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Reinforcement of copolyamide membranes for water treatment applications

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Clean water is the key element for all living organisms to sustain life. However, due to the rapid industrialization and large increase in the population, the contamination of water resources is important issue occurred globally as well as locally here in Middle East region [[1]]. From past few decades, various techniques for treating the wastewater have been developed. Among others, filtration techniques are a commonly used to eliminate contamination of water caused by various materials such as heavy metals, dyes, oil, bacteria etc. Robust, capable membranes are crucial for effective filtration process and various polymeric materials have been studied in last decades. Among others, polyamides membranes have been used as membranes due to their favourable properties such as good thermal and mechanical stability [[2]], which make them suitable for the designing of fibres, mats and membranes. Compared to many commercially available filtering membranes that are produced by conventional fabrication techniques such as phase inversion technique, the pore size distribution of electrospun fibrous membranes can be conveniently tailored in the range of sub-microns up to a few micrometers via simply adjusting the material and process parameters of electrospinning and related post-processes. In addition, electrospun filtering media are also capable of maintaining a high porosity, which guarantees the high-flux liquid filtration.One of the approach to further improved efficiency, mechanical performance and lifetime of membranes is using various fillers.Nanocelluloses are particularly interesting because of their environmental friendliness, high mechanical performance, flexibility, low-cost, versatility, and tailorable surface functionalities. The

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size, structure, and functional groups of nanocelluloses are dependent on the source of cellulosic fibres and preparation method [[3]].Other nanofillers, very recently discovered with large potential in water treatment applications are MXenes. MXenes are a new class of 2D metal carbides and carbonitrides, which are both conductive as well as hydrophilic [[4]]. MXenes have general formula Mn+1Xn, derived from MAX phases, where M is an early transition metal, A is an A-group element, mostly IIIA and IVA, or groups 13 and 14, and X is either carbon and/or nitrogen, by chemical etching in HF or NH4HF2 solutions, where n = 1, 2 or 3. The unique structure of MXenes offers combination of excellent mechanical properties, hydrophilic surface, transparency and metallic conductivity. Herein, we used electrospinning to prepared novel membranes based on copolyamide 6,10 reinforced by nanocellulose prepared from Qatari date palm waste and MXene 2D nanofillers which dramatically improved mechanical performance and separation efficiency of the membranes compared to neat copolyamide membranes. Prepared membranes were able to separate oil (vegetable and diesel) from water with efficiency over 96 % regarding of membrane composition and separation conditions. Additionally membranes exhibited good lifetime with maintaining high efficiency of separation.

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