Technology jointly developed jointly by SCTIMST Trivandrum, and M/s. Tata Steel Limited.

Title of the Technology

Short coir fibre reinforced polylactic acid biocomposite for fabricating external orthosis assistive devices for promoting sustainability and circular economy in healthcare.

Device classification, if applicable

Class A

Intended end use

Short coir fibre reinforced polylactic acid biocomposite is used as an ecofriendly alternative substitute material for engineering thermoplastics for manufacturing external orthotic assistive devices. The developed composite material has mechanical strength at par or exceeding to that of conventional thermoplastic materials such as polypropylene, low and high density polyethylene, and nylon used in the manufacture of external orthotic assistive devices. Unlike petroleum derived thermoplastics, natural fibre reinforced biocomposite completely biodegrades in the soil when disposed at their end of their life. The biocomposite material can used for manufacturing orthotic assistive devices such as wrist support splint, ankle foot orthoses, back support corsets, knee braces and finger orthoses.

Unmet need and market scope

Most medical plastics such as polypropylene, polyvinyl chloride, polyethylene, polystyrene do not degrade easily and persists in the environment for hundreds of years leading to environmental pollution. Improper landfill, or incineration of biomedical waste can pollute, land, water and air with microplastics. A solution to beat medical plastic waste pollution in external orthotic assistive device segment is the use of environmentally biodegradable alternative materials such as bioplastics. Currently orthotic assistive devices utilizing biodegradable polymers are not available in India. The use of bioplastics with improved strength for manufacturing orthotic assistive medical devices align with the goals of green health care, sustainable development and circular bioeconomy.

Market scope

The market for sustainable materials in healthcare is experiencing significant growth, driven by increasing environmental awareness and regulations, as well as the need to reduce healthcare's environmental impact. The biodegradable medical devices market is projected to grow from USD 5.02 billion in 2024 to USD 16.46 billion by 2035, with a CAGR of 11.4%.

The global market for natural fibre reinforced composite (NFRC) (all sectors combined) is projected to reach USD 7–9 billion by 2030. Global orthotic & prosthetic device market is worth ~USD 4–5 billion globally. Medical/orthotic segment of NFRC is still niche but growing at 6–8% CAGR. With policy and R&D support, growth of medical segment of NFRC is expected to be double by 2030.

Technology Description with specification

The Technology of short coir fibre reinforced polylactic acid biocomposite was jointly developed with SCTIMST Trivandrum, and M/s. Tata Steel Limited. The technology includes Mechanized production of short coir fibres with controlled output fibre length for industrial scalability. Critical fibre length, fibre loading, and fibre treatment are optimized for obtaining short coir fibre reinforced polylactic acid biocomposite with tensile and flexural properties at par with engineering thermoplastics. The developed bio composite material is non-cytotoxic, and does not induce skin

irritation. The material prevents catastrophic failure under loading conditions. Following patent application is filed on the technology:
Indian Complete Patent Application No.: 202431025124.
Filing date: 28th March 2024.
Applicant: Tata Steel Limited and Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST)
Title: Method of manufacturing a composite material and Device for Assisting with Composite material manufacturing.

Novelty and Value proposition

Bioplastics offers a solution to environment pollution caused due to non-degradable medical plastic waste. However, the strength of bioplastics is low when compared to engineering thermoplastics used in structural/load bearing applications such as external orthoses. The strength of bioplastics can be improved using reinforcement fibres. Using natural fibres as reinforcements for improving the strength of bioplastics is a breakthrough idea for promoting circular bioeconomy. Technology allows scalable and continuous production of short coir fibres. Mechanical properties of short coir fibre reinforced polylactic acid biocomposites are at par or superior to that of conventional thermoplastics used in orthotic assistive devices. The technology aligns with sustainable development goals and won the Best Oral Presentation Award during India International Science Festival in the Theme 'Sustainable development and Circular economy', held at Faridabad 17-20th January 2024.

Stage of development

TRL 5. Material Development completed, Mechanical testing completed, Biocompatibility studies completed, Industrial scale manufacturability of devices using Injection moulding is ongoing.

Good quality image of the technology

Product attributes \ Manufacturer	tynor	DYNA	AIRCAST	BREG	CORFLEX	TSL – SCTIMST Current Dev.
Materials	Nylon, PP	Nylon, PP	Nylon	Aluminium, Vinyl laminated	PP	PLA- Coir fibre
Strength (MPa)	40	38	70	NA	33	50
Manufacturing method	Injection Moulding	Injection moulding	Injection Moulding	Extrusion, rolling & Pressing	Vacuum Moulding	Injection Moulding
Cost (INR)	650	550	2000	1500	2000	~ 150 estimated
Bio degradable or not	No	No	No	No	No	Yes

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