CHALLENGES IN MULTIPHASE FLOW METER TESTING

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OVERVIEW

Basics of multiphase flow meter (MPFM) testing/calibration

Challenges in <u>laboratory</u> multiphase meter testing:

- **Converting lab results to field application**
- **Working with "live" fluids, pro's and con's**

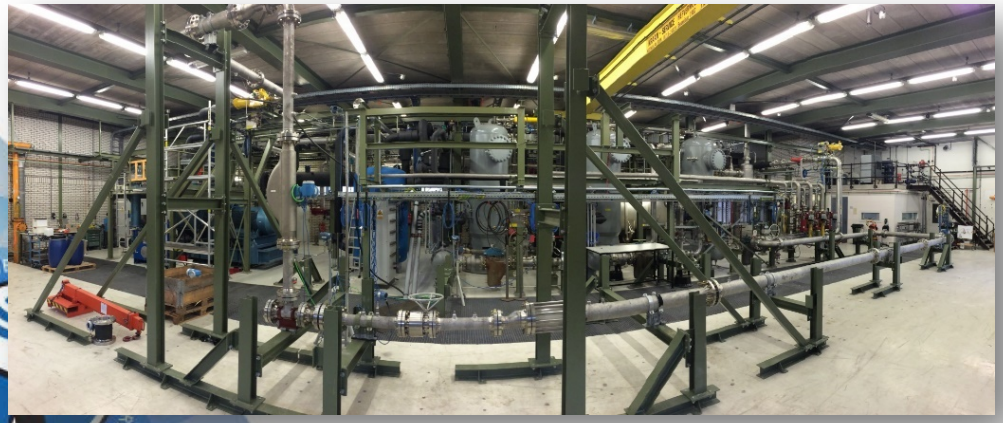
MPFM CALIBRATION: BASICS

Multiphase laboratory calibration:

- Most accurate multiphase reference flows (typically within 1%)
- Allow testing beyond aimed operation in the field: flow rates, pressure, etc.
- But: possibly at different conditions and fluids than the field application in terms of flow regimes, PVT, physical properties, etc.

In-field calibration with test separator:

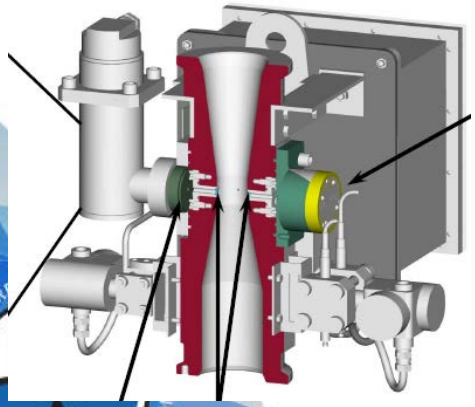
- Exact match with current conditions and fluid properties
- But: less accurate reference flows (can even exceed MPFM specs)

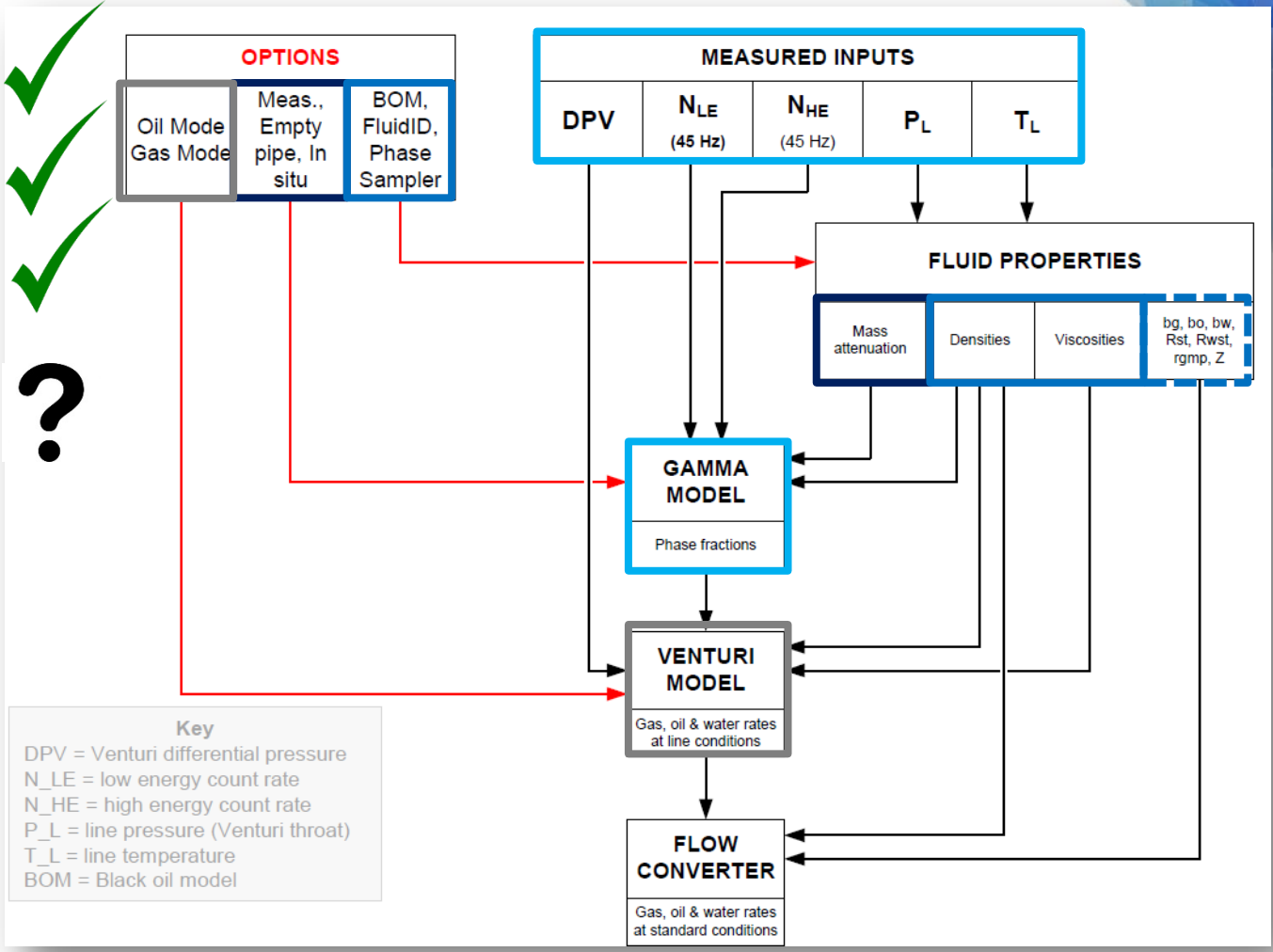


MPFM CALIBRATION: BASICS

Many factors are involved in MPFM calibration:

- PVT
- Pure phase calibration of gamma source
- Basic physics/measurements
- MPFM vendor input





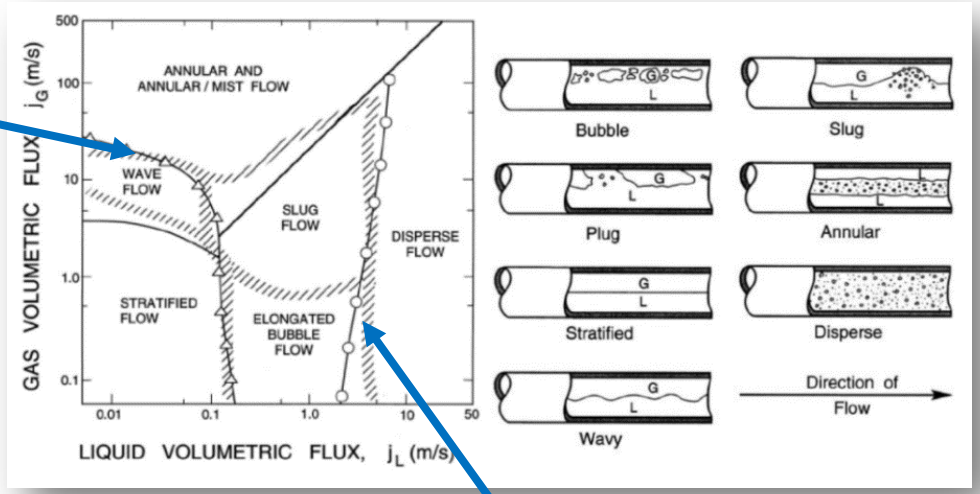
CHALLENGE: LAB TO FIELD

Assessing the multiphase flow model:

- Replicate the field situation in the laboratory → flow regimes

Very simplistic presentation of flow regime maps

pressure, surface tension, diameter

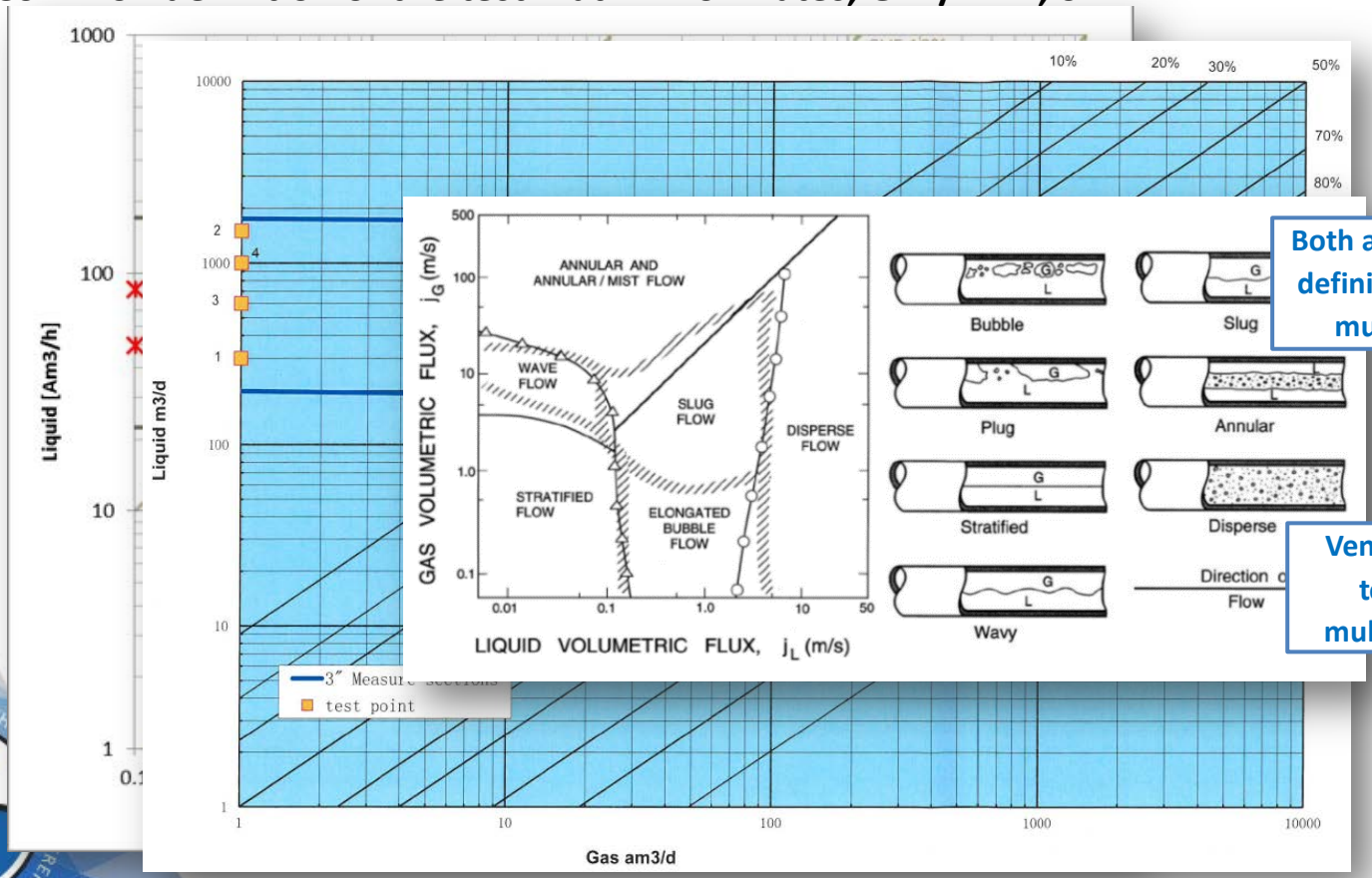


liquid viscosity, surface tension, etc

CHALLENGE: LAB TO FIELD

Assessing the multiphase flow model:

- Replicate the field situation in the laboratory → flow regimes
- Common definition of the test matrix: flow rates, GVF/WLR, or…



Both approaches will not by definition lead to the same multiphase topology!

Vendor flow model is not tested in the correct multiphase flow regimes!

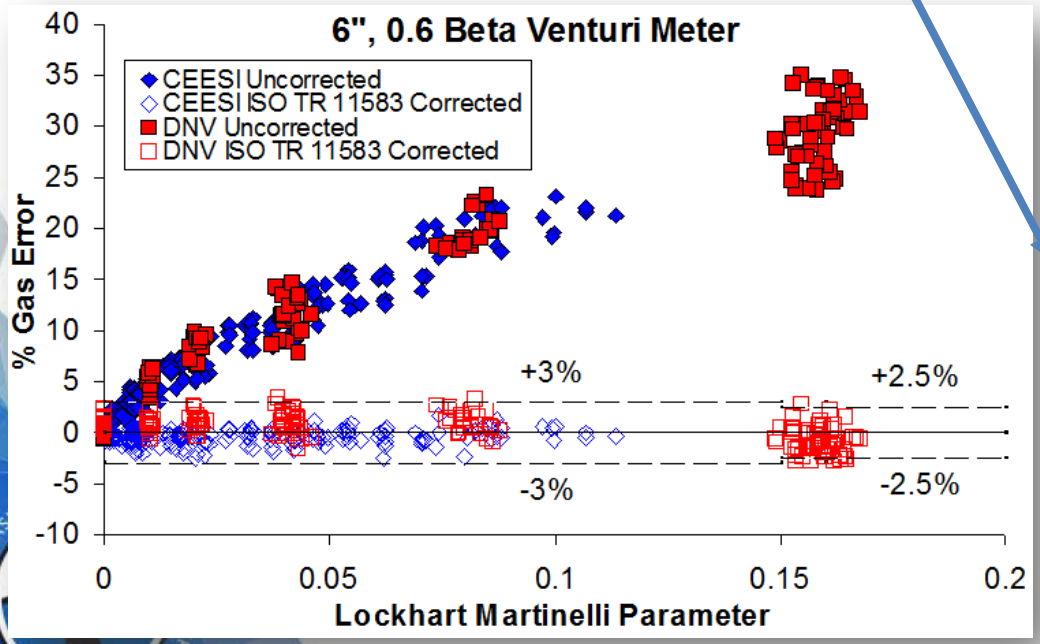
CHALLENGE: LAB TO FIELD

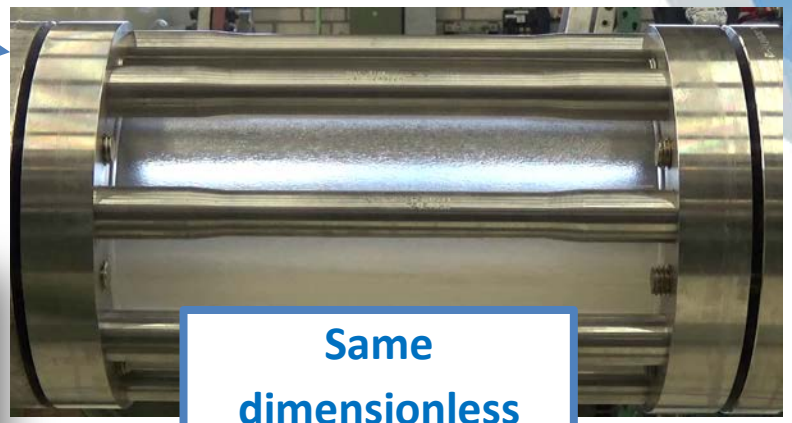
Testing in terms of dimensionless numbers:

- **For wet-gas this is "well-established": use of Froude number and Lockhart-Martinelli**

4", p=31bar, gas=170m3/h, oil=5m3/h, GVF=97,3%

6", p=6.5bar, gas=600m3/h, oil=12m3/h, GVF=98%





Same dimensionless numbers!

CHALLENGE: LIVE FLUIDS

Using artificial (inert/refined) fluids:

- **Metrologically preferred, low uncertainty of reference flows**
- **Differences in physical properties and behavior: degassing oil has other fluid properties than pure oil, oil-water emulsion other than separated flow**

Using field fluids:

- **Identical PVT and physical properties leading to same physical behavior of the multiphase flow**
- **In expense of larger uncertainty possibly higher than MPFM**
- **Deterioration of field fluid in time, leading to changes in physical properties, requires frequent renewal of fluids**
- **Damage to or fouling of metering and control systems, e.g. waxing, corrosion/erosion**

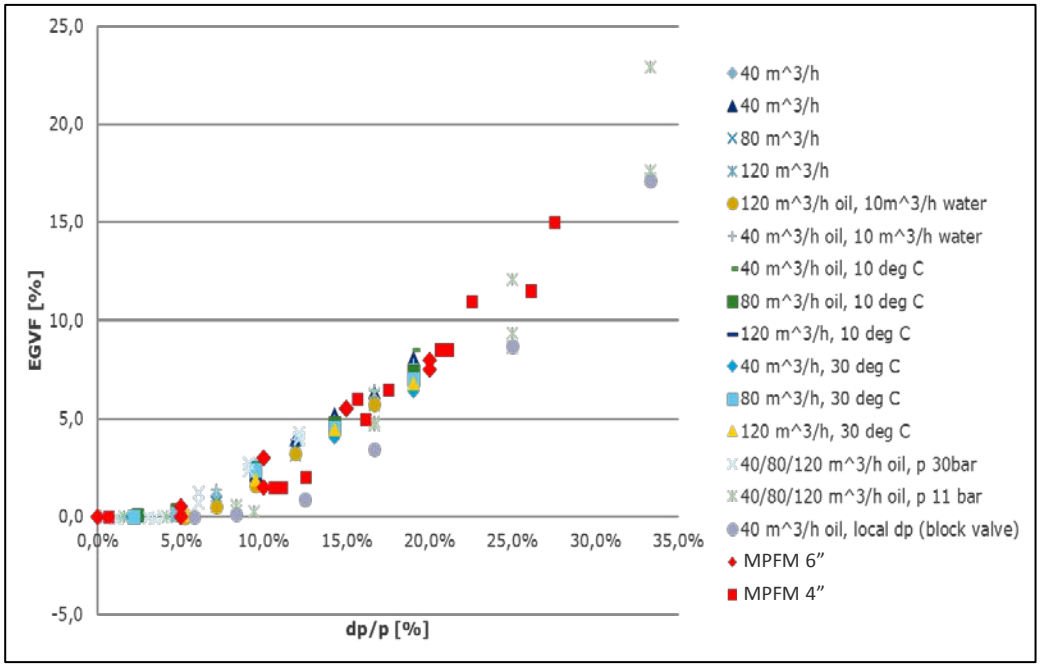
CHALLENGE: LIVE FLUIDS

Balance between these two extremes:

- **Capture most dominant physical effects (e.g. oil degassing, oil-water emulsion), while maintaining sufficient accuracy to asses an MPFM**
- **Requires being in control of these effects and assess the additional uncertainty**

Visual check on oil-water emulsion

Degassing tests with Exxsol D120



CONCLUSIONS

Calibration in-field is only possible when test separator uncertainty is well-known, care needs to be taken when judging results

Facility calibration is a good alternative when the field conditions are properly replicated and it is expected that conversion to dimensionless numbers is essential

When using “live” fluids in facility calibration, the facility needs to be in control of the additional processes of interphase mass transfer and able to quantify them

Thanks for Attention