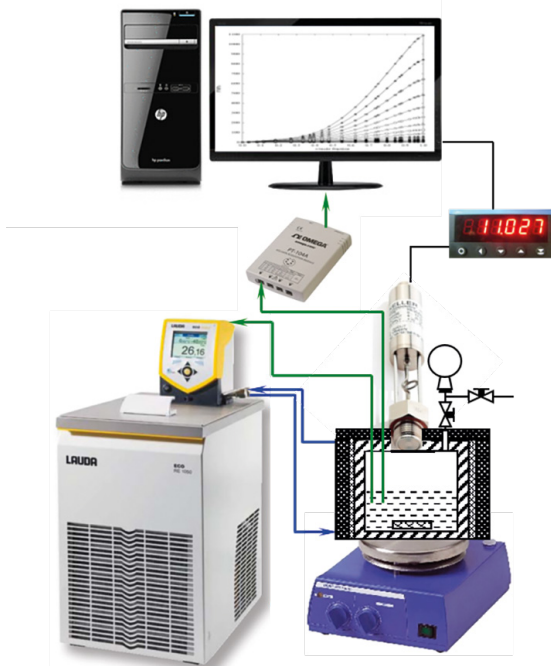




## Thermophysical Properties

The knowledge of thermophysical properties of substances and mixtures is of utmost importance in development and design of almost every technical application. The Germany based FVTR company operates a wide range of specialized measurement equipment as well as mathematical models to describe ideal and non-ideal behavior of various fluids.

### From Measuring...



▲ Schematic of vapor pressure measuring apparatus

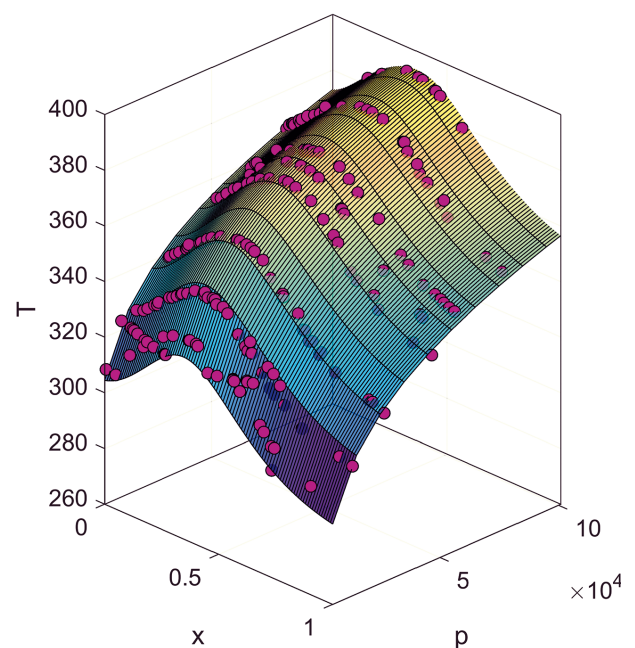
Thermophysical properties are the basis for countless industrial research and optimization processes. The increasing number of synthetically produced substances as well as the combination of mixtures and extending operation ranges of fluids requires precise measurement of thermo-physical properties.

FVTR offers advanced measurement technique on scientific level. Many reviewed publications in the last decade and satisfied customers are a prove of this!

### ...to Modeling!

Apart from measurement data we also support you in fitting the mathematical models describing the thermo-physical behavior of your fluids. These models enable you to estimate properties precisely over a wide range without the need of any interpolation.

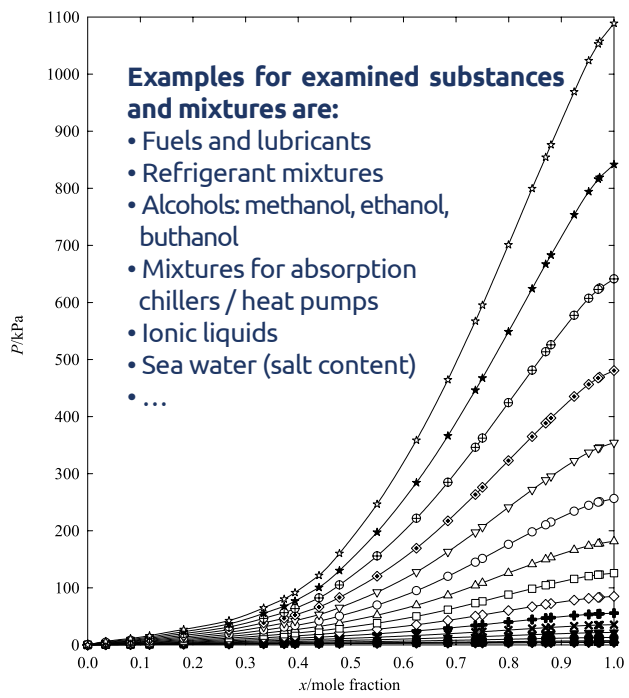
We developed special optimization algorithms which provide a fast and accurate parametrization of various models describing ideal and also non-ideal behavior of several fluids and mixtures.



▲ Simulated vs. measured VLE-data of  $H_2O-HNO_3$

Measurement Technique			
	Properties	Range	Accuracy
Pyris 1 DSC	Specific Heat Capacity	183.15 – 573.15 K	±1%
MCR 302	Dynamic Viscosity	243.15 – 473.15 K	±1%
SVM 3000	Dyn. & Kin. Viscosity	253.15 – 373.15 K	±0.35%
	Density		±0.08 – 0.1%
DMA HPM	Density	263.15 – 473.15 K max. 140 MPa	±0.01 – 0.03%
DSA 5000 M	Density	278.15 – 343.15 K Ambient Pressure	±5e-6 g/cm <sup>3</sup>
	Speed of Sound		±0.1 m/s
Vapor Pressure	Vapor Pressure	248.15 – 323.15 K	±1 – 2 Pa (Differential Meth.) ±10 – 20 Pa (Static Meth.)
		248.15 – 473.15 K	±0.4 – 1.5 kPa (p ≤ 300 kPa) ±1 – 5 kPa (p ≤ 1 MPa) ±2 – 8 kPa (p ≤ 1.6 MPa)
Gas Solubility	Gas Solubility	273.15 – 473.15 K max. 5 MPa	±0.001 mol/kg

## Examined Substances



## Key Benefits for Your Product

- Precise measurement technique on scientific level
- Extended measurement range (p, T)
- Taylor-made models for your fluids
- In-house optimization algorithms ensuring accurate model parameters in short time

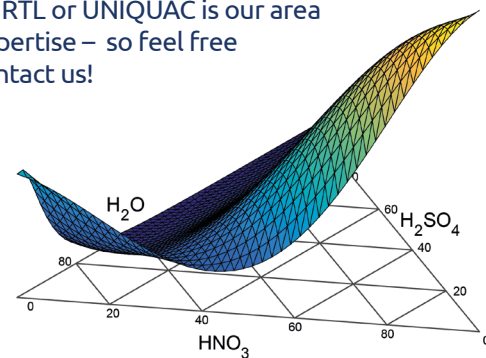
**Are you interested in further information?  
Free to contact our friendly experts.  
Together we will find a solution for your challenges.**

## Calculation of Thermophysical Properties

Measured data enables us to calculate other thermophysical properties like:

- Isothermal compressibility
- Isobaric thermal expansibility
- Thermal pressure coefficient
- Internal pressure
- Isentropic coefficient

In addition, mathematical models describing fluid behavior as functions of temperature and/or pressure can be fitted against measurement data allowing you to precisely describe fluids in your own models and calculations. Especially parametrization of activity coefficient models like NRTL or UNIQUAC is our area of expertise – so feel free to contact us!



▲ Phase diagram of the ternary system H<sub>2</sub>O-H<sub>2</sub>SO<sub>4</sub>-HNO<sub>3</sub>



## FUELS AND LUBRICANTS RESEARCH

Team Lead  
**Dr. rer. nat. Ulrike Schumann**

+49 381 498 9156  
ulrike.schuemann@fvtr.de