Iranian Polymer Journal (2020) 29:13–23
https://doi.org/10.1007/s13726-019-00768-6

ORIGINAL RESEARCH

Comparative evaluation of *Clusia multiflora* wood flour, against mineral fillers, as reinforcement in SBR rubber composites

Emilio Delgado[1,2] · Anny Espitia[2] · William Aperador[2]

Received: 14 May 2019 / Accepted: 4 November 2019 / Published online: 14 November 2019

Abstract

Clusia multiflora sawdust (CMS) was evaluated as filler in rubber composites. CMS at 40 phr was mixed with synthetic styrene butadiene rubber (SBR 1502), the blend was compatibilized with 8 phr of maleated polyethylene (MAPE). To evaluate the curing and mechanical behavior of CMS, it was compared with precipitated silica (reinforcing filler); calcium carbonate and kaolin (non-reinforcing minerals). The addition of CMS reduced the mechanical properties of rubber compound compared to silica rubber/silica composite. The tensile and tear strength values for SBR/CMS were similar to SBR/$CaCO_3$ and SBR/kaolin. The addition of MAPE to SBR/CMS composite slightly improved the tensile strength, tear strength, abrasion resistance and hardness. In general, CMS performed as diluent filler which reduced the weight of the composite. CMS slightly affected curing speed of SBR/CMS blends. CMS is a waste generated by the use of *Clusia multiflora* (a timber species endemic of mountains region of Colombia) in the furniture industry. The novelty of this research consists of evaluating the CMS as an alternative to mineral fillers in rubber compounding to improve its mechanical properties, seeking to contribute to the sustainability and to reduce environmental impacts.

Keywords *Clusia multiflora* · MAPE · SBR · Rubber composites · Sawdust

Introduction

The rubber industry has used fillers since ancient time such as carbon black and silica to improve mechanical properties to rubber composite because virgin elastomer (gum) has weak mechanical properties. Kaolin, calcium carbonate, talcum, are also used according cost/performance criteria. However, production of mineral fillers is currently questioned in relation to sustainability and environmental impacts [1, 2]. Vegetable fillers (VFs): natural fibers, wood flour, and wood sawdust are attractive as replacement for mineral fillers and synthetic fibers in polymeric composites [3–5]. Yadav et al. [6] analyzed mechanical and physical properties of polypropylene (PP)/wood flour composites. Rosário et al. [7] studied the tensile properties of virgin and recycled PP mixed with sisal fibers waste. In general, VFs are cheap, biodegradable, with low density and sustainable production [8–11]. They are less abrasive in process machinery and their mechanical properties can be comparable to those of inorganic fillers.

Wood polymer composites are now being utilized widely in automotive, construction, furniture, and other varieties of end user applications as flooring, decking, doors and windows, lineal, railing, tables and benches, landscape, timber, fencing, roofing, pergolas, gazebos, play park equipment and auto parts [9, 12]. VFs can improve stiffness, hardness and strength to polymers [7], impart dimensional stability to green rubber composites [13]. However, certain drawbacks of VFs such as incompatibility with plastics and rubbers, tendency to form aggregates during processing, and poor resistance to moisture, thermal instability greatly reduce their potential as reinforcement fillers in polymers [14, 15].

Main problem when using VFs in polymer compounding is their low compatibility with polymeric matrix due to the hydrophilic character of VFs [12, 16, 17]. The hydrophilicity is due to the presence of OH groups of cellulose (one of the components present in VFs) [1, 18]. Low compatibility

✉ Emilio Delgado
arnoldo.delgado@unimilitar.edu.co

Anny Espitia
anny.espitia@unimilitar.edu.co

1 Facultad de Ingeniería, Universidad El Bosque, Bogotá, Colombia

2 Facultad de Ingeniería, Universidad Militar Nueva Granada, Bogotá, Colombia