Fig .3 Fuel Cell Model

PEM fuel cell system composes of blocks such as anode model, cathode model, and Linear control. Let us consider the fuel cell voltage model block first. The output fuel cell stack voltage [1] is defined as a function of the stack current, reactant partial pressures, fuel cell temperature, and membrane humidity:

(1)

Vnerst is the reversible (Nernst) output voltage potential. Vcon, Vact and Vohmic define the voltages of concentration, activation and ohmic losses, respectively. The Nernst voltage is obtained as in Eq. (2). In addition, the loss voltages are obtained as in Eqs. (3–5).

(2)

(3)

(4)

(5)

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A detailed explanation of each voltage loss is given in [10], and other voltages are also described in [11], where the fuel cell voltage is mainly expressed by the combination of physical and empirical relationships in which parametric coefficients of the membrane water content, humidity, and temperature.

Fig .4 (a) Anode Model and (b) Cathode Model

The reactant flow rates at the anode and cathode sides are determined by the partial pressures and the stack current. Using the ideal gas law, each partial pressure block can be modelled as shown in Figure 4. As seen in Figure 4(a), the anode block consists of the hydrogen and water models. There are many limiters placed in the output of each pressure and even in the controller outputs to prevent problems caused by algebraic loops and extreme numerical values. The cathode model consists of the oxygen, water, and nitrogen models, as seen in Figures 4(b). In the anode block, the hydrogen inlet flow rate (SLPM) is converted into mol/s using a conversion factor (1 standard litre per minute: 7.034 × 10−4 mol/s); the mole fraction of H2 is assumed to be 99%. In the cathode block, air is uniformly mixed with nitrogen and oxygen in a ratio 21:79, with conversion factor 7.034 × 10−4 mol/s [12]. In order to analyse data in a short time, a fast ode solver is used. The ode45 method is based on Dormand–Prince, which is an explicit, one-step Runge–Kutta that is recommended as a first try method [13].

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6. DC-AC Converter and Control

In the V2G systems, the power electronic-based converter is essential for proper interface functioning [14]. Improvement of energy harvesting capability in grid-connected photovoltaic micro-inverters. Fuel cell units develop DC voltage, but the electric grid is operated using AC voltage. Thus, a DC/AC inverter exists within a V2G interface. The DC/AC inverter does provide the possibility of power transfer from the DC side to the AC grid side. In this concept, one or more single-phase H-bridge inverters can supply the fuel cell power both to the dynamic loads and grid. The inverter contains four electronic switches, primarily IGBTs. To suppress the switching ripples generated by the inverter, the inductor L filter is applied along the path from the inverter to the grid. In the case of power flow control, it can be achieved through control of the electronic switches by using hysteresis modulation, as presented in Eq. (6).

(6)

here, the hysteresis band (h) is set to values of +0.2 and -0.2. The error current signal is determined as follows:

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