

Gas Handling Concepts for C4-FN Mixtures

SC A3 – PS2 – Q12, In different projects, different practices of mixing gas components are reported.

Authors of 10102 prefer off-site mixing, whereas authors of 10656 describe on-site mixing as “most beneficial”. Can specialist (e.g., authors of 10799, 10966) report on experiences in other projects?

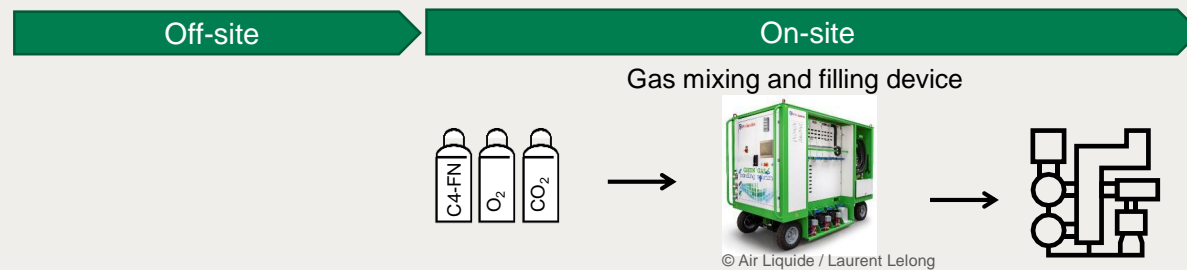
Manuel Naef, Switzerland

HITACHI
Inspire the Next

Practices of mixing and filling C4-FN mixtures

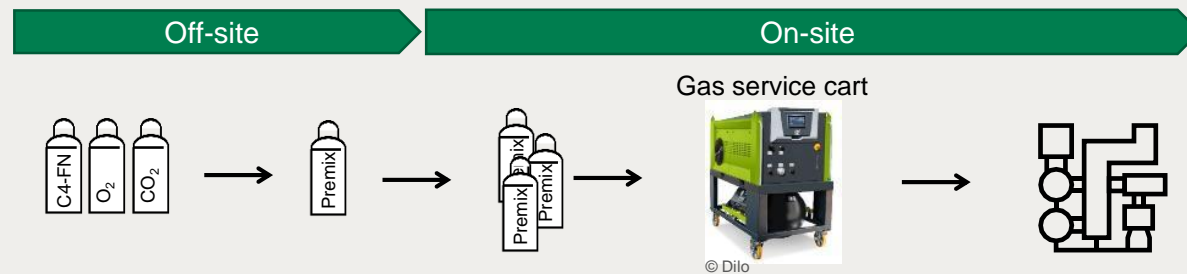
On-site mixing

- The gas is mixed directly on site from the pure components (C4-FN, CO₂, O₂)
- The gas mixing and filling device can mix the gases and directly pump them into the gas-insulated switchgear



Off-site mixing

- The gas is mixed off-site (e.g. at third party supplier) and cylinders with premix are purchased
- On-site, the premixed gas is filled into the high voltage equipment using for example a gas service cart
- The premixed gas can be used in gaseous state or partially liquefied (higher storage pressure, requires homogenization)



Group Discussion Meeting

Practices of mixing and filling C4-FN mixtures

Commissioning: on-site mixing preferred

- Large volumes of gas mixture need to be provided for the GIS application
- From the comparison of different practices regarding logistics, economic and ecologic aspects as well as complexity on-site, preparing the gas mixtures directly on-site was identified as most beneficial
- Easy procurement of substances (CO₂ and O₂ can be purchased locally)



© Air Liquide / Laurent Lelong

Service activities: off-site mixing preferred

- Only limited amounts of gas need to be handled, for example top-up
- A gas handling cart is used, that combines all the functions that are typically needed for handling gas (gas recovery, topping-up, evacuation)
- Top-up directly from gas cylinder with premixed gas (in gaseous state) using pressure regulator



© Dilo

Remarks

- HV equipment is compatible with all filling methods (gas mixing, premixed gaseous, premixed partially liquefied)
- The filling method has no influence on the gas quality in the GIS

Group Discussion Meeting

Practices of mixing and filling C4-FN mixtures

Initial filling with Hitachi Energy GIS: on-site mixing

- The gas is mixed directly on-site from its components (C4-FN, CO₂, O₂) using fully automated device
- QR-Codes for automatic adjustment of gas mixture with filling device
- Easy operation of device during filling of gas, touchscreen with state-of-the-art HMI / GUI
- Initial filling is done by the GIS manufacturer, there is no need for the operator of the GIS to have the gas mixing machine

Gas inlet connection and Gas ID

- DN20 couplings, with different thread M48x2 (SF₆: M45x2) and different colour (green) to avoid interchanging with SF₆
- QR-code with the gas mixture is attached at each gas inlet connection
- The information on the QR-code can also be read with common smart phones

Example: Gas mixture 3.5% mol C4-FN, 10% mol O₂, 86.5% mol CO₂, pressure 910 kPa abs

```
<R2>Modules  
<CL>1  
<C4%>3.5  
<O2%>10  
<CO2%>86.5  
<NP>910
```



Gas inlet connection with gas ID



© Air Liquide / Laurent Lelong

Gas mixing and filling device

Group Discussion Meeting