

# Effect of Nitrogen, Helium, Water and Methanol on Hydrogen Permeation through Palladium Membrane

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Hydrogen permeation through palladium membrane in pure hydrogen and in a gas mixture of hydrogen with nitrogen, helium, water or methanol has been studied, using a semi-batch device to investigate the effect of the co-existing gases on hydrogen permeation through palladium membrane. Experimental results show that existence of water and methanol results in decrease of permeation activity of palladium membrane. The permeation activity decreases more at lower temperature. However, the activity can be regenerated by injecting pure hydrogen into the device at 663K overnight. Experimental results also show that when water, nitrogen, helium or methanol coexists, the coexisting gas simply lowers the hydrogen partial pressure, resulting in decrease of hydrogen flux. It does not affect the adsorption of hydrogen on palladium membrane. The hydrogen permeation flux,  $J$ , for a gas mixture of hydrogen with water, methanol, nitrogen or helium can be calculated using the following mathematical model:

where  $T$  is temperature,  $R$  is gas constant, and  $P_H$  and  $P_0$  are hydrogen partial pressures at high and low pressure side, respectively. The parameters  $\beta_{ref}$ ,  $E_a$  and  $n$ , in the model can be obtained by non-linear regression of the experimental data. The results show that the model calculations agree well with the experimental data for hydrogen permeation through palladium membrane.

Keywords: Hydrogen, Permeation, Palladium, Membrane, Nitrogen, Helium, Water, Methanol

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