



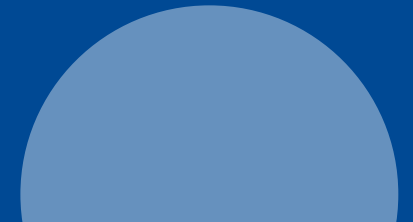
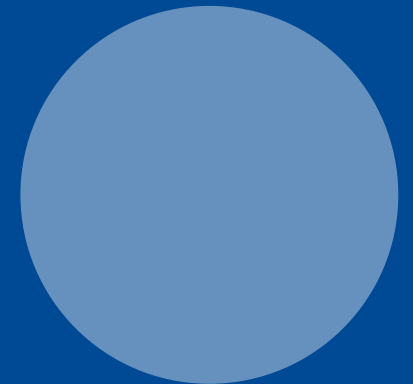
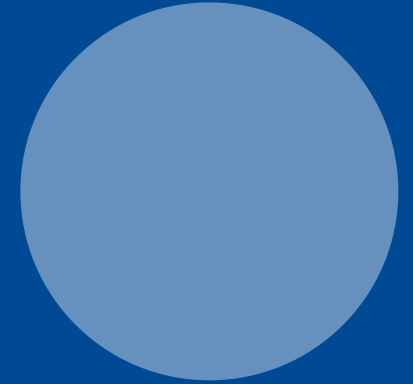
IFA

Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

Revised method for the determination of N-nitrosamines

2019 PEROSH Research Conference in Copenhagen

Carina Engel, September 11, 2019



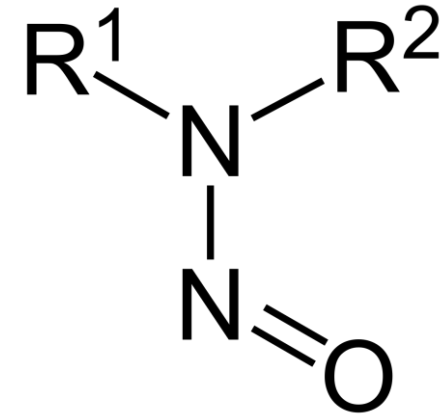
Overview

- N-nitrosamines – occurrence at the workplace
- German regulations for carcinogenic substances
 - TRGS* 910 „Risk-related concept of measures for activities involving carcinogenic hazardous substances”
 - TRGS* 552 „Carcinogenic N-nitrosamines Cat. 1A and 1B
- Revision of the previous IFA-method
- Occurring problems and their solutions
- Summary

*TRGS = Technical Rule for Hazardous Substances

N-nitrosamines

- Most N-nitrosamines are carcinogenic
- Formed in the working process
 - reaction of secondary amines and nitrosating agents
- Formation in the air or in produced substances
- Occurrence at the workplace:
 - Rubber industry
 - Metal industry
 - Chemical industry



TRGS 910: Carcinogenic substances

- Regulation on the handling of carcinogenic substances at the workplace
 - Minimizing the risk of contact
 - Improving protective measures
 - Limit values for acceptable concentration (AK) and tolerable concentrations (TK)
 - below AK: the risk is acceptable (risk level 4:10.000)
 - above TK: the risk is not tolerable (risk level 4:1.000)
 - Examples
 - Benzene AK = 0.2 mg/m³ TK = 1.9 mg/m³
 - Benzo(a)pyrene AK = 0.07 µg/m³ (E*) TK = 0.7 µg/m³ (E*)
 - Cobalt AK = 0.5 µg/m³ (A*) TK = 5 µg/m³ (A*)

*E: inhalable dust, A: alveolar dust

TRGS 552: “Carcinogenic N-nitrosamines Cat. 1A and 1B”

➤ TRGS 910:

N-nitrosodimethylamine (NDMA) AK = 0.075 µg/m³ TK = 0.75 µg/m³

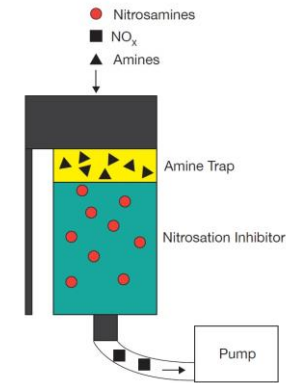
➤ New TRGS 552 (2018)

- Limit value for NDMA (TRGS 910) was transferred to other carcinogenic N-nitrosamines.
- The sum of N-nitrosamines at the workplace must not exceed the following concentrations
 - **AK: 0.075 µg/m³**
 - **TK: 0.75 µg/m³**

➤ Revision of the IFA method to adopt this limit value

Revision of the IFA-Method

- Analytics of 7 N-nitrosamines
- Sample carrier: Thermosorb-N sampling cartridge
- Elution with dichloromethane/methanol
- Analysis with GC / TEA* detector



	Previous IFA method	Revised IFA method
Sampling time	2 h	4 h
Air volume	200 litres	400 litres
Limit of quantification	0.02 µg/m ³	0.010 µg/m ³ (1/5 AK)

*TEA = Thermal Energy Analyser

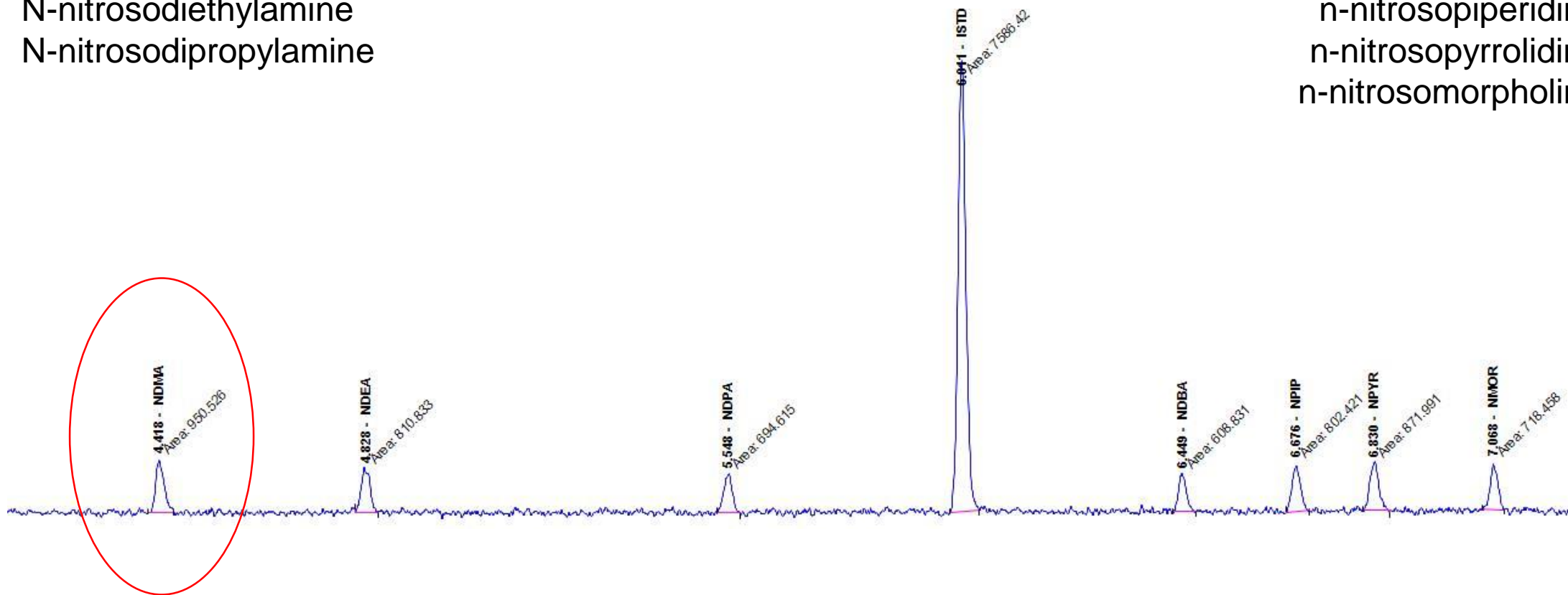
Sampling tests at the laboratory

- Recovery and storage tests
- Spiking the cartridge with N-nitrosamine standard solution
- Sucking air through the cartridge
 - Variation of relative air humidity:
 - 20 % - 80 % rel. humidity
- Desorption of the N-nitrosamines and analysis with GC/TEA detector

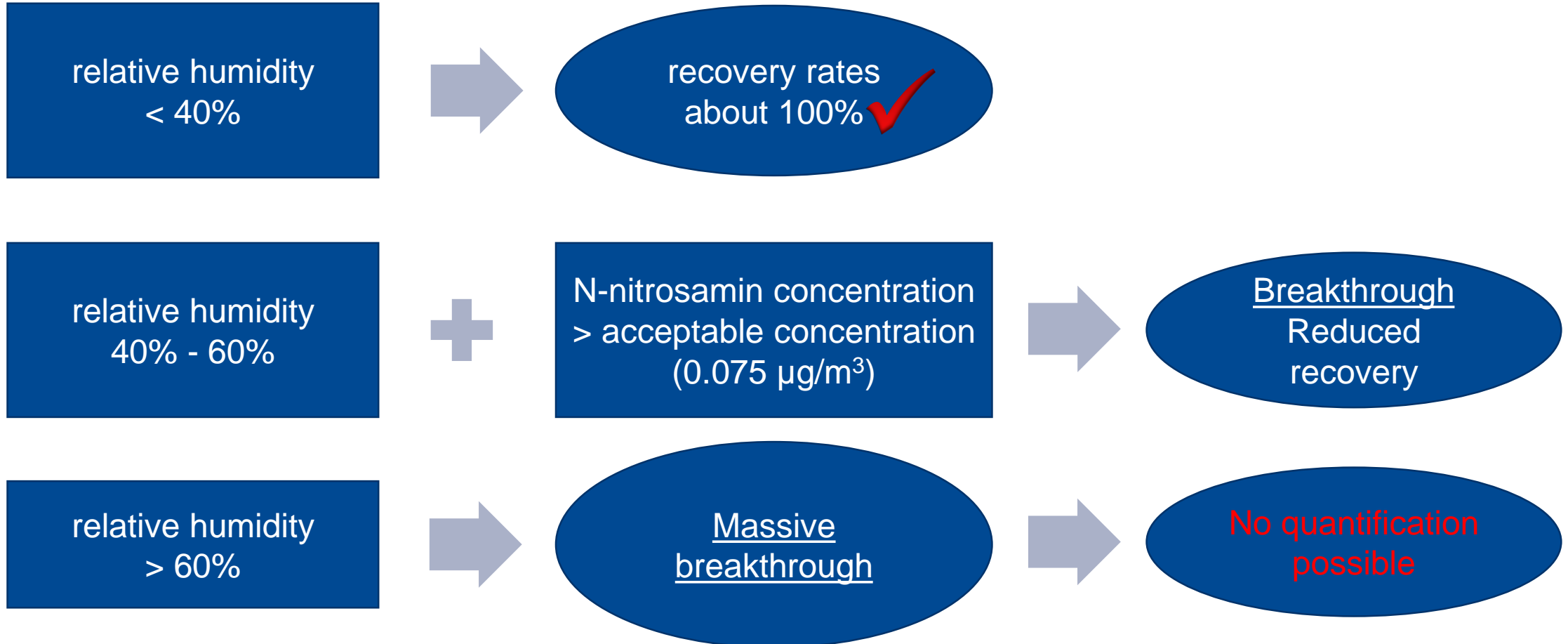
Chromatogram of a standard solution (c = 0,006 µg/ml)

N-nitrosodimethylamine
 N-nitrosodiethylamine
 N-nitrosodipropylamine

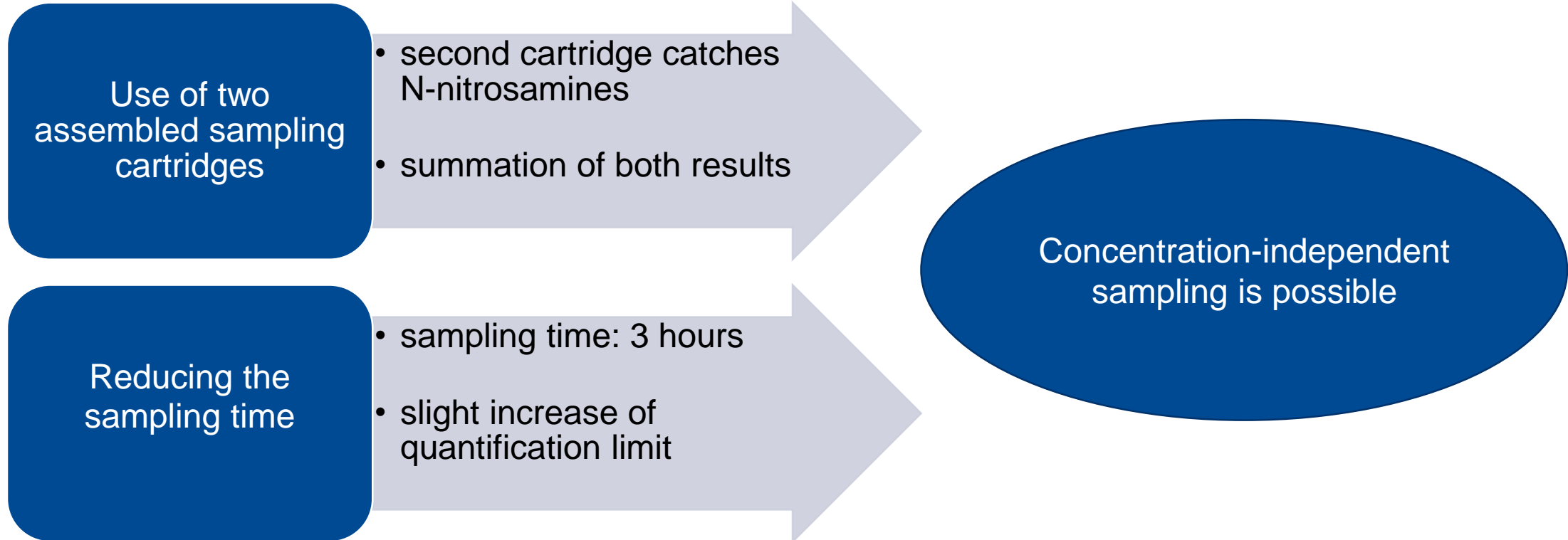
N-nitrosodibutylamine
 n-nitrosopiperidine
 n-nitrosopyrrolidine
 n-nitrosomorpholine



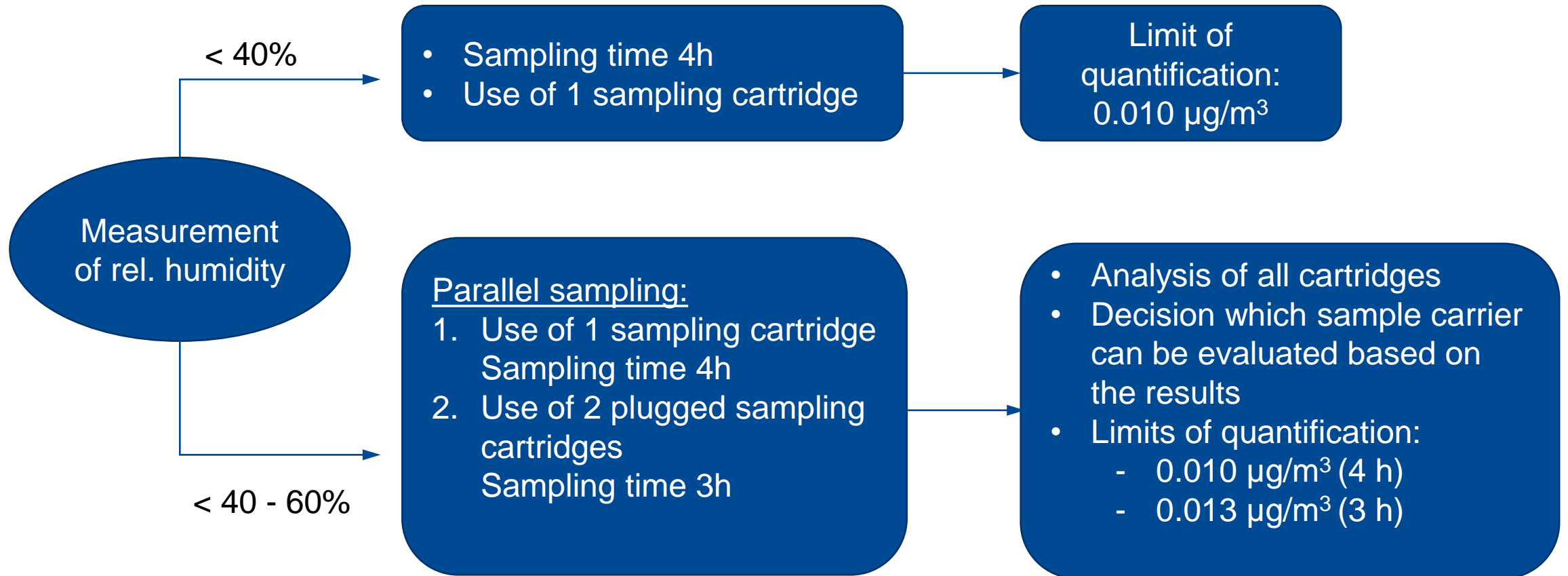
Problem: relative air humidity



Humidity range 40% - 60%



Measurements at the workplace



Method summary

Operational range:	0.010 µg/m ³ – 0.75 µg/m ³
Sample carrier:	Thermosorb-N sampling cartridge
Flow rate:	100 l/h
Sampling time:	3h / 4h (depending on rel. humidity)
Limit of quantification:	0.010 µg/m ³ (4h sampling) – 0.013 µg/m ³ (3h sampling)
Recovery:	About 100% for all 7 N-nitrosamines
Rel. measurement uncertainty:	19 % – 26 %
Storability:	Up to 7 days at room temperature
Restriction:	No quantification possible at rel. humidities > 60%

Thank you for your attention.

