Passive Autocatalytic Recombiners (PAR) are frequently used today as safety devices to mitigate hydrogen risk in confined spaces. The present study aims to investigate by CFD tools the PAR performance under potentially adverse counter-current flow conditions. Experimental data obtained from the THAI+ two-compartment facility are used to validate the numerical simulation. Counter-current flow is created by a fan in the larger vessel which produces a downward flow in the second vessel housing the PAR unit. In the simulation, the H_2 reaction rate is computed by a correlation given by the PAR manufacturer, and hence no detailed chemistry is necessary. In agreement with test data, the simulation results show that PAR operation is not hindered by the imposed counter-current flow, although the plume exiting the PAR is somewhat compressed compared to that existing in quiescent atmospheres. It is also found that the computed parameters of interest (reaction rates, mean flow velocities, hydrogen PAR inlet/outlet concentration, temperature, pressure) agree well with the measured data. This confirms the usefulness of using CFD simulations to predict PAR behavior in complex flows and geometries