Estimation of water desorption in drying of membrane structure system

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Abstract. In general, ceramic membranes consist of top layer possess structure a hygroscopic zone which acts as a separator while the following bottom layers form a porous nonhygroscopic zone which provides the permeation paths and acting as supporting structures. Thus, the combination of these two different multilayer systems will exhibit different water desorption behavior especially in ceramic membrane preparation. Experimentally, this water characteristic is defined through water retention curve (WRC). Since there is no detailed study on the fitting parameters that associated with WRC on membrane structure has yet been reported, therefore, this paper investigates the effects of various parameters used in WRC equation that represent material properties of the membrane structure using mathematical model. The results showed that hygroscopic material has higher r and n value with lower m value compared with nonhygroscopic material. Hence, understanding the variation of the fitting parameters in the WRC equation is essential for the configuration of WRC slope associated with the material properties especially during drying process of membrane.

Introduction

In ceramic membrane preparation, controlling the drying phenomena is one of the crucial tasks to avoid the defects and failures that caused by different material properties. Basically, the top layer of a ceramic membrane is always associated with fine pore structure denoted as a separation layer meanwhile bottom layers that acting as supporting layer should has coarse pore structure to allow the permeation stream [1]. In other words, multilayer ceramic membrane represent by hygroscopic materials at the top layer and nonhygroscopic materials at the bottom layers. Hygroscopic materials possess denser, finer pores structure and smaller intrinsic permeability values have generate greater water retention inside matrix causes greater resistance of water to pass through compared to nonhygroscopic materials. Thereby, the WRC is in opposed pattern for both types of materials.

WRC is defined as the relationship between water content and suction of the porous matrix, commonly used in geotechnical engineering practice [2]. The water content defines amount of water inside the pores and commonly represent by volumetric water content, 9 or degree of saturation, S [2]. Force or suction that acting in the filled pores can be classified as matrix or capillary suction and also total suction (plus osmotic suction) [3]. Consequences of the various terminologies, the WRC have taken on numerous forms but in present study, the term of WRC used to represent the relationship between degree of saturation, S and capillary suction, P. Among the earliest equation that has been