

Pretreatments of wheat straw for possibility use in maintenance-free compressed green roof substrates

Chao Xu^{a,b}, Qiaoxia Yuan^{a,b}, **Eid S. Gaballah**^{a,b,c}, Shuai Zhao^{a,b}, Chenxin Fan^{a,b}, Xin Zhang^{a,b}, Yong Gao^d, Na Song^e

A College of Engineering, Huazhong Agricultural University, Wuhan 430070, China

b Key Laboratory of Agricultural Equipment in Mid-lower Yangtze River, Ministry of Agriculture, Wuhan 430070, China

c Agricultural Engineering Department, Faculty of Agriculture, Fayoum University, Fayoum 63514, Egypt

d Wuhan Optics Valley Bluefire New Energy Co., Ltd., Wuhan 430000, China

e Hubei Haitu Horticultural Landscape Engineering Co., Ltd., Wuhan 430070, China

Abstract

Green roofs are a key measure used to alleviate the urban heat island effect and reduce stagnant water from urban runoff. However, the expensive substrate material and high construction cost restrict the large-scale application of green roofs. Wheat straw (WS) contains abundant nutrients needed for plant growth; however, burning this straw waste causes severe environmental pollution. In this study, six pretreatment methods, including mixed, soaked, hydrothermal, ultrasonic, microwave, and steam explosion, and three liquid media, including deionized water, acetic acid, and wood vinegar, were used to treat WS to improve its properties and decrease its environmental pollution effects. The results showed that, compared to other treatments, physical methods (microwave, ultrasonic) used in conjunction with wood vinegar could effectively break down the particle structure of WS and increase porosity. Most of the crystallinities were reduced by 1.45–6.66% compared to WS when using these methods, and the absolute values of the surface zeta potential were reduced by 4.22–4.67 mV. Additionally, the contents of macromolecular lignocellulose, which is difficult to decompose, were reduced by 3.66–13.75%. Compared with the use of deionized water or acetic acid, wood vinegar reduced the compressive force of the WS substrates and the energy consumption of compression. Hydrophilic groups such as hydroxyl were introduced into the WS to increase the water absorption rate. Overall, the microwave-assisted wood vinegar pretreatment was an effective method for improving the WS properties for use as a potential alternative substrate material in green roof construction.

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C. Xu · Q. Yuan (✉) · E. S. Gaballah · S. Zhao · C. Fan · X. Zhang
College of Engineering, Huazhong Agricultural University, Wuhan 430070, China
e-mail: qxyuan@mail.hzau.edu.cn

C. Xu · Q. Yuan · E. S. Gaballah · S. Zhao · C. Fan · X. Zhang
Key Laboratory of Agricultural Equipment in Mid-lower Yangtze River, Ministry of Agriculture, Wuhan 430070, China

E. S. Gaballah
Agricultural Engineering Department, Faculty of Agriculture, Fayoum University, Fayoum 63514, Egypt

Y. Gao
Wuhan Optics Valley Bluefire New Energy Co., Ltd., Wuhan 430000, China

N. Song
Hubei Haitu Horticultural Landscape Engineering Co., Ltd., Wuhan 430070, China