

# *Validity of different biomonitoring strategies in the polyacrylonitrile fibre production*

Thomas Göen, Elisabeth Eckert, Hans Drexler



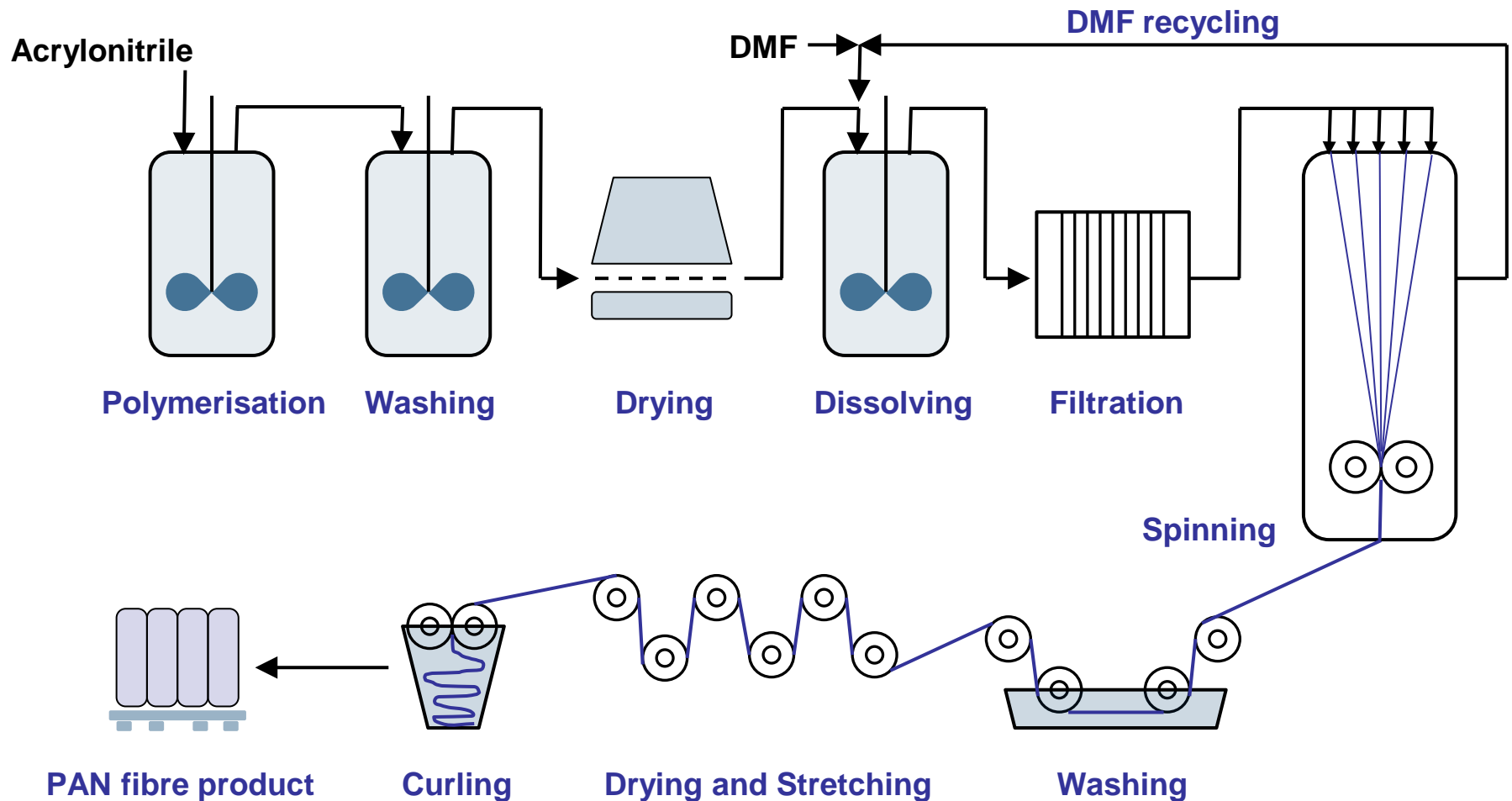
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## Dry-spinning process of PAN fibres



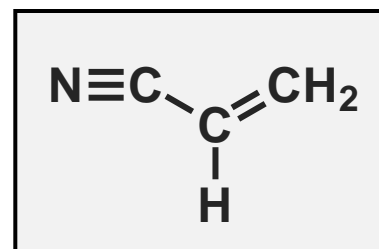
## Acrylonitrile (ACN)

### Physical properties:

- Volatile liquid (bp. 77.3°C)
- amphiphilic chemical  
(log P<sub>OW</sub> 0.25)

### Consumption:

- High Production Volume (HPV);  
Production volume in EU:  
1,250,000 t/a (OECD 1998)
- Production of polyacrylonitrile (PAN) fibers, acrylonitrile butadiene styrene (ABS) resins and styrene acrylonitrile (SAN) resins



### Toxicity / Hazards:

- Neurotoxic, irritant, sensitizer
- Carcinogenic (Cat. 2<sub>DFG</sub>; A3<sub>IARC</sub>)
- Dermal resorption (H<sub>DFG</sub>; S<sub>ACGIH</sub>)
- Occupational exposure limits  
ARL 0.12 ppm; TRL 1.2 ppm; TLV 2 ppm  
BAR 14 pmol CEV/g globin  
ARL 650 pmol CEV/g globin  
TRL 6500 pmol CEV/g globin

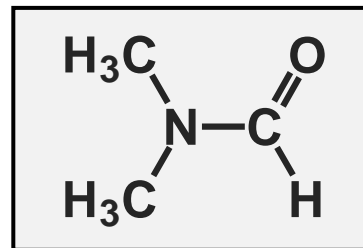
## N,N-Dimethylformamide (DMF)

### Physical properties:

- liquid (bp. 153°C)
- amphiphilic solvent  
(log P<sub>OW</sub> -1,01)

### Consumption:

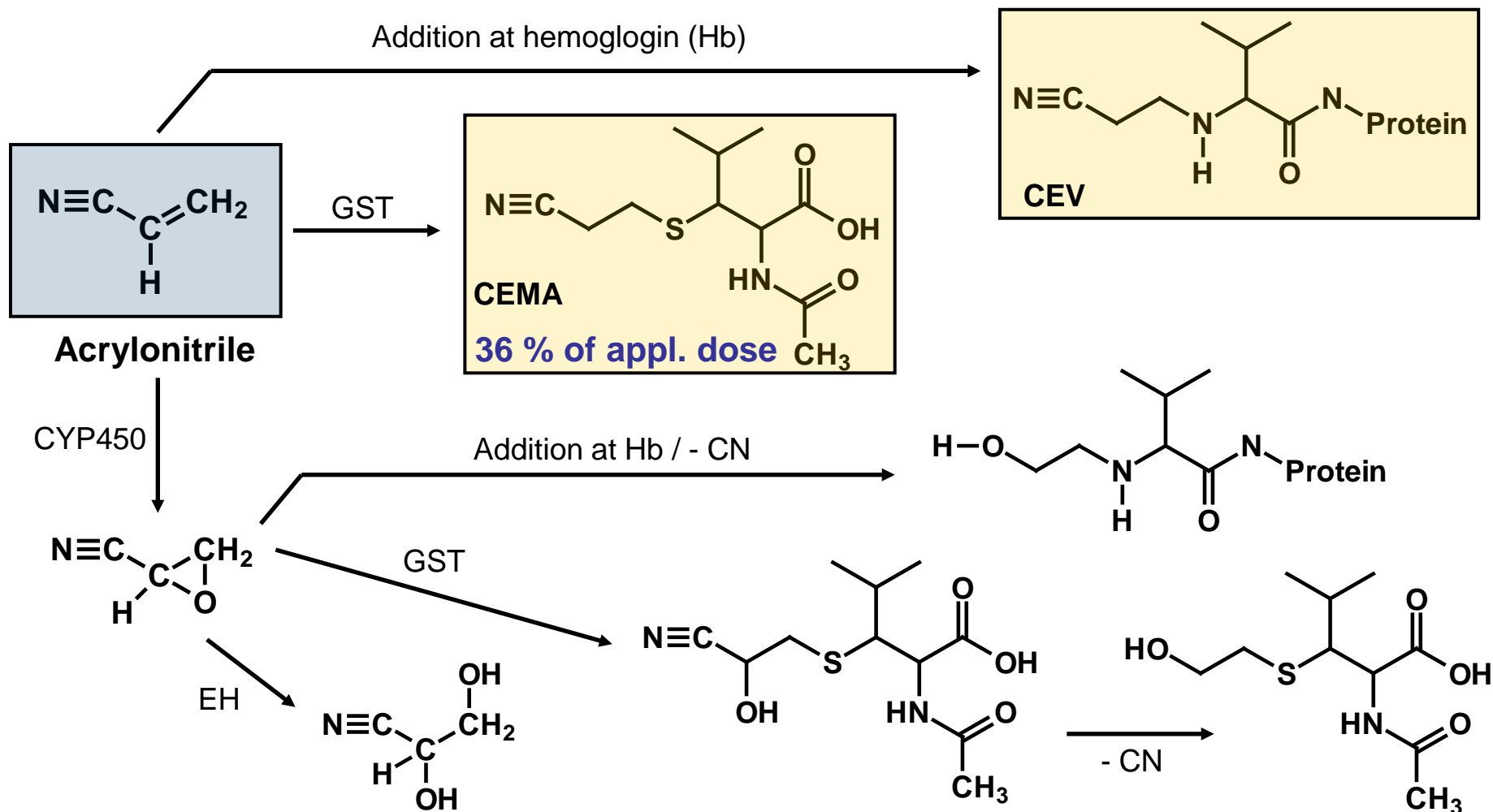
- High Production Volume (HPV);  
Production volume in EU:  
50,000-100,000 t/a (OECD 2001)
- Solvent, particularly for polymers  
(polyacrylonitrile, PVC,  
polyamide, polyurethane,  
epoxy resin, cellulose)



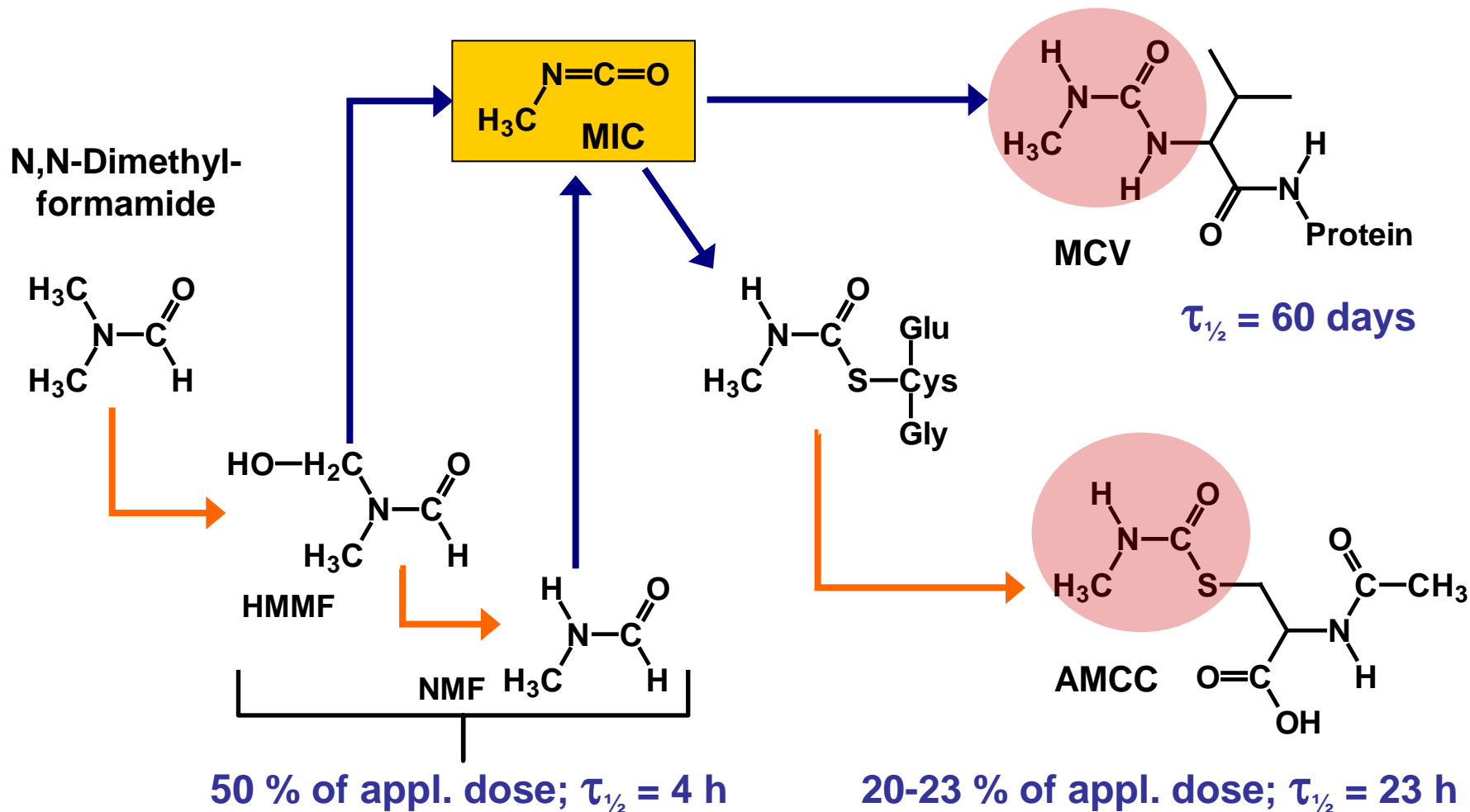
### Toxicity / Hazards:

- Hepatotoxic
- Embryotoxic
- Dermal resorption (H<sub>DFG</sub>; S<sub>ACGIH</sub>)
- Occupational exposure limits  
MAK 5 ppm; TLV 10 ppm  
BAT 35 mg NMF+HMMF/L urine (es)  
BEI 15 mg NMF+HMMF/L urine (es)  
BEI 40 mg AMCC/L urine (pns)

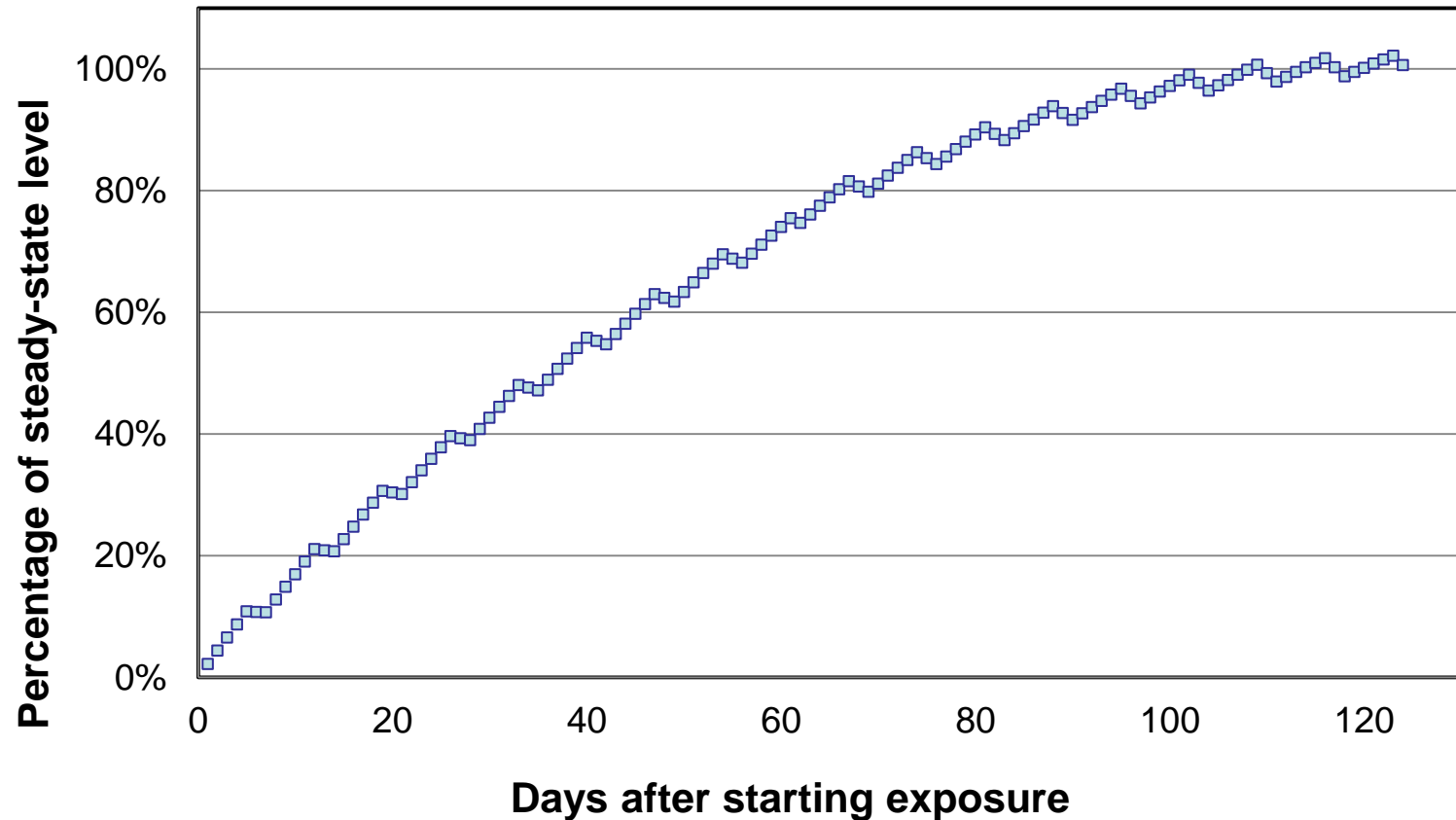
## Metabolism of Acrylonitrile (ACN)



## Metabolism of N,N-Dimethylformamide (DMF)



## Accumulation stage of Hb adducts

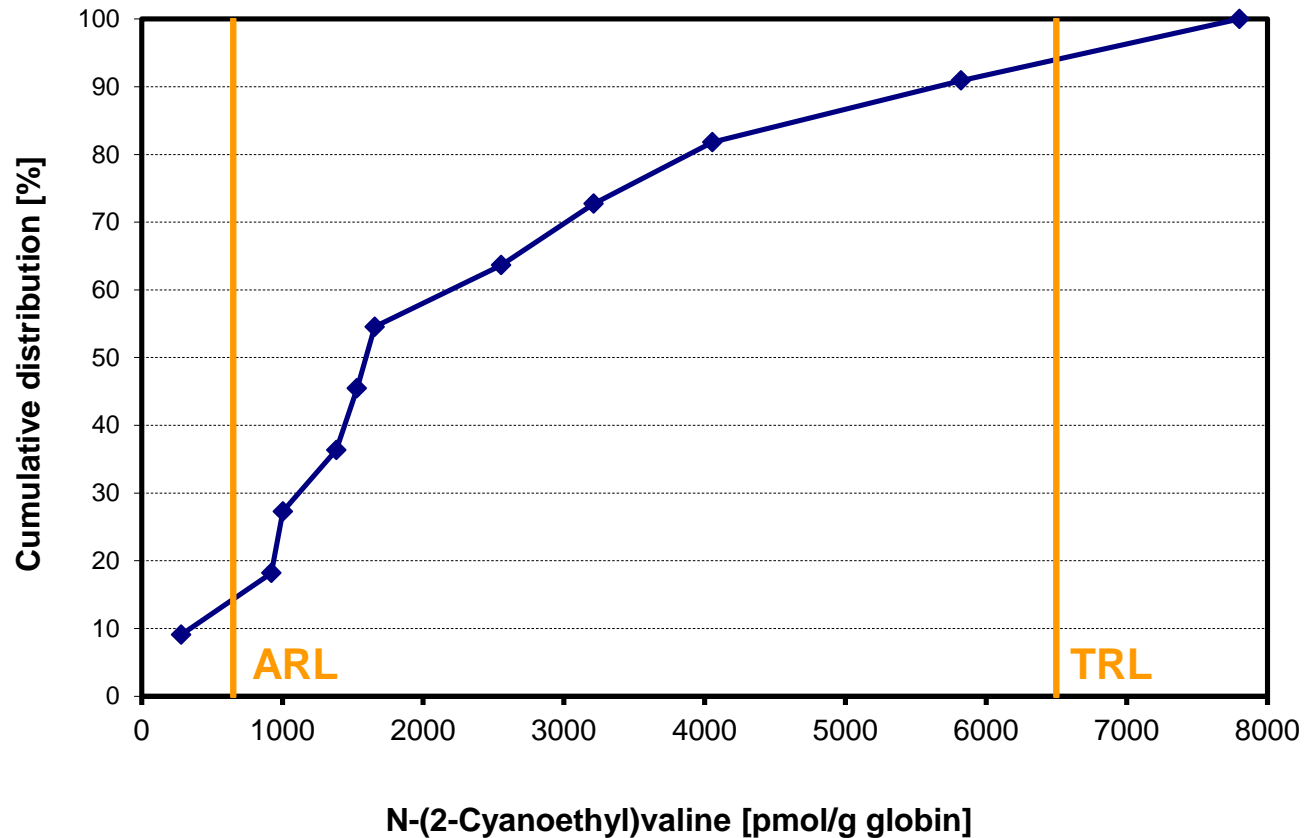


## Study description (individuals and parameters)

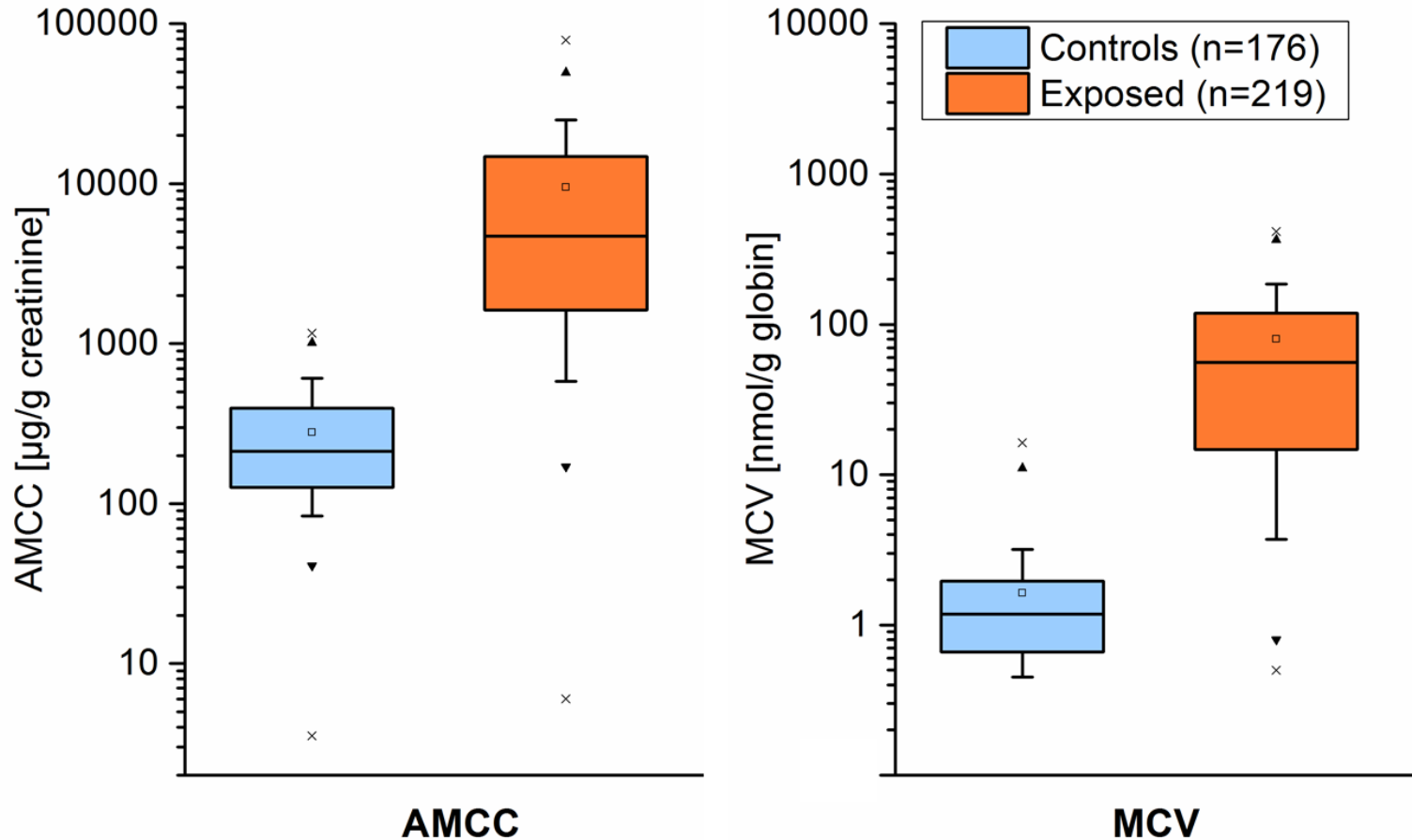
Study	Exposure situation	DMF biomonitoring	ACN biomonitoring
I	Regular occupational medical examinations for ACN (11 individuals)	-	CEV
II	Cross-sectional study (219 individuals after several weeks regular service in the PAN fibre production; 176 controls)	NMF, AMCC, MCV	CEMA
III	Occasional assessment of ACN exposure (3 individuals; filling and controlling the PAN polymerization process)	-	CEMA, CEV



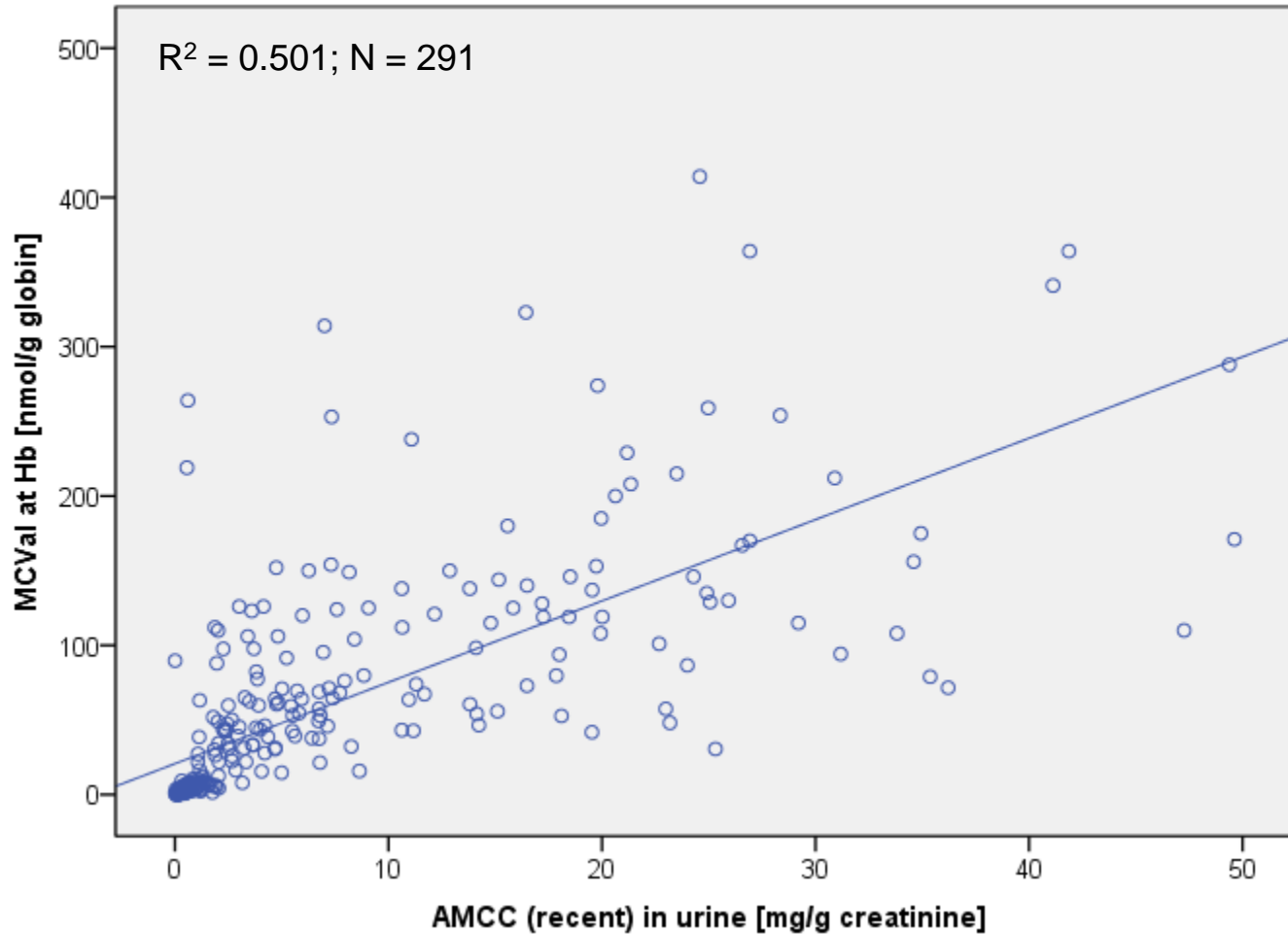
## CEV in individuals during regular practice (Study I)



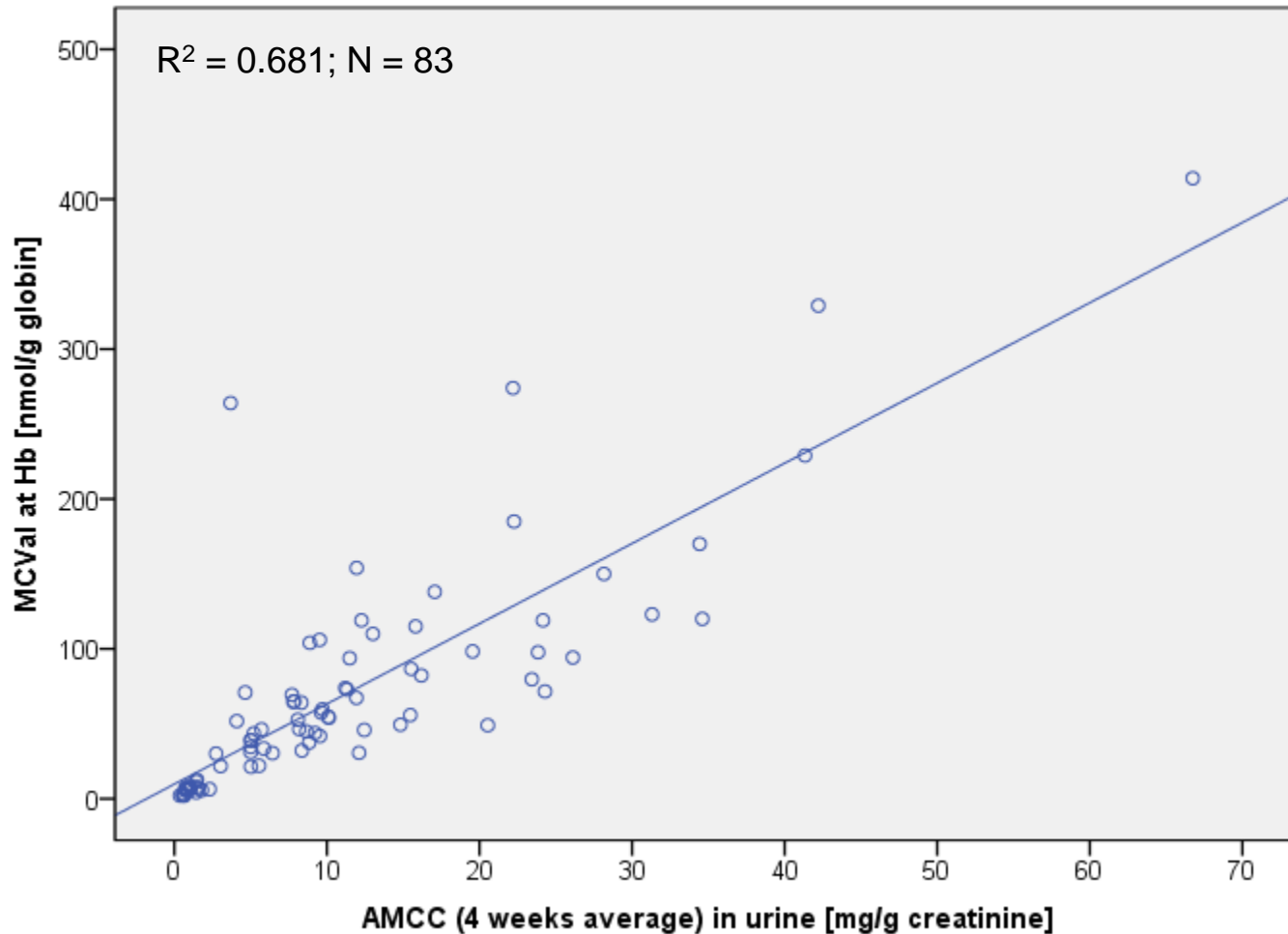
## AMCC and MCV in exposed subjects and controls (Study II)



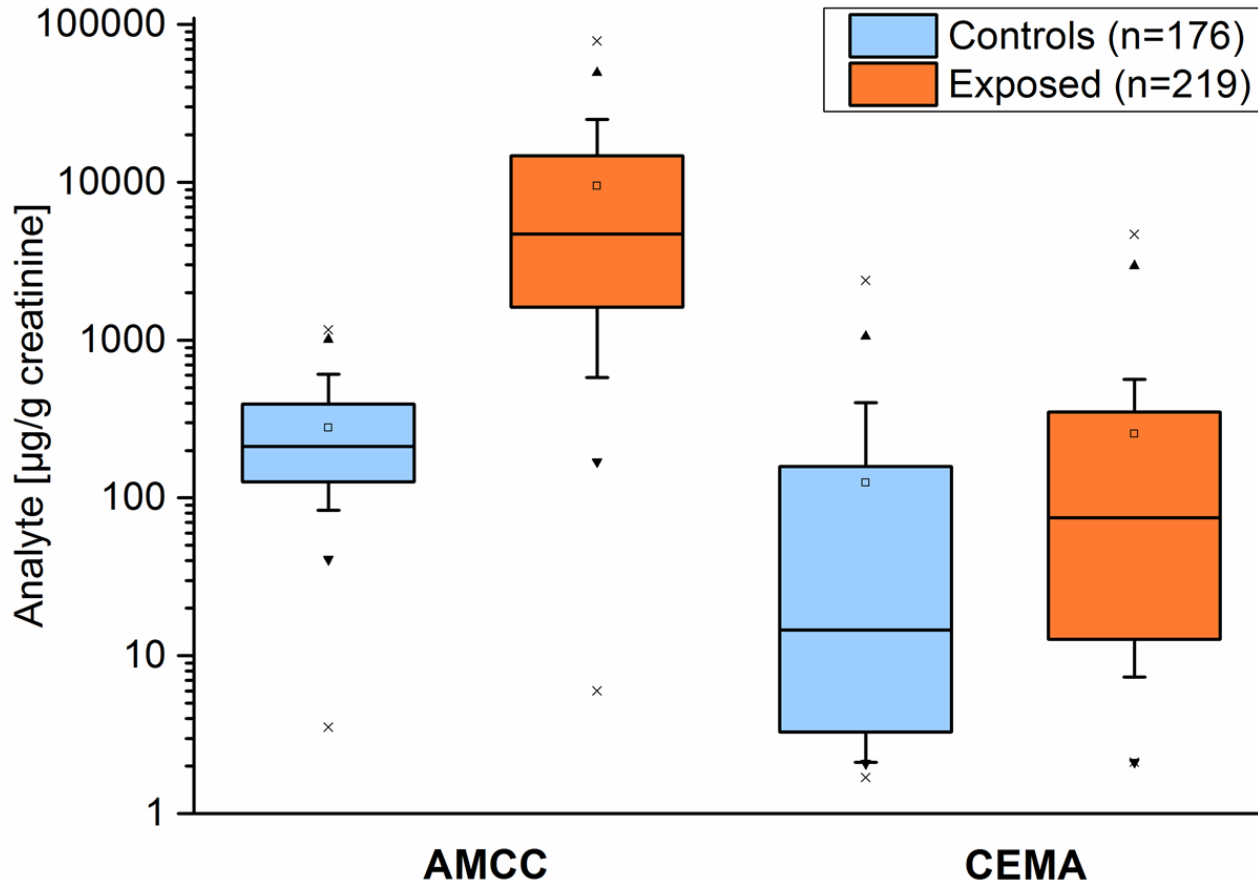
## MCVal level vs. Recent AMCC level



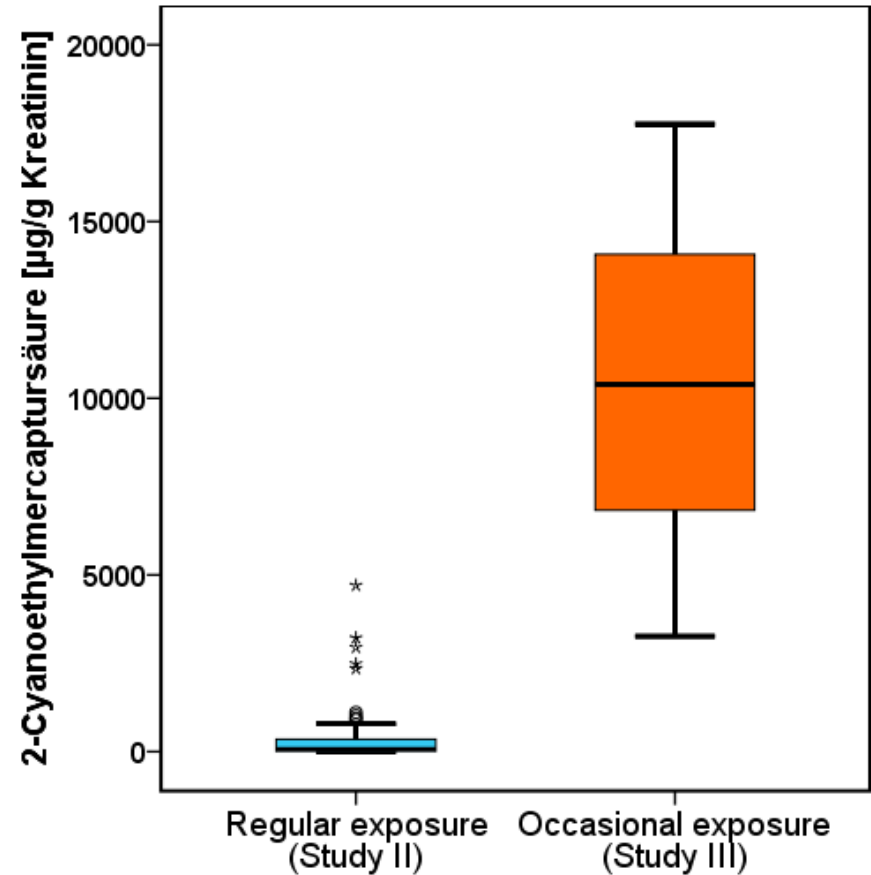
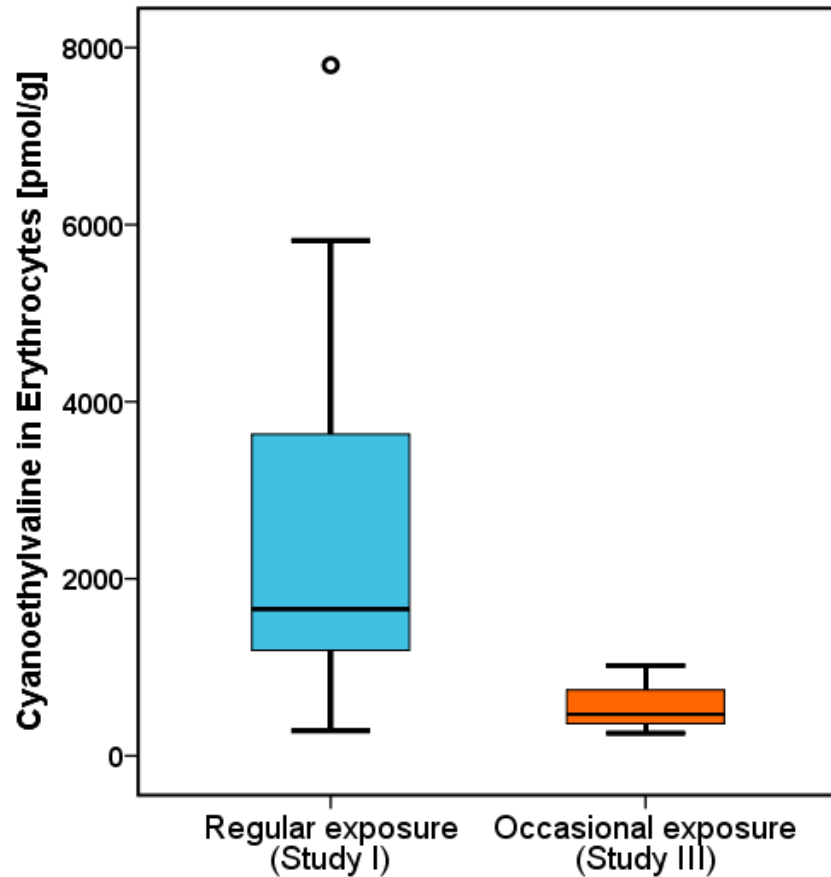
## MCVal level vs. Average of AMCC level



## AMCC and CEMA in exposed subjects and controls (Study II)



## CEV and CEMA after regular vs. occasional exposure



## Conclusions

- Availability of valid biomonitoring of long-term (Hb adducts) and short-term (mercapturic acids) exposure to DMF and acrylonitrile
- Hb adduct levels of ACN indicate considerable carcinogenic risks for several employees in the PAN fibre production
- DMF parameter AMCC exceed occupational exposure limit only in particular cases
- ACN adduct monitoring does not discover occasional high ACN exposure certainly
- Simultaneous assessment of long-term and short-term biomarkers are highly recommended to protect against chronic and acute toxic effects



Thank you for your attention!



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