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Hansen Solubility Parameter from Surface Measurements

Authors : Neveen AlQasas, Daniel Johnson

Abstract : Membranes for water treatment are an established technology that attracts great attention due to its simplicity and cost effectiveness. However, membranes in operation suffer from the adverse effect of membrane fouling. Bio-fouling is a phenomenon that occurs at the water-membrane interface, and is a dynamic process that is initiated by the adsorption of dissolved organic material, including biomacromolecules, on the membrane surface. After initiation, attachment of microorganisms occurs, followed by biofilm growth. The biofilm blocks the pores of the membrane and consequently results in reducing the water flux. Moreover, the presence of a fouling layer can have a substantial impact on the membrane separation properties. Understanding the mechanism of the initiation phase of biofouling is a key point in eliminating the biofouling on membrane surfaces. The adhesion and attachment of different fouling materials is affected by the surface properties of the membrane materials. Therefore, surface properties of different polymeric materials had been studied in terms of their surface energies and Hansen solubility parameters (HSP). The difference between the combined HSP parameters (HSP distance) allows prediction of the affinity of two materials to each other. The possibilities of measuring the HSP of different polymer films via surface measurements, such as contact angle has been thoroughly investigated. Knowing the HSP of a membrane material and the HSP of a specific foulant, facilitate the estimation of the HSP distance between the two, and therefore the strength of attachment to the surface. Contact angle measurements using fourteen different solvents on five different polymeric films were carried out using the sessile drop method. Solvents were ranked as good or bad solvents using different ranking method and ranking was used to calculate the HSP of each polymeric film. Results clearly indicate the absence of a direct relation between contact angle values of each film and the HSP distance between each polymer film and the solvents used. Therefore, estimating HSP via contact angle alone is not sufficient. However, it was found if the surface tensions and viscosities of the used solvents are taken in to the account in the analysis of the contact angle values, a prediction of the HSP from contact angle measurements is possible. This was carried out via training of a neural network model. The trained neural network model has three inputs, contact angle value, surface tension and viscosity of solvent used. The model is able to predict the HSP distance between the used solvent and the tested polymer (material). The HSP distance prediction is further used to estimate the total and individual HSP parameters of each tested material. The results showed an accuracy of about 90% for all the five studied films

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