At first, a classical irreversible thermodynamic model of the hydrogen pump is derived in this thesis. The model is then numerically implemented by using the Finite volume method in the *VoronoiFVM* library in Julia. The numerical implementation is further used to explain the measured experimental data from [1]. The plateau observed in the Voltage-current figure could not be explained in the original work, as the membrane was approximated with a single point. Such a zero-dimensional model did not predict the plateau, and it was believed to originate from some Interfacial effects. This work will focus on the correct implementation of the equations inside the membrane and try to explain the observed effects using no additional assumptions.