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1 Rheological properties of micro-/nanofibrillated cellulose suspensions: wall-slip 2 and shear banding phenomena

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13 Abstract

14 The rheological properties of enzymatically-hydrolyzed and TEMPO-
15 oxidized microfibrillated/nanofibrillated cellulose (MFC/NFC) aqueous suspensions were investigated
16 in oscillation and steady-flow modes and were compared with the morphology of the studied
17 materials. The flow instabilities, which introduce an error in the rheological measurements, were
18 discovered during flow measurements. A wall-slip (interfacial slippage on the edge of geometry
19 tools and suspension) was detected at low shear rates for two types of NFC suspensions while
20 applying cone-plate geometry. A roughening of the tool surfaces was performed to overcome the
21 aforementioned problem. Applying to TEMPO-oxidized NFC, a stronger suspension response was
22 detected at low shear rates with higher values of measured shear stress. However, a shear banding
23 (localization of shear within a sample volume) became more pronounced. The use of serrated
24 tools for enzymatically-hydrolyzed NFC produced lower shear stress at the moderate shear rates,
25 which was influenced by water release from the suspension.

26 Keywords

27 Rheology, nanofibrillated cellulose (NFC), microfibrillated cellulose (MFC), cellulose
28 nanofibers (CNF), wall-slip, shear banding

29 1 Introduction

30 The use of nanocellulose has gained much interest lately, especially in such areas as
31 composites, packaging, adhesives, biomedicine, automotive *etc.* Since it is a renewable and
32 biodegradable material, possessing specific properties, it has a great potential for industrial
33 application.

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