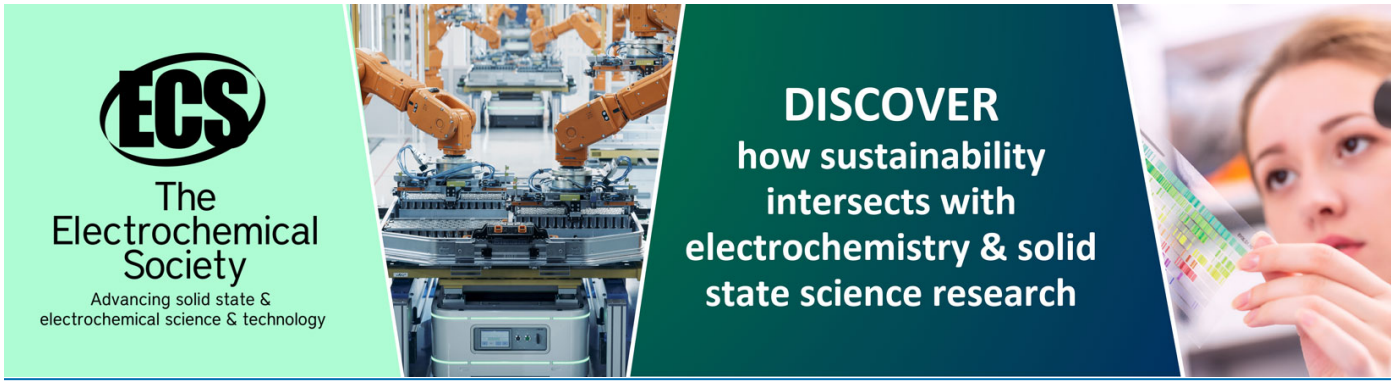
A Comparative Study on Recycled Plastic Railway Sleeper with Concrete Sleeper



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Retraction

Retraction: A Comparative Study on Recycled Plastic Railway Sleeper with Concrete Sleeper (*IOP Conf. Ser.: Mater. Sci. Eng.* **1145** 012006)

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This article (and all articles in the proceedings volume relating to the same conference) has been retracted by IOP Publishing following an extensive investigation in line with the COPE guidelines. This investigation has uncovered evidence of systematic manipulation of the publication process and considerable citation manipulation.

IOP Publishing respectfully requests that readers consider all work within this volume potentially unreliable, as the volume has not been through a credible peer review process.

IOP Publishing regrets that our usual quality checks did not identify these issues before publication, and have since put additional measures in place to try to prevent these issues from reoccurring. IOP Publishing wishes to credit anonymous whistleblowers and the Problematic Paper Screener [1] for bringing some of the above issues to our attention, prompting us to investigate further.

[1] Cabanac G, Labbé C and Magazinov A 2021 arXiv:2107.06751v1

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A Comparative Study on Recycled Plastic Railway Sleeper with Concrete Sleeper

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Abstract. India is the country that largely depends on railway networks. The material used for casting of railway sleepers should be of good quality, economical, eco-friendly and strong. Concrete and steel are most commonly used material. Concrete sleepers are very heavy and crack easily and steel also having corrosion problem, so we need the correct alternative sleeper for long duration. The plastic has a good quality, durability and life span against decomposition and make it most eco-friendly these days. Plastic sleepers have excellent damping characteristics combined with the relatively low weight and recycling of plastic wastes reduces the global environmental problem. The recycled plastic railway sleepers employed at the railway networks in abroad Railway sleepers made up of waste plastic are often the simplest choice for the revolution in railways. It is made by using plastic from waste polycarbonate and polyethylene and then glass fiber is added in the sleeper as a reinforcement. It is often the simplest alternative over concrete and steel sleepers. The test results of Flexural strength show the plastic railway sleeper is a bit on a longer scale compared to the concrete sleeper. Therefore, the plastic sleepers are excellent alternative for concrete and steel sleepers in railways.

1. Introduction

Railway sleepers are one among the foremost priority components of the track. To support the railway track, there are the beams/ties arranged beneath the rails. Their perform is to transfer and distribute the transported rail loads o the ballast, transversally secure the rails to require care of the correct gauge-width and to resist the cutting and abrading actions of the bearing plates and therefore the ballast material. Generally, Sleepers are provided to resist longitudinal and lateral movement of railway track.

In high speed Railway track lines, Pre-stressed concrete sleepers became wide and with success accepted for railway sleeper usage. Concrete sleepers, on the other hand, are difficult to handle and instal since they appear to twist when lifted. The issue with concrete sleepers is their considerable weight, which necessitates the use of specialised machinery during delivery and installation [1].

1.1 Railway Sleepers – Existing Materials

Since the introduction of railways, a huge amount of research and development has gone into materials for sleepers. Conventional wooden sleepers are still the most common, but pre-stressed concrete and steel sleepers are increasingly becoming more popular in track laying [2].

1.2 Railway Sleepers - The need for alternatives

Most railway infrastructure companies have been testing standard concrete and steel for commutation timber sleepers in existing railway tracks for quite some time. This maintenance technique, on the other hand, has limited effectiveness. These types of materials had little impact on the number of timber sleepers that could be used. Despite the growing accountability and efficacy of alternatives such as steel and concrete, according to Gruber [3], over ninety percent of railway track maintenance and construction still uses timber sleepers. [4].

Concrete sleepers have the power to supply higher line and holding the gauge characteristics than timber sleepers, however they are comparatively dearly-won more serious and are usually incapacitate of giving a forecasted service life of 50 years [5]. Sleepers made up of steel materials could give extreme strength than that of concrete as well as wood, however steel sleepers area unit being employed in medium quantities due to their huge value.

Frequent changes and alteration of fixtures & fastenings are needed. Similar to that changes of timber with concrete or sleepers made up of steel are going to be each tough also it may be expensive. Concrete and sleepers made up of steel have mechanical properties irreconcilable with the prevailing sleepers made with steel. The upper concrete structural stiffness suggests that a better stress is loaded to the RCC sleepers that may tends to larger degeneration because of flexural cracks [6]. Similar to that sleepers made by steel shouldn't be combined with sleepers made up of timber due to the occurrence of settlement [7]. The dimension and texture of steel railway sleepers leads to a bent to settle a lot of faster than wooden sleepers. One more consideration is producing conventional sleeper needs significantly a lot of power and is one among the biggest developers of part carbon. The Report given by Australian Greenhouse workplace [8] says that the dioxide emissions throughout the assembly of conventional sleepers are 100–200 times more than the hardwood timber, severally. it's proven that timber should be the alternative for sleepers, particularly for the changing of broken and damaged one.

2. Literature Review

[9] suggested that there is a global environmental crisis facing the mother earth. plastic recycling can minimally reduce this problem. INDIA is the country that relies primarily on railway networks. Therefore, the rail manufacturing materials used should be high quality, economical, eco-friendly and solid. Concrete, steel, concrete that becomes exhaust after several decades is the most commonly used. In order to avoid this, we need the material so these sources can be replaced. Nowadays, in many manufacturing sectors, plastic is known as the primary fuel. The plastic has a decent consistency against decomposition in terms of its length and life span, so this makes it most eco-friendly these days. It led to rapid change that all sleepers are replaced by plastic sleepers in most of the railways. Our task, therefore is to observe the operation and efficiency of recycled plastic railway sleepers used in the railway networks.

[10] investigated that Concrete is the most commonly used railway sleeper material, but as a sleeper material it damages over years and desires suitable changes. Recently, Concrete has become more costly, less offered and of poor quality compared to the previously offered Concrete for railway sleepers. Concerning the employment and disposal of chemically impregnated concrete sleepers, there are still several environmental concerns at present. This has resulted in the checking out of various materials by most railway industries to swap existing concrete sleepers. This paper provides a study of recent developments and presents as another material for railway sleepers an initiative specializing in fibre composites. The square measure of fibre composites is increasing as another viable building material. In addition, a description of the ongoing study and production of innovative composite fibre railway sleepers is listed.

[11] clarified that railway sleepers made of waste plastic, as well as recycled bumper scrap and recent personal computer and laptop cases could soon set up a look at United Kingdom railway tracks, making waste sleepers. In disposable coffee cups, polystyrene is sometimes used, and polyethylene is far more likely to be seen hanging from trees in the style of carrier luggage. The durability of this

plastic, however, implies that victimization caused by railway sleepers is likely to last for hundreds of years. Concrete area unit sleepers are terribly severe and simply crack, and wood sleepers require tons of maintenance and chemical treatments to avoid decomposition. The sleepers have a time span of several decades in each case. In India, where Micron has a plant in the making, plastic sleepers have already been tested and authorised. Two US plants capable of generating more than 20000 plants a month also have a production contract with the company.

[12] explained that despite a spread of environmental considerations, most of the railway corporations worldwide still use Plastic sleepers to take care of their existing Plastic lines. At present, improved polymer sleepers have emerged as distinct as possible, but their adoption has been terribly slow due to their high value. In Australia variety of exciting new developments in reinforced polymer sleepers have recently been introduced into the market place by Carbonloc Private Ltd, a spin-off company of the University of Southern Queensland in Toowoomba.

According to [13], several railway infrastructures forms have tried for years to replace timber sleepers with pre-stressed concrete and steel, these materials have not proved to be reliable replacements for timber turnout sleepers. Fibre composites have currently been targeted for analysis and production as this material is created to possess similar usability and style characteristics to the superimposed blessings of hardwood timber. However, for fibre composite sleepers to become an acceptable variety for timber sleepers, several obstacles should be addressed. This paper summarizes the numerous projects at the Center of Excellence in Designed Fibre Composites aimed at better understanding the preparation and efficiency concerns associated with the ultimate use of this emerging technology.

[14] described the employment of composite materials has become associate more and more vital consider engineering style. Even at warm temperatures, heat, corrosive atmosphere or high stress, they meet stringent requirements such as satisfactory results. Joint attempts are being made to incorporate the use of composites by Indian Railways in various applications. Square interventions exasperate the world's push for quantum gains in material efficiency by rising energy costs and environmental concerns. Originally designed for regional industry, fibre reinforced plastics (FRP) are used extra and additional due to their wonderful unique characteristics, e.g. high strength and rigidity, low weight and hence the ability to engineer the characteristics of the load bearing by orientation of fibres (esp. continuous) on the load paths.

3. Scope and Objectives of Study

This investigation creates all the citizens to know the uses of recycled materials and paves some way so everybody tries to introduce a new product obtaining acknowledged about numerous things. The goals of the research are the subsequent

- Determining and contrasting the compressive strength of Recycled Plastic Sleeper with traditional concrete sleepers of various ages
- To study and compare the flexural strength of Recycled plastic Sleeper with Conventional concrete sleepers at different ages
- To conduct the rebound hammer test on both the sleepers and analyse the results
- To increase the usage of efficient recycled materials by studying its properties.

4. Experimental Investigation & Discussion of Results

4.1. General

In this study, using plastic from waste polycarbonate and polyethylene, plastic sleepers are made and glass fibre is added as a reinforcement [15]. After that the same to be compared with concrete sleeper in terms of Compressive Strengths, Flexural strength and Rebound hammer value at different ages.

4.2. Compressive Strength Test at Different Ages

The plastic and concrete sleepers created should be checked with the load carrying capacity, because of overload, they should bear to avoid facing cracks [16]. A minimum of three railway sleepers were

taken from each group and weighed according to the measurements. Then the sleepers were positioned for testing in the compressive testing unit. It noted the amount of load added which was seen at the top of the machine. The load is applied before the sleeper's rupture. The specimen's load at failure is the maximum capacity a sleeper can tolerate for its construction uses.

Table 1. Compressive strength of Plastic and Concrete sleepers

Age in Days	Plastic Sleeper	M45 Grade Concrete Sleeper
7	29.41 N/mm^2	29.68 N/mm^2
28	43.9 N/mm^2	44.30 N/mm^2

Table 1 shows the compressive strength test results of both plastic and concrete sleepers after 7- and 28-days curing. After evaluating the compressive strength of both concrete and plastic sleepers, the strength of concrete railway sleeper is little greater than plastic sleeper but the difference is small [17]. Therefore, plastic railway sleepers can be used in railway so as to decrease the plastic waste. The figure 1 shows the Comparison of compressive test results of both concrete and plastic sleepers.

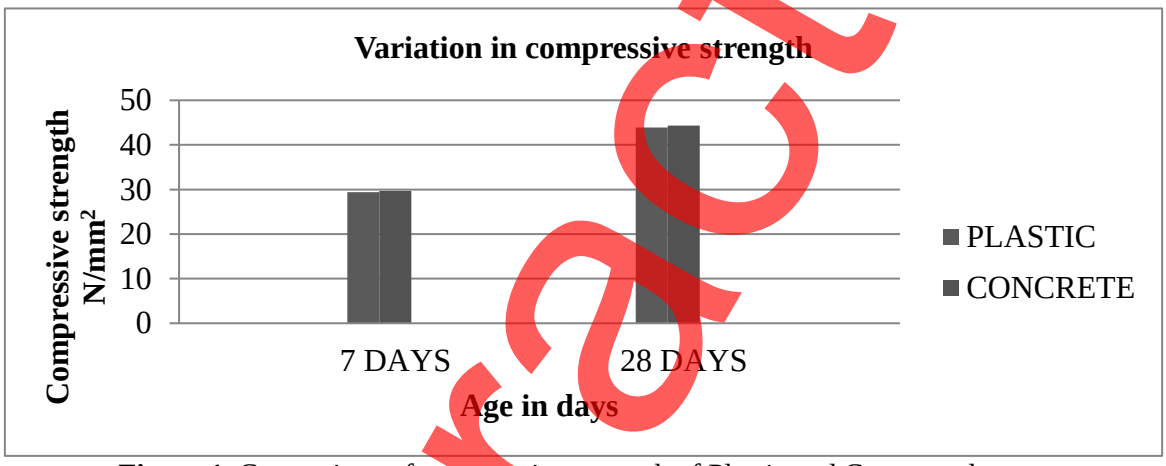

Figure 1. Comparison of compressive strength of Plastic and Concrete sleepers

4.3. Tensile Strength Test at Different Ages

At different healing ages, the Plastic and Concrete sleepers are tested for flexural strength. The tensile strength of the concrete and plastic sleeper at 7 and 28 days of healing as shown in Table 2. And the test results indicate that the difference between the two specimens is only small. So, it is important to promote the use of plastic sleepers in the railway system.

Table 2. Tensile strength of Plastic and Concrete sleepers

Age in Days	Plastic Sleeper	M45 Grade Concrete Sleeper
7	3.34 N/mm2	3.29 N/mm2
28	4.94 N/mm2	4.92 N/mm2

Figure 2 shows the Comparison of tensile strength of both concrete and plastic sleepers at 7 and 28 days of curing.

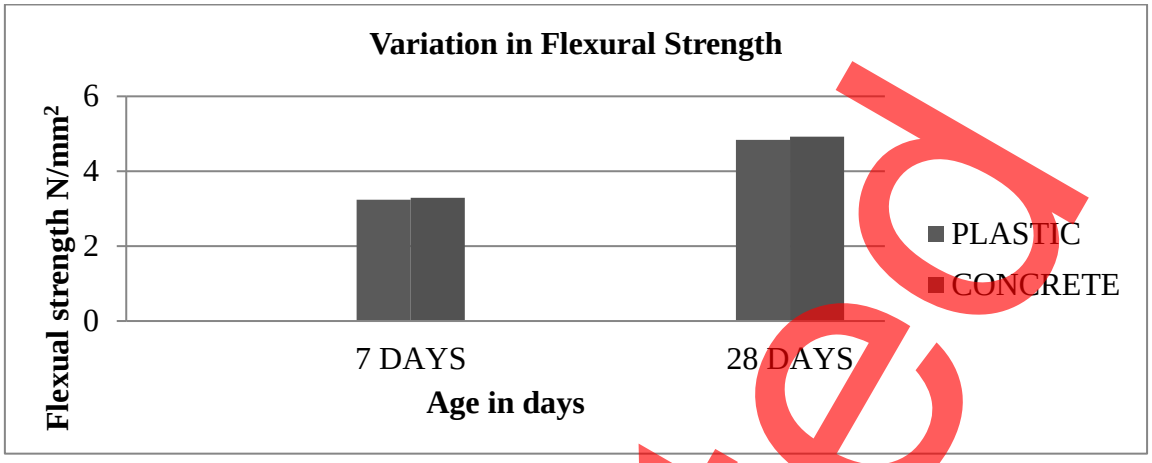

Figure 2. Comparison of Tensile strength of Plastic and Concrete sleeper

The above graph demonstrates the flexural strength in relation to the different curing age of the nominal concrete sleeper and plastic railway sleeper [18]. With an improvement in the healing time, as is clearly seen, concrete flexural strength continues to increase.

5. Conclusion

The following inference is drawn from the comparative research based on the restricted study carried out on the intensity behaviour of the plastic railway sleeper:

- After evaluating the flexural strength of both concrete and plastic sleepers the flexural strength of plastic railway sleeper is a bit on a longer scale compared to the concrete sleeper. The strength of plastic sleeper is greater than concrete sleepers.
- After evaluating the compressive strength of both concrete and plastic sleepers, the strength of concrete railway sleeper is little greater than plastic sleeper but the difference is small, so there will be no problem in loading
- Therefore, plastic railway sleepers will be employed in railway therefore on decrease the plastic waste
- Plastic sleepers are impermeable to insect and wetness injury, immune to plant life, electrically non-conducive, immune to chemical injury, and scale back vibration which will shorten the lifetime of alternative track material.
- The technical and economic advantage of incorporating plastic sleeper ought to be exploited by the railway department of India.

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