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Incorporation of Never-Dried Cotton fibers with Methylmethacrylate: A Gateway to Unique Transparent Board-Like Nanocomposites

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Abstract: For the first time, it is shown that water medium allows dissolved methylmethacrylate monomer to penetrate water-swollen natural nanoporous structure of never-dried cotton fibers (biological cellulose fibers). Unique cellulose copolymer nanocomposites are obtained by green nanotechnology process (solvent is water -ideal green solvent- and reaction conducted at 25ºC). It was found that after only 2 h polymerization the conversion of MMA monomer to polymer was 42.97%, compared to zero polymer conversion in absence of never-dried cotton. Higher water uptake i.e. water retention value (WRV) of the cellulose-PMMA-copolymer nanocomposites prepared from never-dried biological cotton fibers, and microscopic investigations confirmed that the polymer was mostly grafted on the cellulose rather than homopolymer filling the fiber pores. Early products of polymerization e.g. dimmers and trimmers act as spacers and widen the porous structure of cell wall, thus increasing water retention value (WRV). We called this phenomenon *"intra-polymerization"*. As the process of polymerization proceeds, polymerization within cell walls leads to cell wall destruction, increasing WRV of fibers, giving superabsorbent end product. The produced unique biological cotton-PMMA green nanocomposite we discovered find their use in several advanced medical and pharmaceutical fields; as nonwoven pads, bandages or board-like transparent nanocomposites of bending strength up to 955 kg/cm^2.

Keywords: Green nanocomposites; Never-dried cotton fibers; Cellulose-polymethyl methacrylate -copolymer; Transparent board-like nanocomposites; Bending strength.

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