Test Module 07
Reactant Utilisation

(Version 5.1, 09 May 2017)

Objective and Scope

The purpose of this test module is to characterize the influence of the reactant utilisation on the performance of a Solid Oxide Cell (SOC) cell/stack either in fuel cell (SOFC) mode or in electrolysis (SOEC) mode. The parameters governing the reactant utilisation are the current generated (SOFC) or consumed (SOEC) by the cell/stack, the gas composition and the volumetric flow rate of the fuel/oxidant gas stream.

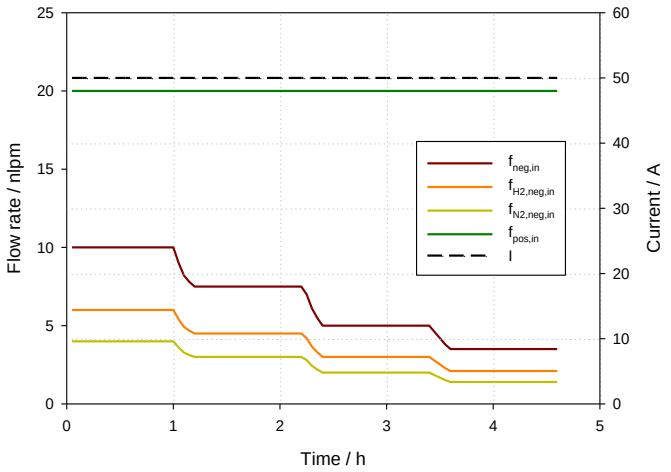
It must be noted that TM07 only contains the variation of the volumetric flow rate of the fuel/oxidant gas streams because the variation of the electrical current is already described in TM03: *Current Voltage Characteristics* and the effect of the gas composition variation is already described in TM08: *Reactant Gas Composition*.

Main Test Input Parameters (TIPs)

Static TIP	Variable TIP
Current (I)	Flow rates of inlet gases (f_{in})
Temperature of the oven (T_{oven})	
Composition of inlet gases ($x_{i,\,in}$)	

Test Procedure

- The operating conditions of the cell/stack, including the temperature, the electrical current and the reactant gas composition will be defined beforehand and will be kept constant throughout the whole TM07. Only the volumetric flow rates of the negative or positive electrodes will be varied, being this variation discrete and only happening in one electrode at a time.
- It is recommended to start the test with low fuel utilisations (i.e. high volumetric flows) and not to surpass the maximum reactant utilisation recommended by the manufacturer.



Qualitative representation of evolution of TIPs for instance in SOFC mode when carrying out TM07 varying $f_{neg,in}$.

Critical Parameters and Parameter Controls

- For all test conditions care should be taken not to incur reactant starvation.
- The test campaign will begin with the most benign operating conditions (low gas utilizations) and will shift towards harsher conditions.

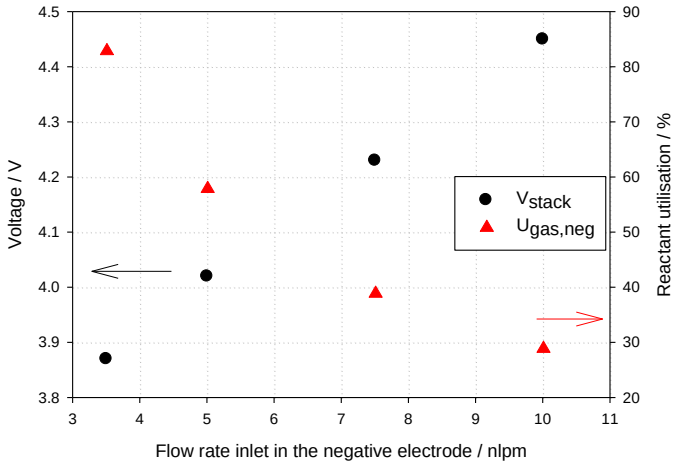
TIPs	Direction of change
$f_{neg,in}$ or $f_{pos,in}$	$HIGH \rightarrow LOW$

Main Test Output Parameters (TOPs) and Derived Quantities

TOP	Derived Quantities
Voltage of cell/RU/stack (V)	Current density (j)
Temperature of gas streams at cell/stack inlet/outlet, temperature of cell/stack (T)	Electrical power density ($P_{d,el}$)
Flow rates of outlet gases (f_{out})	Reactant gas utilization (U_{gas})

Data Post Processing and Representation

The figure below is an example of how to correlate graphically the TIPs and TOPs of this test module. In this particular example, the average cell voltage has been the chosen TOP. Nevertheless, others could be plotted, such as the various temperatures in the stack.



Example graph of representation of results in SOFC mode when varying $f_{neg,in}$.

SOCTESQA:
Solid Oxide Cell and Stack Testing, Safety and Quality Assurance

Project website: www.soctesqa.eu

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