Paris Session 2022

MV C4-FN MIXTURE HARMONIZATION IN NORTH AMERICA

A3 PS2: Decarbonization of T&D equipment

Q13: A variety of C4-FN based mixtures (with and without oxygen) and composition ratios (some even undisclosed) is reported. Can specialist predict whether a “one-gas-fits-all” solution is waiting at the horizon or at what time horizon convergence of various technologies can be expected?

Andres Laso, USA

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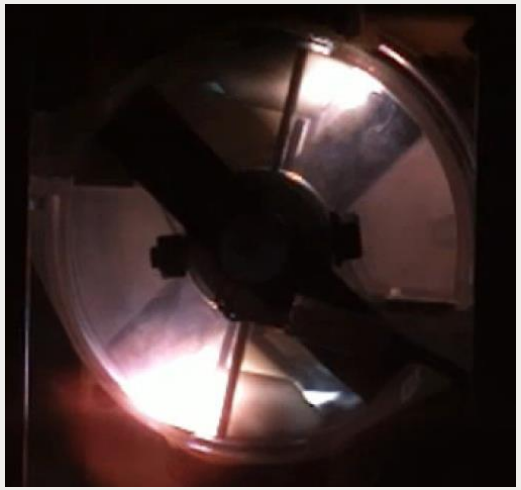
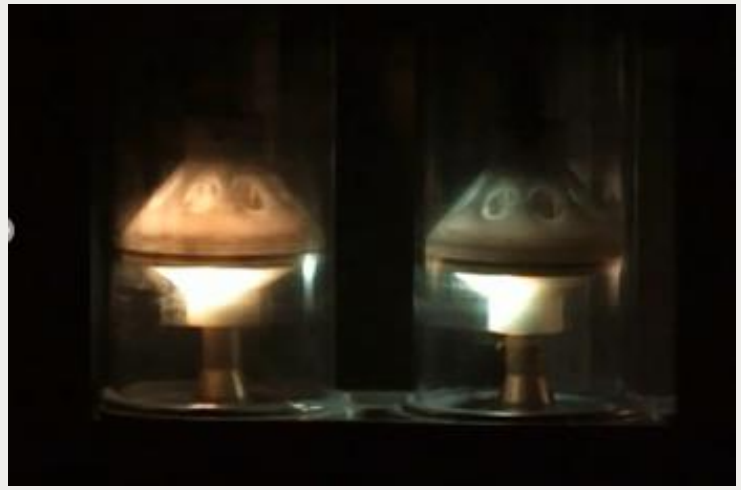
BACKGROUND AND O_2

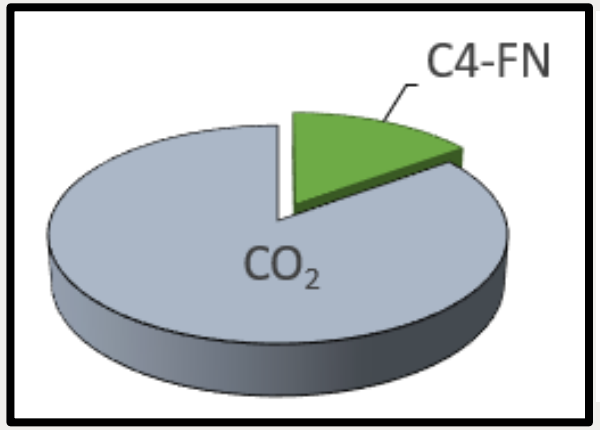
Requirements
- <2 bar absolute
- +65C/-30C or +50C/-40C (Canada)
- Same size and ratings as SF6

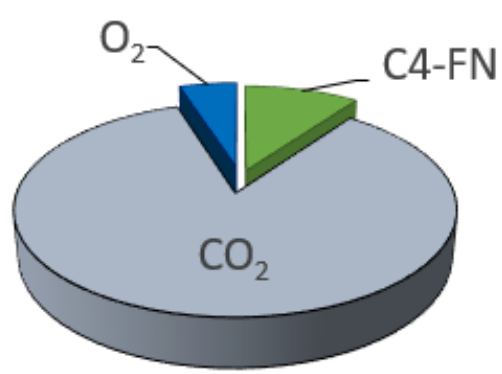




Application of gas alternative
- Insulation media
- Load break switchgear

Gas mixture
- C4-FN evaluated for 5-15%$_{mol}$
- Performance investigated w/ and w/o O_2.
- High provability that O_2 won't be required for MV.
- Existing SF6 switchgear may require redesign.





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PARTIAL LIQUIFICATION DYNAMICS

Observations after partial liquification

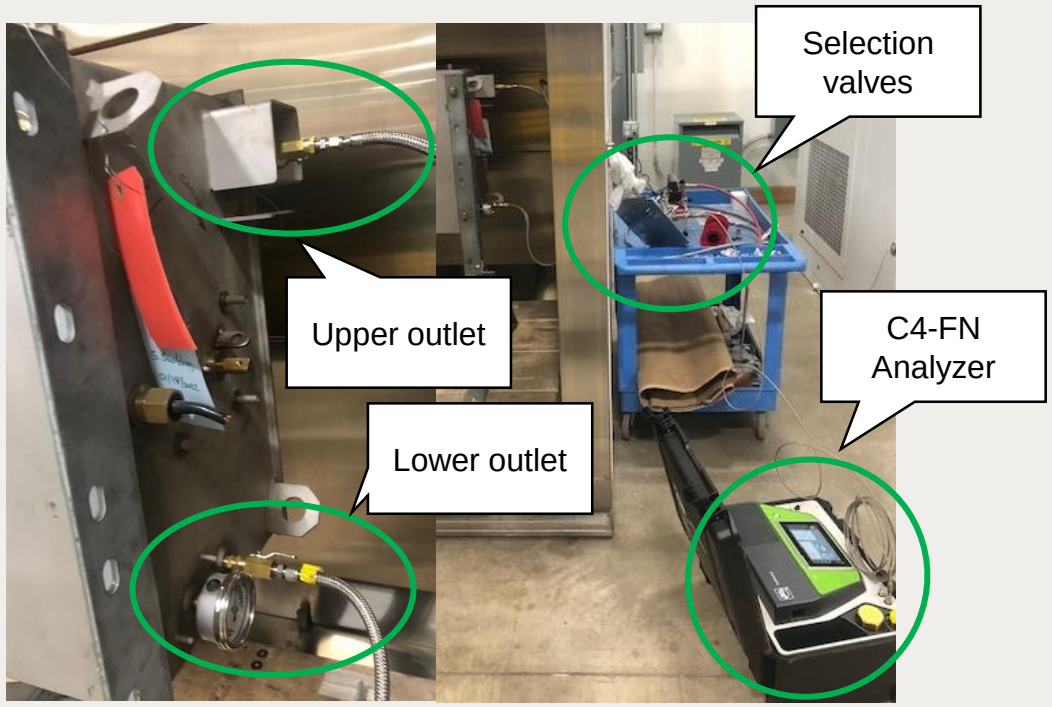
→ No mist or fog formed

→ C4-FN liquifies on switchgear enclosure's walls

→ C4-FN return to gas phase after 10 cycles -30C/-50C

Device filled with 13/87 ratio 1.7bar

→ T_{liq} = -43C



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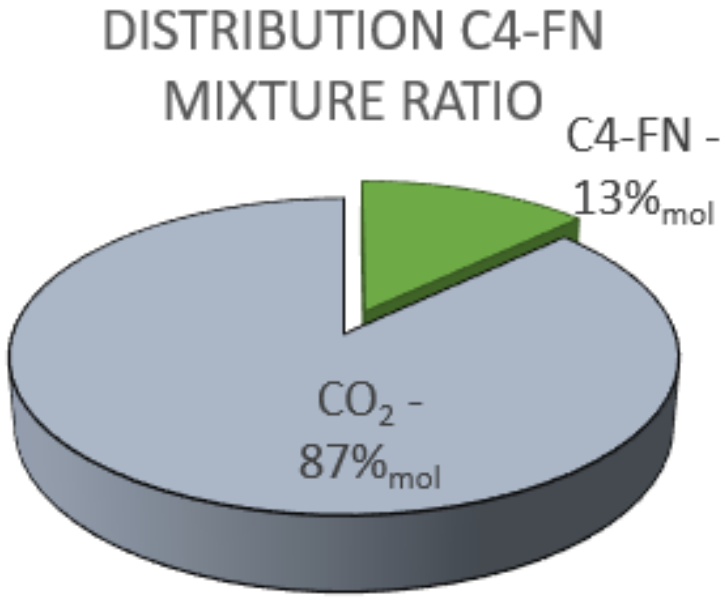
CONCLUSIONS

Homogenization

Gas mixture homogenizes naturally in the event of partial liquification after temperature rises from dew point.

Partial liquification

- Gas mixture ratio and density can effectively be selected to avoid partial liquification.
- Switch is capable to withstand 80% of rated power frequency in the event of partial liquification.



Takeaways for MV

- $13\%_{mol}$C4-FN / $87\%_{mol}CO_2$ selected.
- No requirement O_2 for MV.
- For example, 2 MV switchgear manufacturers in North America have harmonized this mixture.