**Scale up: Towards Microfibrillated Cellulose (MFC)/clay films produced by paper making**

D.O. Castro, Z. Karim, L. Medina, F. Carosio, A. Svedberg, L. Wågberg, D. Söderberg, L.A. Berglund
*MoRe Research Örnsköldsvik AB/KTH Royal Institute of Technology,
Sweden*

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Summary:

Polymeric-inorganic hybrid nanocomposites with biobased matrices are of increasing scientific and industrial interest. These nanocomposites exhibit favorable characteristics include reduced gas permeability and improved fire retardancy. In addition, the origin of the polymer matrix from renewable resources is an advantage as well as the biodegradable character of the organic components. The use of renewable resources that reduces the need for fossil fuel as a feedstock for materials in packaging and other single use applications has achieved much attention. Abundance, availability and renewability are sought-after characteristics of eligible biopolymers, and in this respect, nanocellulose derived from wood fibers stands out as a resource of high potential. Nanostructured materials are difficult to prepare rapidly and at large scale. Nanocomposites were prepared from kaolinite nanoplatelets, MFC nanocellulose and wood fibers by a continuous paper-making process. This is in support of the industrial scalability of these inorganic hybrid nanocomposites. The role of the wood pulp fibers is to improve dewatering and nanoparticle retention through rapid formation of a wood fiber “filter network”. The hydrocolloidal nature of the MFC suspension invites addition of kaolinite clay platelet particles with nanoscale thickness dimension. Composition effects on nanocomposite film preparation (dewatering, small particle retention etc) and properties (mechanical, density etc) were investigated for films produced using using a pilot-scale web former. Compared with neat pulp fiber paper, strength and modulus were dramatically improved by MFC addition. The nanoscale fibrils act as a bonding agent improving the fiber-fiber bond strength and stress transfer between all three components, and making the high clay content possible. Nanocomposite morphology was assessed by scanning electron microscopy (SEM). These nanocomposites from the pilot-forming equipment show a layered structure with oriented platelets. The fire retardancy was evaluated by cone calorimetry. Inorganic hybrid composites with high content of in-plane oriented nanocellulose and nanoclay were successfully produced at pilot scale, mimicking industrial scale conditions. The nanocomposites showed excellent mechanical properties and fire retardancy.