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A viscoelastic-based model for TFC membranes flux reduction during compaction

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Abstract: During the initial operation of membranes, large reduction in flux can occur due to membrane structure compaction. Since compaction results in the deformation of the polymer matrix of the membrane, it has been proposed that the flux decline can be described by viscoelastic models. However, the proposed models so far did not provide direct connection between flux decline and membrane compaction. Indeed, for thin film composite (TFC) membranes, the reported deformation, as measured by real-time thickness measurements, occurs at a much faster rate than the accompanying flux reduction during compaction. We attribute this discrepancy to the complex structure of TFC membranes which must be properly addressed by the viscoelastic model. The current study proposes the use of the Voigt?Wiechert model to describe the compressive strain experienced by TFC membranes. This model provides the advantage of deconvoluting the response of the TFC membrane. Based on this model, a new relation is proposed to describe the flux decline during compaction. The model is tested on strain/flux data and found to give excellent predictions. The model was also found to represent the flux decline better than the traditional power law relation. The model also describes the increase in salt rejection observed during compaction. Insight into the physical properties of the active layer is introduced based on the model fitting results.