



Study and Development of a Health-Oriented Shoe Insole Made from Natural Rubber Combined with Carbon Rubber Plate

Rattanan Thumjareesakul ¹, Sasikan Wanghom ¹ and Namthip Srikaew ^{1*}

Princess Chulabhorn Science High School Loei, That, Chiang Khan, Loei, 42110 Thailand

**E-mail: rattanan05567@pcshsloe.ac.th*

Abstract

This study aimed to develop a health-oriented shoe insole from natural rubber materials that can effectively absorb impact and distribute plantar pressure while increasing the value of Thai natural rubber and agricultural waste. Thailand is one of the world's leading producers of natural rubber; however, declining rubber prices continue to affect farmers' income and quality of life. Therefore, value-added applications of natural rubber are of great importance. The insole was designed as a three-layer sandwich structure consisting of a latex foam top layer for shock absorption, an EVA foam middle layer for pressure distribution and structural stability, and a bio-carbon rubber plate made from coconut-shell-derived carbon black as the bottom layer to improve durability and wear resistance. Different formulations of latex foam and carbon rubber plates were prepared and evaluated. The carbon rubber plate was fabricated through sulfur vulcanization, in which sulfur and accelerators were used to create crosslinks within the rubber matrix, thereby enhancing its mechanical strength and elasticity. The materials and the assembled insole were characterized through tensile, compression, and simple drop-impact tests. The results showed that the latex foam exhibited excellent softness and resilience, while the carbon rubber plate enhanced load-bearing capacity and pressure distribution. The developed insole significantly reduced peak impact forces and localized pressure, demonstrating strong potential as a health-oriented footwear material and providing an alternative approach for adding value to natural rubber and agricultural by-products in Thailand.

Keywords: Natural rubber, Sandwich structure, Health-oriented insole, Shock absorption