitar esses resíduos para evitar o descarte inadequado, agregar novo valor ao polímero e promover a reflexão sobre as práticas e a ressignificação do setor joalheiro. A metodologia estruturou-se em quatro etapas: definição do projeto, conceituação, pesquisa qualitativa e exploratória, e materialização. Por meio de quatro testes experimentais, os resultados estabeleceram parâmetros ideais de temperatura, tempo de forno e quantidade de camadas de PLA. Essas definições foram essenciais para otimizar o derretimento do material, homogeneizar a cor, garantir a formação de facetas precisas e prevenir o surgimento de bolhas. Como validação prática, confeccionaram-se cinco séries de gemas e um par de brincos. Essa aplicação demonstrou o potencial técnico, estético e simbólico do PLA reciclado, consolidando-o como uma alternativa sustentável e inovadora no design de joias.

**Palavras-chave:** Polilático; Gemas; Joalheria Contemporânea; Inovação; Reciclagem.

**Abstract:** Contemporary jewelry is characterized by process innovation and the adoption of unconventional materials, frequently incorporating recycled inputs. Within this framework, this article describes the application of recycled polylactic acid (PLA) derived from 3D printing waste as a substitute for natural gemstones. The objective is to repurpose such waste to prevent improper disposal, add new value to the polymer, and foster reflection regarding the practices and re-signification of the jewelry sector. The methodology was structured into four stages: project definition, conceptualization, qualitative and exploratory research, and materialization. Through four experimental tests, the results established ideal parameters for temperature, furnace time, and the number of PLA layers. These definitions were essential to optimize the material's

### **Conflict declaration**

Nothing to declare.

### **Funding source**

This research was supported by CNPq/MCTI Universal Call 2023, FAPERGS Call 09/2023 – Gaúcho Researcher Program, and FAPERGS Call 10/2024 – ARD/ARC.

melting process, homogenize color, ensure the formation of precise facets, and prevent the occurrence of bubbles. As a practical validation, five series of gemstones and a pair of earrings were fabricated. This application demonstrated the technical, aesthetic, and symbolic potential of recycled PLA, consolidating it as a sustainable and innovative alternative in jewelry design.

**Keywords:** Polylactic Acid; Gems; Contemporary Jewelry; Innovation; Recycling.

**Resumen:** La joyería contemporánea se destaca por la innovación en sus procesos y por la adopción de materiales diversos, incorporando frecuentemente insumos reciclados. En este contexto, el presente artículo describe el empleo del ácido poliláctico (PLA) reciclado, proveniente de residuos de impresión 3D, como sustituto de gemas naturales. El objetivo es reutilizar dichos residuos para evitar su eliminación inadecuada, agregar un nuevo valor al polímero y promover la reflexión sobre las prácticas y la resignificación del sector joyero. La metodología se estructuró en cuatro etapas: definición del proyecto, conceptualización, investigación cualitativa y exploratoria, y materialización. A través de cuatro pruebas experimentales, los resultados establecieron los parámetros ideales de temperatura, tiempo de horno y cantidad de capas de PLA. Estas definiciones resultaron esenciales para optimizar la fundición del material, homogeneizar el color, garantizar la formación de facetas precisas y prevenir la aparición de burbujas. Como validación práctica, se confeccionaron cinco series de gemas y un par de pendientes. Esta aplicación demostró el potencial técnico, estético y simbólico del PLA reciclado, consolidándolo como una alternativa sostenible e innovadora en el diseño de joyas.

**Palabras clave:** Ácido Poliláctico; Gemas; Joyería Contemporánea; Innovación; Reciclaje.

**Como citar:** SILVA, Eduarda David Marques da; IZIDIO, Luiz Claudio Lagares; SANTOS, Denilson Moreira. O que floresce nas fissuras: práticas de design situadas no contexto do Antropoceno. **Mix Sustentável**, Florianópolis, v. 11, n. 4, p. IV-VIII, 2026. DOI: <https://doi.org/10.29183/2447-3073.MIX2025.v11.n4.IV-VIII>

## **1 INTRODUCTION**

Contemporary jewelry is distinguished by innovation in processes and materials, incorporating principles of sustainability using recycled materials (COHN, 2012; SKINNER, 2013; CIDADE; PALOMBINI, 2023). Within this framework, the aim of this study was to employ polylactic acid (PLA), derived from 3D printing waste, as a substitute for natural gemstones. This approach seeks to prevent improper disposal, grant new value to the material, and prompt reflection on the socio-environmental impacts of mining. Moreover, the use of PLA reinforces the principles of innovation, sustainability, and re-signification that currently define jewelry practices.

## **2 METHOD**

Following Cidade and Palombini (2022) methodology, the research was structured into four stages: (1) project definition; (2) conceptual definition; (3) qualitative and exploratory research; and (4) materialization. In the final stage, PLA was separated and processed in different colors, placed into silicone molds shaped as gemstones, and melted in a furnace under varying conditions of temperature, time, and amount of residue.

## **3 RESULTS**

Four tests were conducted to assess the feasibility of PLA as a substitute for natural gemstones. The optimal outcome combined solutions to issues such as bubble formation, energy consumption, color stability free of stains, and clearly defined facets. The ideal parameters established were temperature between 160 °C and 180 °C, total furnace time of 4 hours, and the use of three layers of PLA. Based on these parameters, five series of gemstones in different colors were produced (Figure 1), yielding pieces with an appearance similar to natural gemstones. Validation was achieved through the creation of a pair of earrings, which demonstrated the practical feasibility of the application.

---

**Figure 1 – Gemstones produced in PLA and “Dragonfly” earrings.**



Source: Authors (2025).

#### 4 CONCLUSION

This study explored new possibilities for producing gemstones from 3D printing waste. The proposal arose from concerns regarding the improper disposal of this material and from the intention to integrate it into jewelry design, which challenges traditional values associated with jewelry and proposes new ways of conceptualizing luxury, aesthetics, and sustainability. Throughout the process, it became evident that PLA, when properly handled, exhibits real potential both technically and symbolically, as well as aesthetically. More than a solution for waste reuse, the use of this material contributes to broadening the debate on what can be considered valuable within the field of jewelry.

#### REFERENCES

CIDADE Mariana Kuhl; PALOMBINI, Felipe Luis. Design de joias: proposição de metodologia para ensino voltado ao mercado joalheiro. *Revista Design & Tecnologia*, v. 12, n. 24, p. 57–72, 2022.

CIDADE, Mariana Kuhl; PALOMBINI, Felipe Luis. Design e sustentabilidade: práticas experimentais com materiais problemáticos no ensino de joalheria contemporânea. *MIX Sustentável*, v. 9, n. 4, p. 17–26, 2023.

COHN, Susan.; SUDJIC, Deyan. *Unexpected pleasures: the art and design of contemporary jewelry*. New York: Skira Rizzoli, 2012.

SKINNER, D. *Contemporary jewelry in perspective*. Asheville: Lark Crafts, 2013. Disponível em: <https://artjewelryforum.org/library/contemporary-jewelry-in-perspective/>. Acesso em 20 set. 2025.