

Manufacture of synthetic railway sleepers from recycled plastics

Fabricación de durmientes sintéticos a partir de plásticos reciclados

Franco Frola

Degree in Business Administration, specialist in waste management and sustainability. Speaker at the JST 2023 Symposium.

Keywords: TRANSPORT- OPERATIONAL SAFETY- RAILWAY- ENVIRONMENT- SUSTAINABILITY.

Palabras clave: TRANSPORTE- SEGURIDAD OPERACIONAL- FERROVIARIO- MEDIOAMBIENTE- SUSTENTABILIDAD.

Received: 05/01/2023

Accepted: 15/02/2023

Abstract

To provide environmental solutions that promote the implementation of the principles of the circular economy and avoid the burial of this material, the first factory of synthetic sleepers made from recovered plastics in Argentina has been developed. This article details the background of this material and the benefits for the industry and the railway sector.

Resumen

Con el objetivo de brindar soluciones ambientales que promuevan la implementación de los principios de la economía circular y evitar el enterramiento de este material, se ha desarrollado la primera fábrica de durmientes sintéticos a partir de plásticos recuperados de Argentina. El presente artículo detalla los antecedentes de este material y los beneficios para la industria y el sector ferroviario.

Introduction

The lack of availability of wooden railway sleepers has led to ecosystem degradation in central and northern Argentina during the 20th century, particularly due to indiscriminate logging of valuable tree species. Additionally, poor planning in the sector and the expansion of agricultural and urban borders have impoverished the national railway system, discouraging its rehabilitation. Furthermore, plastic constitutes the material with the highest proportion of waste and the most significant environmental and cost-related problems for its management. Therefore, the manufacture of synthetic railway sleepers provides a definitive and long-term solution for the recovery of railway tracks, reducing environmental impact, optimizing regional logistics, and creating new jobs in the sector. In this regard, the main objectives of this project are as follows:

- Promote the development of the national industry.
- Restore the Argentine railway system as a clean and efficient transport system.
- Meet the objectives of the Paris Agreement regarding sustainable mobility.
- Reduce the environmental impact of plastic waste without a commercial circuit.
- Protect the native forests of Argentina by avoiding the logging of valuable species like quebracho.
- Foster strategic partnerships to achieve long-term scalability and exportability for the project.
- Recover complex plastic materials, avoiding sanitary landfill and the associated costs.
- Generate new job opportunities and professionalize trades.
- Manufacture other furniture or urban products as a replacement for wood.

Talking about the circular economy today implies a deep commitment to the environment and society, understanding that the cost-benefit formula no longer works from a linear perspective. We are currently facing an unprecedented crisis, where it depends solely on us to question the ways of economic growth to ensure future well-being. In this sense, this socio-environmental crisis opens opportunities if we become aware of our place and our potential to take local actions. This is how Grupo RFG company committed to this innovation project, with the potential to drive the country's industrial development (image 1).

Image 1: Ground plastics ready for processing



Source: own elaboration.

The vision and mission to pursue this path date back almost ten years when the dream of this family company was just beginning to take shape. During all this time, Grupo RFG has had the opportunity to work with important organizations in the province of Córdoba, which trusted them with the management of their recyclable materials. This has allowed them to get to know the sector closely and plan their work on the three pillars that the system should be based on: economic, social, and environmental. In this context, with each new material, the challenge arises to give it a new life before disposal, following the principles of the circular economy. Here, raw materials are obtained from discarded materials, reducing them and reusing them within the production chain. This is why a holistic approach to sustainable development is advocated, ensuring environmental management that reaches all sectors involved.

***“To ensure their functionality and durability, the railway sleepers have been tested for strength by the National Institute of Industrial Technology (INTI) and certified according to the IRAM 1610 standard on Synthetic Railway Sleepers.*”**



The agreement with Trenes Argentinos for the manufacture of plastic sleepers and the rehabilitation of the country's railway tracks is of great importance for the current reality. It is not just about recycling one of the most abundant materials in the market but precisely about giving it a definitive disposal. Because until now, although most plastics are potentially recyclable, there were no channels for all their types that guaranteed their traceability, or even their new life, and their subsequent recovery would again depend on responsible circuits and management.

Thinking today about synthetic sleepers is projecting an increasingly positive environmental impact; it is promoting a sector for the promotion of public policies for job creation and the consolidation of public-private sector alliances; it is reducing deforestation and finally providing the country with a clean, safe, and high-potential transport system.

For the first time in Argentina, the manufacture of sleepers from recovered plastic material is a reality and thus guarantees a progressive reduction in greenhouse gas emissions, contributing to Argentina's commitments under the Paris Agreement to tackle climate change. In this regard, according to the United Nations Environment Program (UNEP), plastic accounts for 85% of the waste that reaches the oceans and warns that, by 2040, the volumes of this material flowing into the sea will almost triple, with an annual amount of between 23 and 37 million tons. This situation is not only critical for marine life but also for human health, which is vulnerable to pollution in water sources, which could cause hormonal changes, developmental disorders, reproductive abnormalities, and cancer.

Furthermore, this project contributes to halting deforestation of the country's native forests, which are carbon sinks par excellence. Based on recent research, 85% of the red quebracho forests in the Chaco have been lost, so the project would contribute to the restoration of one of the most important ecosystems in Latin America. It is even known that white quebracho sleepers are an alternative; however, they do not have the same durability, so the pressure on the system is even greater. At the same time, the wood of the sleepers must be treated with creosote or heavy metal salts, which are toxic and can leach into the groundwater. Table 1 presents a comparison between both alternatives.

In contrast, plastic sleepers allow for the recovery of a widely circulated material, perpetuating it for sustainable use and enabling recycling at the end of its life cycle. This technology, widely used in other parts of the world, had its beginnings in Argentina based on the research thesis of engineer Mariano

***“To think about synthetic sleepers today is to project an increasingly positive environmental impact: it is to drive a sector for the promotion of public policies, for job creation, and for the consolidation of public and private sector alliances.*”**



Fernández Soler, a member of the National Center for Railway Development and Innovation (CENADIF), who has been researching its formula and applicability for several years. Additionally, to ensure their functionality and durability, the sleepers have been tested for their strength by the National Institute of Industrial Technology (INTI) and certified according to the IRAM 1610 standard for Synthetic Sleepers. This standard establishes the requirements that synthetic sleepers must meet for their application in railway infrastructures, manufactured from polymer matrix compounds, additives, and/or reinforced or unreinforced with substances improved in physical, mechanical, or weather resistance characteristics.

On the other hand, rehabilitating the country's railway tracks not only provides a cleaner mode of transport with reduced emissions of pollutants but also optimizes the logistics of raw materials and

Table 1: Comparative table between sleepers alternatives.

Characteristics	Railway sleepers	
	White quebracho	Recyclable materials
Lifespan	10 years	50 years
Fixation physical behavior	Fails over time	Good
Resistance to climatic behaviors	Bad	Good
Resistance to organic decomposition	Bad	Good
Fire resistance	Bad	Good
Abrasion resistance	Bad	Good
Electrical isolation	Good	Good
Elasticity	Good	Good
Ability to withstand derailment	Good	Good

Source: own elaboration.

products within the country. This implies, on the one hand, alleviating congestion and discouraging the construction of new highways, which restrict the growth of our cities and harm the health and resilience of our ecosystems. On the other hand, it offers the potential for greater economic development in the logistics and transportation sectors.

Furthermore, channeling this bulky material promotes the growth and institutionalization of the industry. Today, informal recyclers play a key role in material recycling; however, their working conditions do not meet basic social security requirements. In this regard, the procurement of raw materials for sleepers will generate not only thousands of direct and indirect jobs but also their formalization and consolidation in the market.

“Rehabilitating the country's railway tracks not only provides a cleaner mode of transport with reduced emissions of pollutants but also optimizes the logistics of raw materials and products within the country.”



Finally, one of the most significant benefits of the project is the formation of key alliances, as promoted by Goal No. 17 of the Sustainable Development Goals (SDGs). When we talk about public policies, it not only refers to a management that integrates economic, social, and ecological aspects for sustainable development but also aims for the participation of all involved actors, interdisciplinary and cross-sectoral, to ensure its long-term continuity. This effort would not make sense or be a reality today without the involvement of the academic, public, and private sectors, in all their spheres of influence, with the confidence to develop a one hundred percent national innovation technology. Thanks to the participation of the Ministry of Transport, the Ministry of Environment and Sustainable Development, and the Ministry of Productive Development of the Nation, the National Center for Railway Development and Innovation (CENADIF), the National Institute of Industrial Technology (INTI), Belgrano Cargas, the Faculty of Exact, Physical, and Natural Sciences (FCEFYN) of the National University of Córdoba, the Secretariat of Environment and Climate Change of the province of Córdoba, the Argentine Institute of Standardization and Certification (IRAM), the Argentine Network of Municipalities Facing Climate Change, the Biocórdoba

Wood and Concrete vs. Recycled Plastic

Most of the railway sleepers in our country are made of quebracho wood and concrete. These materials, while having certain benefits, also present some problems. For example, it is impossible to meet the total demand for quebracho sleepers, and the unsatisfied demand drives up the selling price, leading to massive deforestation and environmental damage. Concrete sleepers, on the other hand, are less flexible and heavier than wooden ones and can only be used for full track renovations.

The possibility of replacing these materials with recycled plastic not only contributes to environmental conservation but also enhances transport safety. Synthetic sleepers are lightweight, have a rapid manufacturing process, are flexible, and resistant to torsion and weather-related wear and tear.

The use of components enhanced by new technologies (R&D) could lead to much more reliable track structures and, therefore, safer transportation for both cargo and passenger trains. It could improve the circulation speed and capacity for cargo transport vehicles. Additionally, more efficient maintenance plans could be established to reduce the risks of railway incidents.

National Directorate of Railway Incident Investigation

entity of the Municipality of Córdoba, the Municipality of Córdoba, Córdoba Works and Services (COyS), Cormecor, the Municipality of Montecristo, and associated private companies, it is now possible to plan a large-scale venture that will achieve new sustainability goals for the entire region.

The project has also been declared of national interest by the Ministry of Environment and Sustainable Development of the Nation and the Ministry of Transport of the Nation, of legislative interest by the Legislature of the province of Córdoba, and of municipal interest by the Deliberative Council of the City of Córdoba.

