Modification of coal surface to improve adhesion in Coal Plastic Composites (CPCs)

Clive T. Chirume[1], Yahya Al Majali[1,2], Samuel Forshey[1], Kerrti Kappagantula[2], Jason Trembly[2]

1. Institute for Sustainable Energy and the Environment, Ohio University, Athens, OH 45701
2. Center for Advanced Materials Processing, Ohio University, Athens, OH 45701

Abstract

Recently, the fastest-growing decking materials segment in the U.S. are wood plastic composites (WPCs), with the market expected to grow over $9 billion annually by 2024. Ohio University (OHIO) has been investigating the use of sub-bituminous and bituminous coals as a low-cost filler for thermal plastic composite applications. In addition to cost, coal offers additional advantages including less moisture, lower water absorption, and resistance to fungal attack. Results from OHIO's coal plastic composite (CPC) research has shown the materials possess similar thermal expansion as to commercial WPCs, meet International Building Code specifications, absorb less water than WPCs, and show no leaching of heavy metals under extreme testing.

However, to expand CPCs into market segments beyond decking, there is room to improve both CPC flexure and tensile properties. A previous study showed that unlike wood flour; Appalachian bituminous coal possesses little hydroxyl surface functionalities [1]. This lack of surface hydroxyl group prevents bonding with maleic acid-grafted coupling agent meant to improve adhesion between the polymer matrix and the coal filler.

Addition of hydroxyl surface functionalities to carbon nanotubes via acid oxidation and subsequent treatment with hydrogen peroxide has been proven feasible. OHIO is investigating the use of such techniques to improve hydroxyl surface functionality of sub-bituminous and bituminous coals. This presentation will report results from these studies, including ATR – FTIR spectroscopy and Boehm analysis of functionalized coal samples, performance of CPCs with functionalized coal filler, and techno-economics of using functionalized coal in manufacturing CPCs.

References

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