Consideration of Non-radioactive Harmful Substances

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inorganic:

- metals
  - Cd
  - Cr
  - Hg
  - Pb
- asbestos
- rare substances
  - B
  - Be

organic:

- mineral oil hydrocarbons
- polyvinyl chloride (PVC)
- polycyclic aromatic hydrocarbons (PAH)
- polychlorinated biphenyls (PCB)

Atomic safety, radiation protection

- Ministry of the environment (Saxony)
- radiation protection at deconstruction
- monitoring, analysis of radionuclides for controlling

Environmental law

- Environmental Agency, Regional Commission
- environmental protection at deconstruction
- chemical analysis of harmful substances, also in materials with minor radioactivity

“Laboratory for Environmental and Radionuclide Analyses” of VKTA is accredited according to DIN EN ISO/IEC 17025 for radionuclide and conventional analysis

Procedure

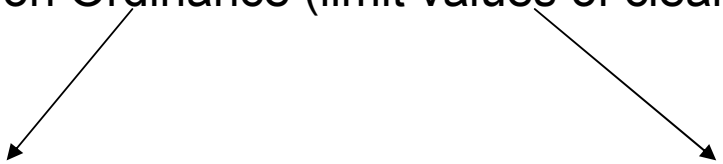
environmental investigation parallel to radiological surveys

- historical research
- environmental investigation
  - buildings before deconstruction
  - underground structures during deconstruction
- sampling parallel at deconstruction
  - measurements for clearance (radiation protection)
  - chemical characterisation of demolition rubble, soil … (environmental protection)
- chemical analysis of different matrices
- estimation of analytical results in comparison with limit values to make a decision for waste management

Procedure

Environmental requirements taking into account of radiation protection

materials with minor radioactivity:
clearance of materials in accordance with §29 Radiation Protection Ordinance (limit values of clearance)



unrestricted clearance

material can be recycled

restricted clearance

- removal (controlled landfill, combustion)
- the way is restricted, fixed and allowed by authorithies

✓ remarks for occupational health and safety

Analysis

methods:
appropriate sample preparation for different materials;
validation (chemical digestion, elution, extraction)

determination of inorganic parameters,
•heavy metals in solids and eluats – ICP-MS
•pH, electric conductivity
•anions – IC, FIA

determination of organic compounds,
•PAH (Polycyclic Aromatic Hydrocarbons) according EPA – HPLC
•hydrocarbon index – GC
•phenol index
•tensides – FIA

Analysis

HPLC

ICP-MS

Importance of Polycyclic Aromatic Hydrocarbons (PAH)

- product of incompletely combustion of oil, coal, gas
- tar coating of buildings – to protect against water
- old tar coatings: highly contaminated with PAH

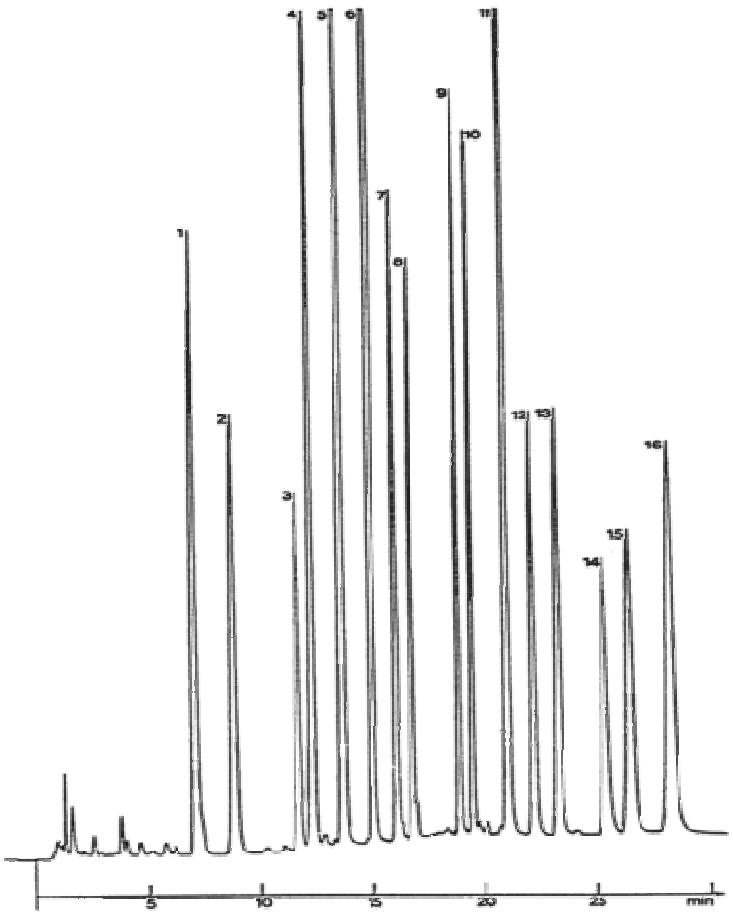
PAH

characteristics

- toxic, carcinogenic because of aromatical structure
- minimal 2, maximal 7 rings of benzene
- persistent

- limit values:
  - drinking water 0,2 µg/l (Σ PAH)
  - ground water 0,2 µg/l (Σ PAH)
  - soil 3 mg/kg (Σ PAH)
  - demolition rubble 1 mg/kg (Z0) up to 15 mg/kg (Z2 for utilization) (Σ PAH)
  - dangerous waste 1000 mg/kg (Σ PAH)

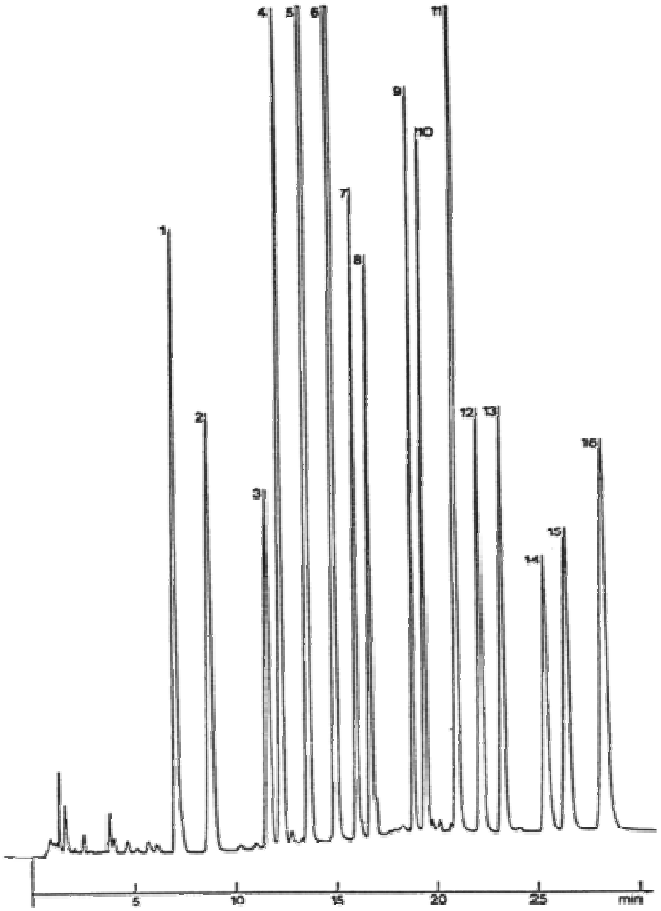
Analysis of Polycyclic Aromatic Hydrocarbons part 1



HPLC chromatogram of 16 EPA-PAH

Name	Summen-formel	Molare Masse	Prozent an Kohlen-stoff	CAS-Nummer	Struktur
Naphthalin	$C_{10}H_8$	128,17 g/mol	93,75 % C	091-20-3	
Acenaphthen	$C_{12}H_{10}$	154,21 g/mol	93,05 % C	083-32-9	
Phenanthren	$C_{14}H_{10}$	178,23 g/mol	94,05 % C	085-01-8	
Fluoranthen	$C_{16}H_{10}$	202,26 g/mol	95,0 % C	206-44-0	
Benzo(a)-anthracen	$C_{18}H_{12}$	228,29 g/mol	94,45 % C	056-55-3	
Benzo(b)-fluoranthen[a]	$C_{20}H_{12}$	252,32 g/mol	95,2 % C	205-99-2	
Benzo(a)pyren[a]	$C_{20}H_{12}$	252,32 g/mol	95,2 % C	050-32-8	
Dibenzo(a,h)-anthracen	$C_{22}H_{14}$	278,35 g/mol	94,7 % C	053-70-3	

Analysis of Polycyclic Aromatic Hydrocarbons, part 2



HPLC chromatogram of 16 EPA-PAH

Name	Summen-formel	Molare Masse	Prozent an Kohlen-stoff	CAS-Nummer	Struktur
Fluoren	$C_{13}H_{10}$	166,22 g/mol	93,59 % C	086-73-7	
Anthracen	$C_{14}H_{10}$	178,23 g/mol	94,05 % C	120-12-7	
Pyren	$C_{16}H_{10}$	202,26 g/mol	95,0 % C	129-00-0	
Chrysen	$C_{18}H_{12}$	228,29 g/mol	94,45 % C	218-01-9	
Benzo(k)-fluoranthen[a]	$C_{20}H_{12}$	252,32 g/mol	95,2 % C	207-08-9	
Indeno-(1,2,3-cd)-pyren[a]	$C_{22}H_{12}$	276,34 g/mol	95,6 % C	193-39-5	
Benzo(ghi)-perylen[a]	$C_{22}H_{12}$	276,34 g/mol	95,6 % C	191-24-2	

ANMERKUNG Die Auswahl der 15 PAK entspricht der US EPA-Liste, unter Auslassung von Acenaphthylen, das nach diesem Verfahren nicht bestimmbar ist, da es nicht fluoreszenzaktiv ist.

[a] Verbindungen, die in der Richtlinie 98/83/EG genannt sind.

tube system for radioactive waste water

history

- 40 years in use
- acids, bases, organic solvents, poisons, radionuclides
- tubes, inspection points, waste water tank
- leakages
- harmful substances also in building materials

removal of old tubes with leakages: soil, several types of tubes

tube system for radioactive waste water

results for tubes and soil:

harmful substances from operation

- •Hg in soil
- •only punctiform
- •advantageous hydrological circumstances,
- •no radionuclides
- •possible use for backfill

results for buildings:

harmful substances in „old“ building materials

- •waste water tank, ca. 60 m^3 with protective coating outside

contamination

- •PAH (Σ EPA-PAH 6300 mg/kg),
- •mobile, eluate above inspection value for ground water

→ **removal of protective coating, dangerous waste**

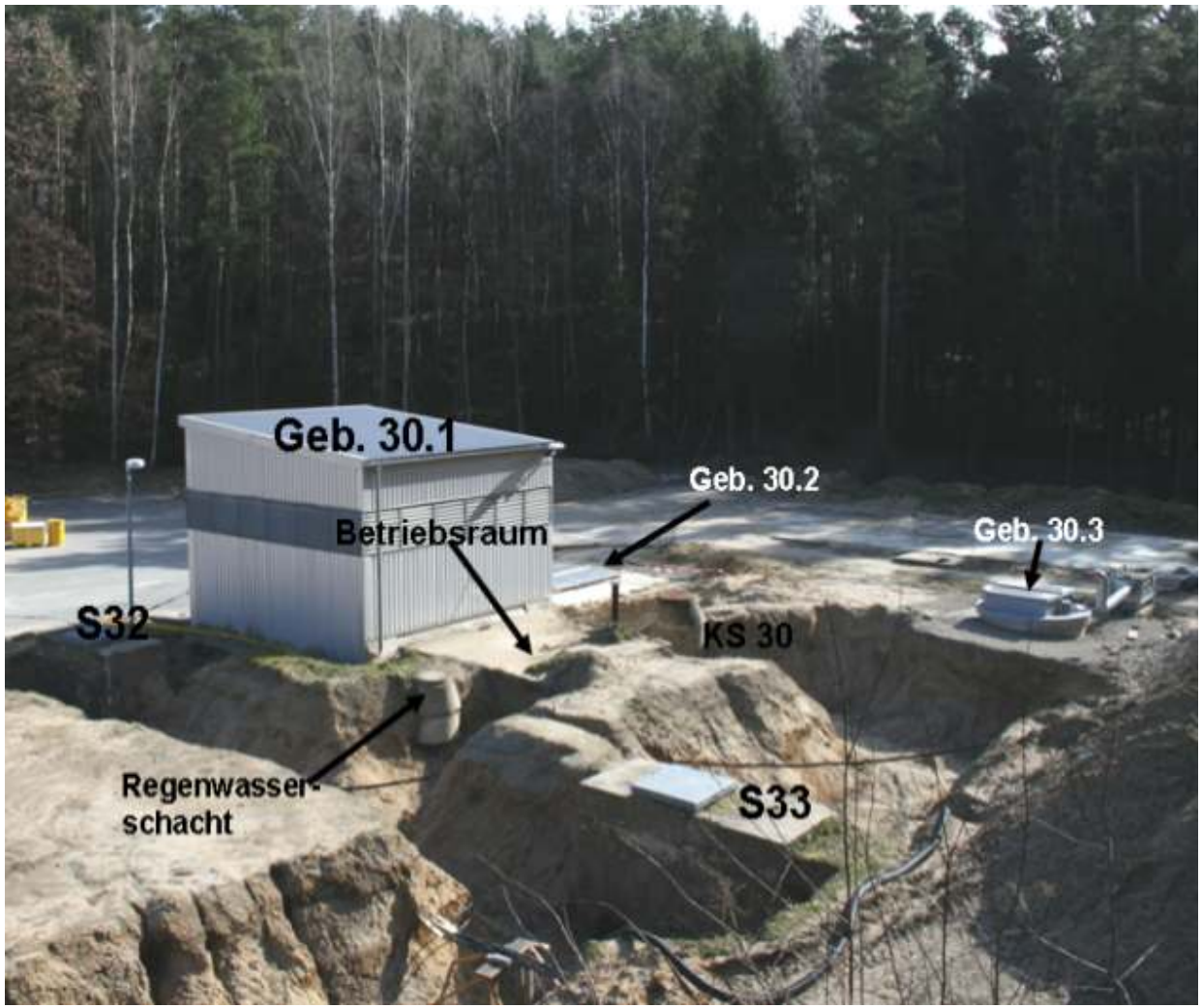
tanks for liquid radioactive waste

history

•40 years in use

•water with acids, bases, organic solvents, poisons …, radionuclides

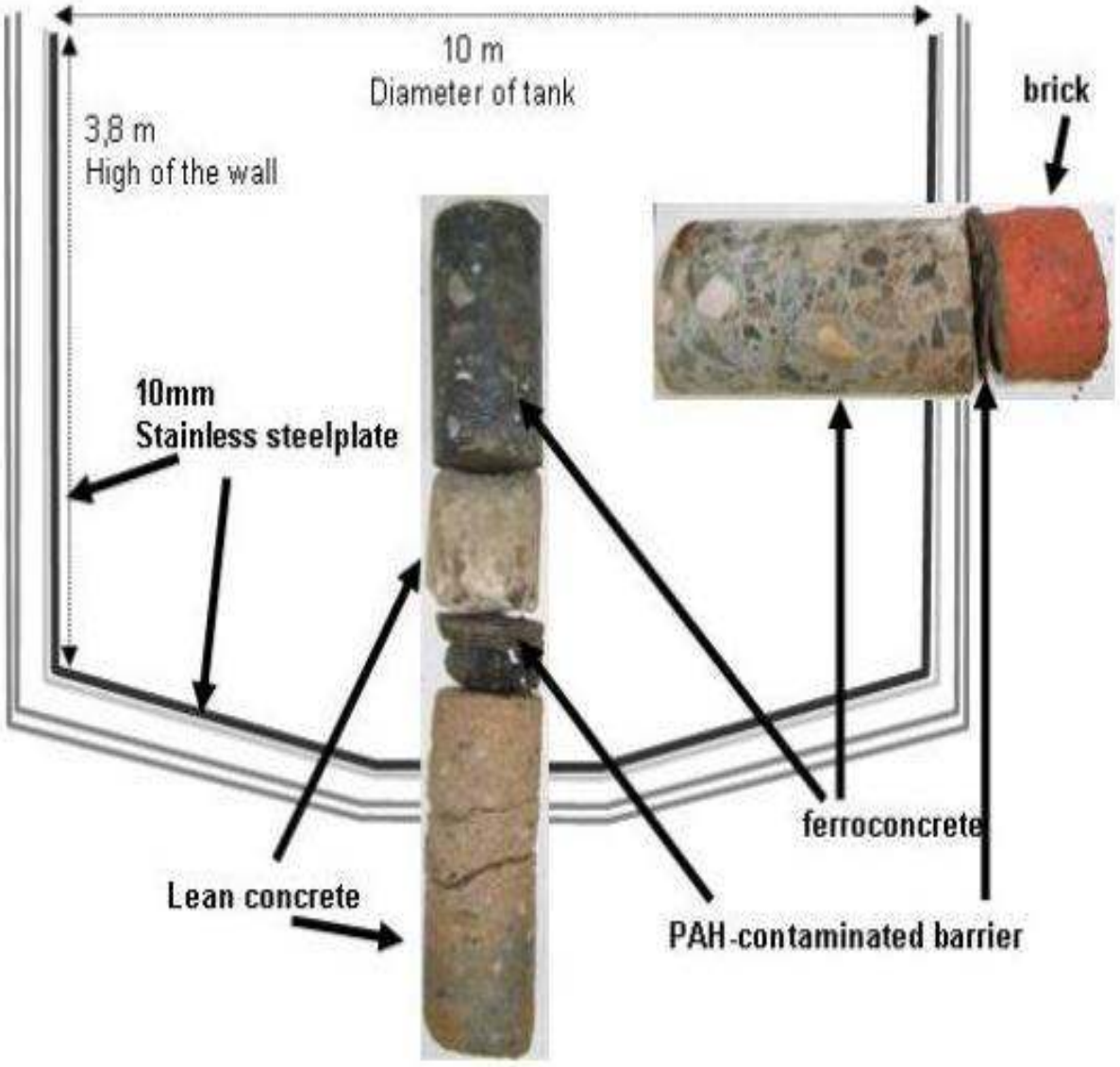
•harmful substances in building materials ?



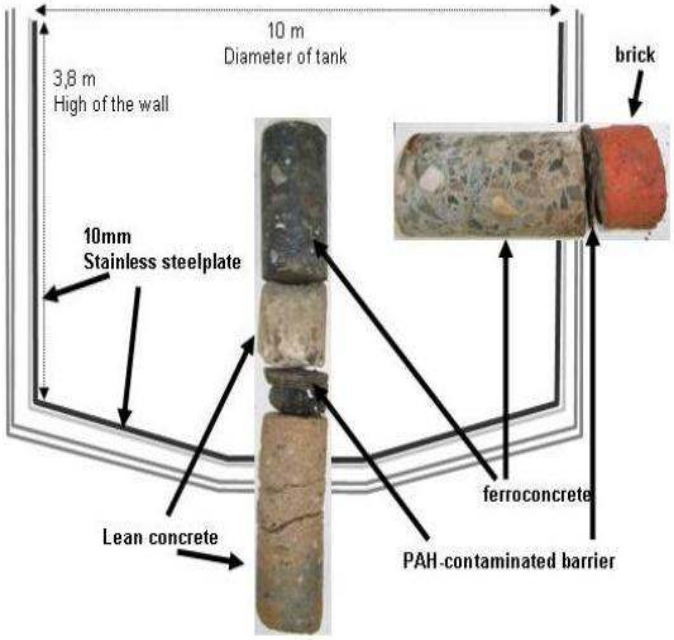
analysis:
•drilling cores of walls
•several materials

tanks for liquid radioactive waste

tanks for liquid radioactive waste



tanks for liquid radioactive waste



results:

harmful substances in„old“ building materials

contamination:

- PAH (Σ EPA-PAH 50 000 …120 000 mg/kg)
  dangerous waste (> 1000 mg/kg)
- mobile PAH 210 µg/l in eluate
  above inspection value (0,2 µg/l)
- serious danger for ground water

removal of the buildings

tanks for liquid radioactive waste

Thank you for attention!