World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:18, No:07, 2024

Analysis of Pavement Lifespan - Cost and Emissions of Greenhouse Gases: A Comparative Study of 10-year vs 30-year Design

Authors : Claudeny Simone Alves Santana, Alexandre Simas De Medeiros, Marcelino Aurélio Vieira Da Silva

Abstract : The aim of the study was to assess the performance of pavements over time, considering the principles of Life Cycle Assessment (LCA) and the ability to withstand vehicle loads and associated environmental impacts. Within the study boundary, pavement design was conducted using the Mechanistic-Empirical Method, adopting criteria based on pavement cracking and wheel path rutting while also considering factors such as soil characteristics, material thickness, and the distribution of forces exerted by vehicles. The Ecoinvent® 3.6 database and SimaPro® software were employed to calculate emissions, and SICRO 3 information was used to estimate costs. Consequently, the study sought to identify the service that had the greatest impact on greenhouse gas emissions. The results were compared for design life periods of 10 and 30 years, considering structural performance and load-bearing capacity. Additionally, environmental impacts in terms of CO2 emissions per standard axle and construction costs in dollars per standard axle were analyzed. Based on the conducted analyses, it was possible to determine which pavement exhibited superior performance over time, considering technical, environmental, and economic criteria. One of the findings indicated that the mechanical characteristics of the soils used in the pavement layer directly influence the thickness of the pavement and the quantity of greenhouse gases, with a difference of approximately 7000 Kg CO2 Eq. The transportation service was identified as having the most significant negative impact. Other notable observations are that the study can contribute to future project guidelines and assist in decision-making regarding the selection of the most suitable pavement in terms of durability, load-bearing capacity, and sustainability.

Keywords : life cycle assessment, greenhouse gases, urban paving, service cost
Conference Title : ICALCA 2024 : International Conference on Advances in Life Cycle Assessment
Conference Location : Vienna, Austria
Conference Dates : July 29-30, 2024