Paris Session 2022

Influential factors on temperature rise performance of SF_6 alternatives

Study Committee A3 – PS2 – Q9

There are conflicting reports on temperature rise performance of SF_6 alternatives. Report 10658 reports an issue, 10657 reports high values at 2500 A whereas authors of 10126 show results like SF6. Can specialists shed some light on the various influential factors and how they are controlled?

Cyril GREGOIRE - FRANCE

Influential factors on temperature rise performance of SF6 alternatives

- *Influence of changing the gas: thermal effusivity*

  - Effusivity is much higher in SF6 than in natural origin gas at a given pressure
  - Technical air and CO_2 have similar effusivity
  - C4FN slightly enhances the performance
  - Higher pressure partly compensates the reduced effusivity

$$e = \sqrt{k.\rho.C_p}$$

with e : thermal effusivity [J/m² K $s^{0.5}$]
k : thermal conductivity [W/(m K)]
ρ: density [kg/m³]
C_p : specific heat capacity [J/(kg K)]

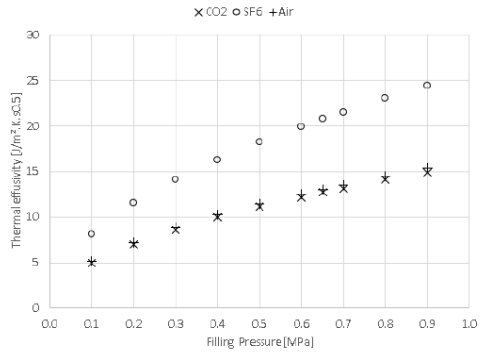
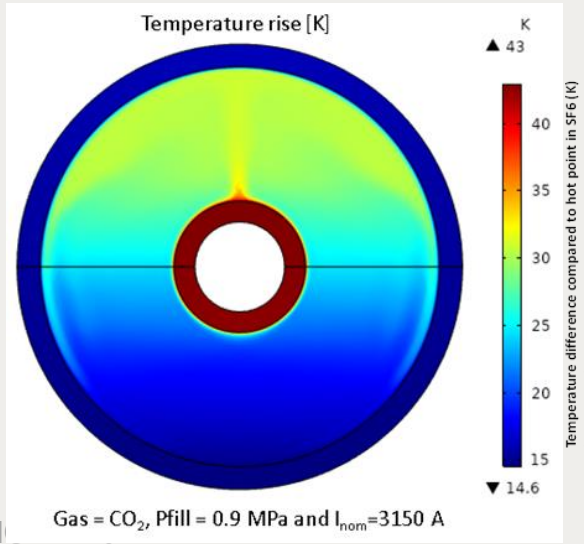
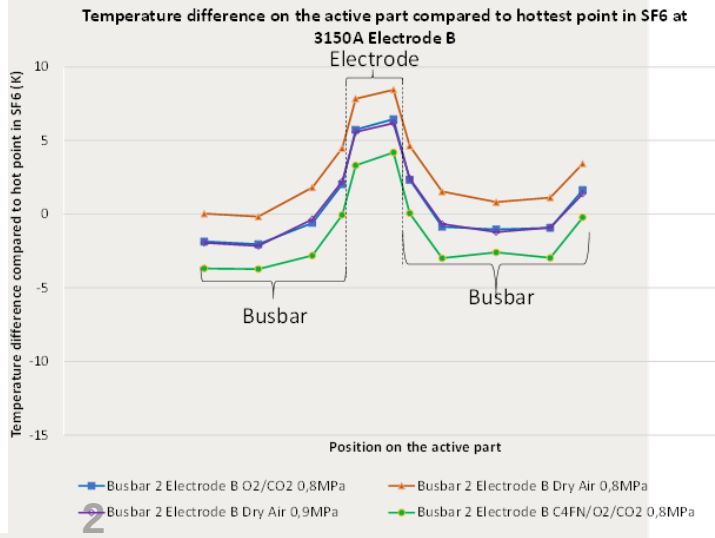


Figure 1: Thermal effusivity of CO_2, SF_6 and technical air in gaseous form over pressure





Influential factors on temperature rise performance of SF_6 alternatives

- *Overall temperature rise increases by 10-15% between SF_6 and its alternatives*

- The influential factors are mainly:
  - Gas type and filling pressure
  - Conductor design and material (impact on heat source, convective and radiative heat transfer)
  - Contacts design (impacts on heat sources)

- The same nominal current ratings and footprint can be achieved with C4FN/O_2/CO_2 by implementing small design adaptations.