

ADVANCES IN MATERIALS TECHNOLOGY FOR IMPROVED SUSTAINABILITY IN RAILWAY TRANSPORTATION

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Summary: Recent years have been characterised by ongoing efforts towards the development of increasingly sustainable transportation systems, across all associated manufacturing and operations industries. Such efforts aim to, among other objectives, develop the means necessary for the compliance of the goals set by the European Union's Green Deal, which seeks to achieve carbon neutrality by 2050. To achieve this goal, it is necessary to reduce carbon emissions by at least 55% by 2030 and 90% by 2050, which inevitably encompasses a considerable shift from roadway traffic to railway, both for passenger and freight transportation [1]. This shift is sustained by the fact that railway mobility is currently the more sustainable means of transportation, as the low rail-wheel friction coefficient assures a high energy efficiency, coupled with the abundant use of electric traction for train propulsion or the use of passive cooling systems [2, 3]. The development and employment of new materials for the manufacturing of rolling stock has the potential for overall increased energy efficiency, as the movement of lightweight vehicles inherently involves lower energy consumption. In this context, materials such as high strength/ultra-high strength steels, new lightweight alloys (aluminium, magnesium, and compositionally complex alloys), carbon fibre reinforced polymers (CFRP), as well as metal-matrix composites have been considered as alternatives to the conventional materials used in bogies, car bodies and other rolling stock structural components or subcomponents, such as beams for bogies, which can decrease cumulative energy demand by as much as 25% [3, 4]. The employment of new materials and hybrid construction present challenges that must be overcome at the manufacturing level. Additionally, the development of emerging technologies, such as additive manufacture of metals, broadens the spectra of materials and applications that can be used to benefit the railway sector as a whole [5].

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