Addressing airborne pollutant exposure at the source: an example of coal tar pitch volatiles (CTPV)

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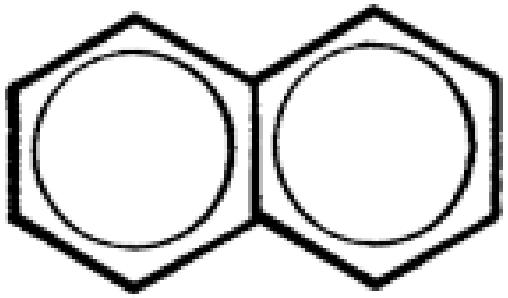
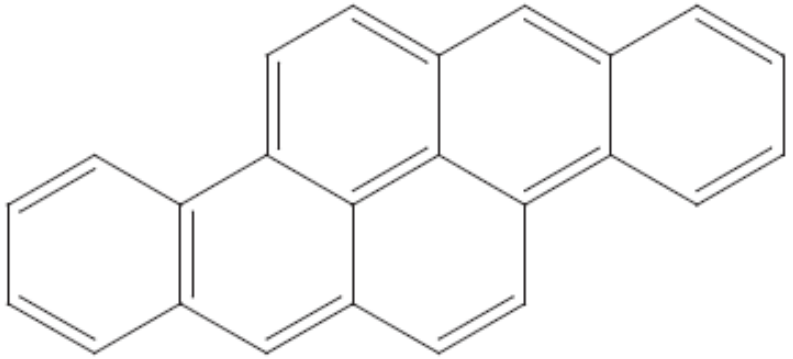
BACKGROUND: CTPV

- Coal Tar Pitch Volatiles (CTPV): group of volatile organic compounds released during carbonisation of coal
- Composition and properties depend on:
  - Primarily the temperature of carbonisation
  - The nature of the coal used
- Synonyms: Acridine, Anthracene, Benzo(a)pyrene, Chrysene, Coal tar, Phenanthrene, pyrene
- Terms may include: coal tar, coal tar pitch, and creosote to be coal tar products

BACKGROUND: PAHs

- Largest portion of CTPV consist of polycyclic aromatic hydrocarbons (PAHs)
- PAH content of coal tars increases with increasing carbonisation temperature



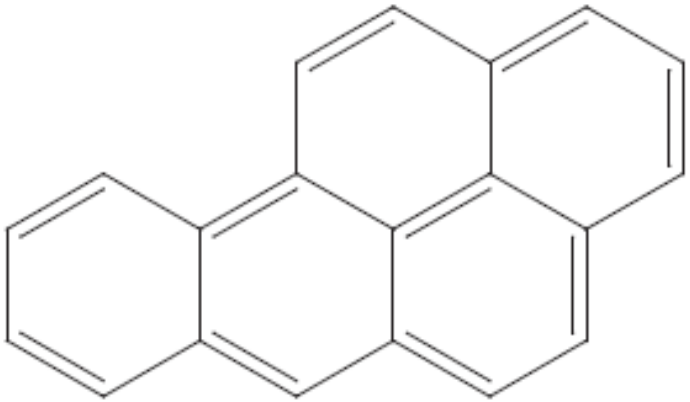


BACKGROUND: PAHs

PAH (Polycyclic Aromatic Hydrocarbons)	Carcinogenicity
Naphthalene	Probable Carcinogen
Acenaphthylene	Not Classified
Acenaphthene	Not Classified
Dibenzofuran	Not Classified
Fluorene	Not Classified
Phenanthrene	Not Classified
Anthracene	Not Classified
Carbazole	Not Classified
Fluoranthene	Not Classified
Pyrene	Not Classified
Benzo[a]anthracene	Probable Carcinogen
Chrysene	Probable Carcinogen
Benzo[b]+[k]fluoranthene	Probable Carcinogen
Benzo[a]pyrene (BaP)	Classified Carcinogen
Indeno[1,2,3-cd]pyrene	Probable Carcinogen
Dibenz[a,h]anthracene	Probable Carcinogen
Benzo[g,h,i]perylene	Not Classified

BACKGROUND: BaP

- Benzo(a)pyrene: most toxic PAHs
- Formed during incomplete combustion of coal, oil, gas, wood etc.
- Previously used as marker for PAHs. Recently individual PAHs are analysed



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HEALTH EFFECTS

- Routes of exposure: inhalation, ingestion, and dermal contact
- Symptoms: Dermatitis and bronchitis
- Lung, kidney and skin cancer
- Target organs: lungs, skin, bladder, kidney

OCCUPATIONAL EXPOSURE LIMITS

	CTPV	Cyclohexane soluble fraction (CSF)	Benzene soluble fraction (BSF)	BaP
IARC	Group 1 Human Carcinogen	-	-	Classified as Human Carcinogen
DMR	-	0.14 mg/m^3	-	None
DOL	Classified as Human Carcinogen	0.14 mg/m^3	-	Suspected Human Carcinogen
NIOSH	-	0.1 mg/m^3	-	-
ACGIH	-	-	0.2 mg/m^3	-

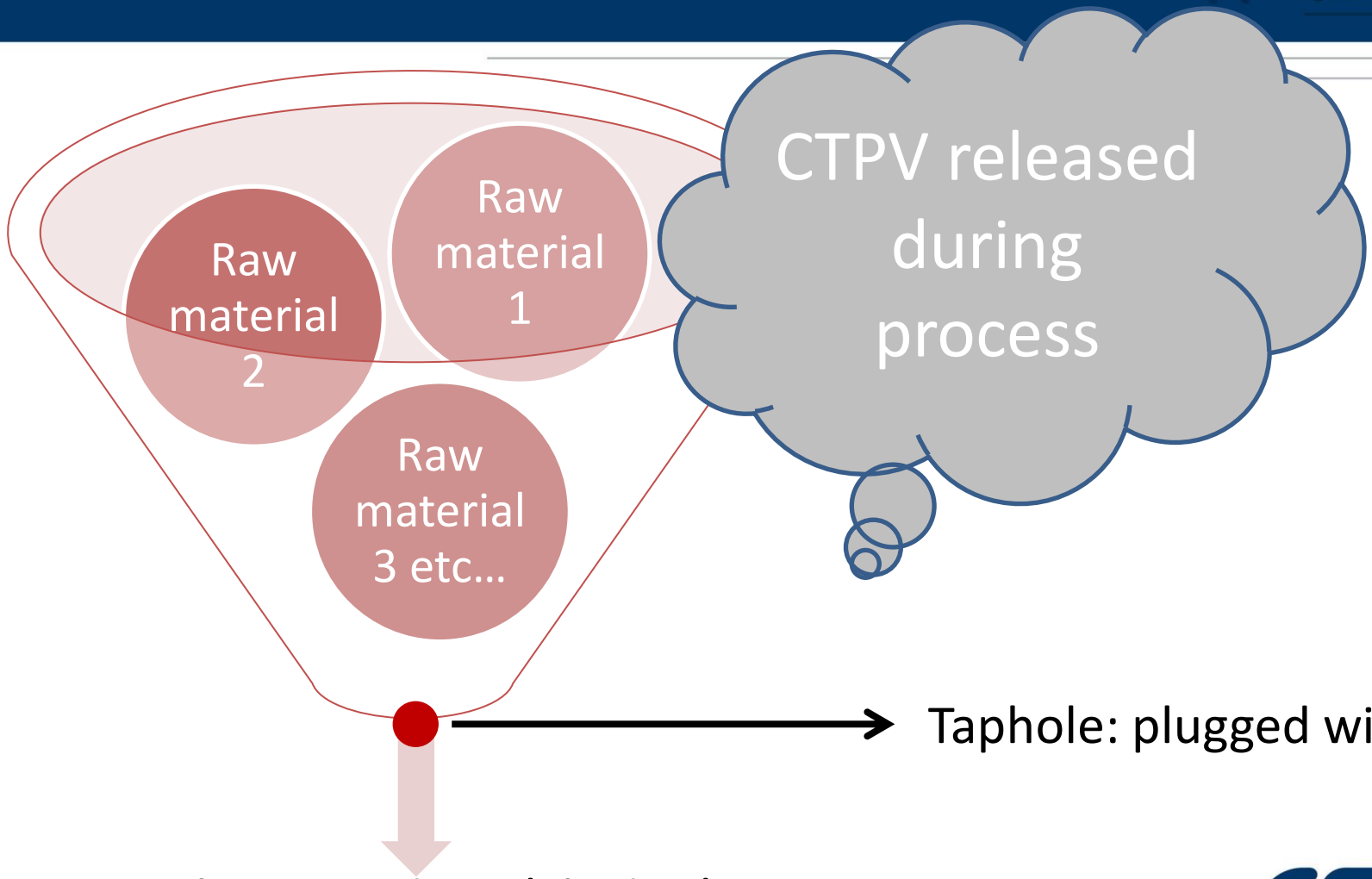
CLIENT REQUEST

- Personal exposure to CTPV and BaP were of concern
- Suspected source: tapping clay to plug taphole
- Client requested the analysis of all raw materials

CHALLENGES

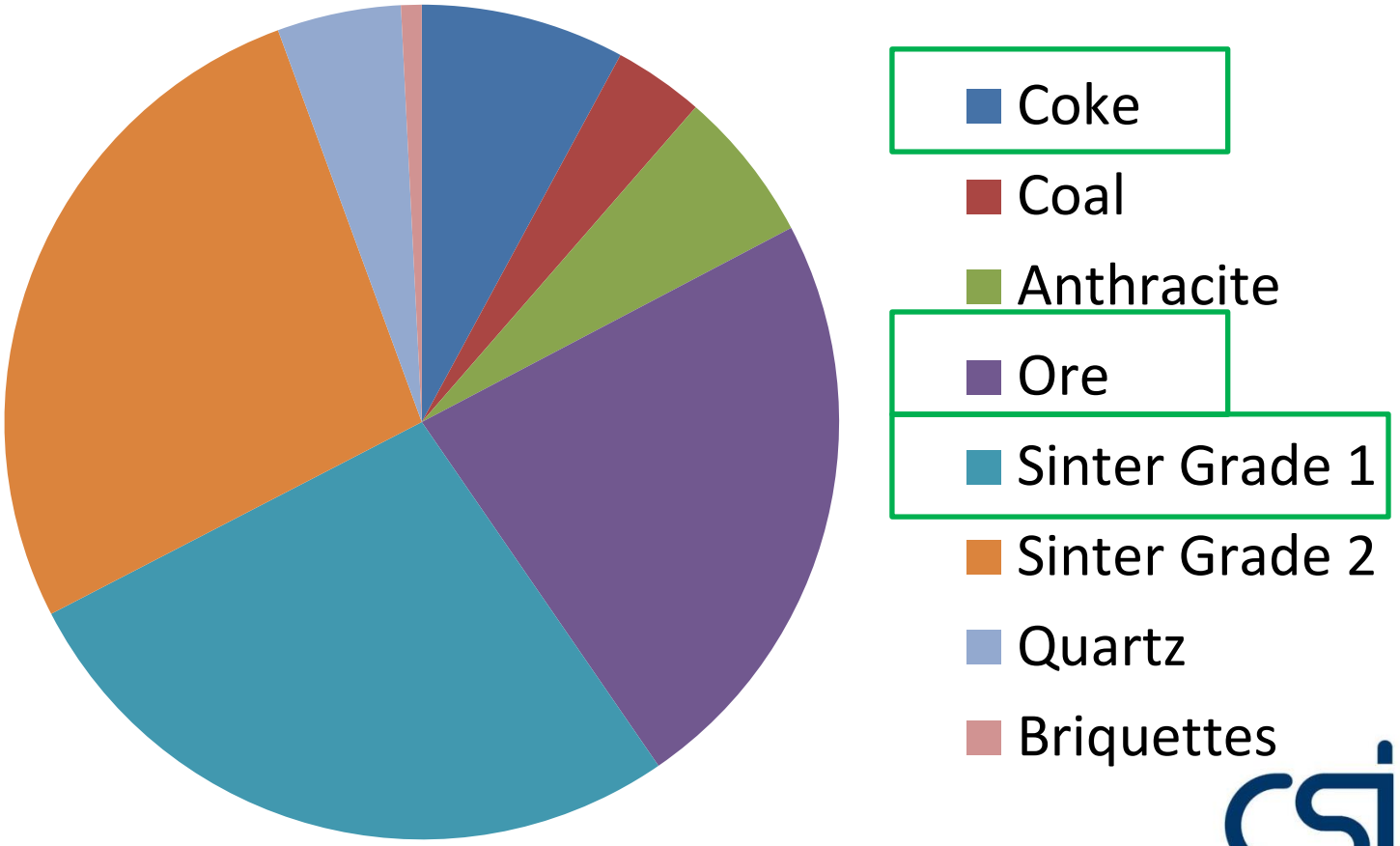
- Complexity of pollutant
- Definition of limit - informs analysis method used
- Determine the source of the CTPV - informs the control measures

SMELTER PROCESS



INPUTS: RAW MATERIALS

Ratio of raw materials used is company confidential



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INPUTS: TAPHOLE CLAY

- Two types were compared for use as a taphole clay:
  - Tar based taphole clay
    - ➢ Currently used. High expected CTPV content
  - Mineral based taphole clay
    - ➢ Proposed replacement. No CTPV content
- Quantities used per process is approximately 1 kg

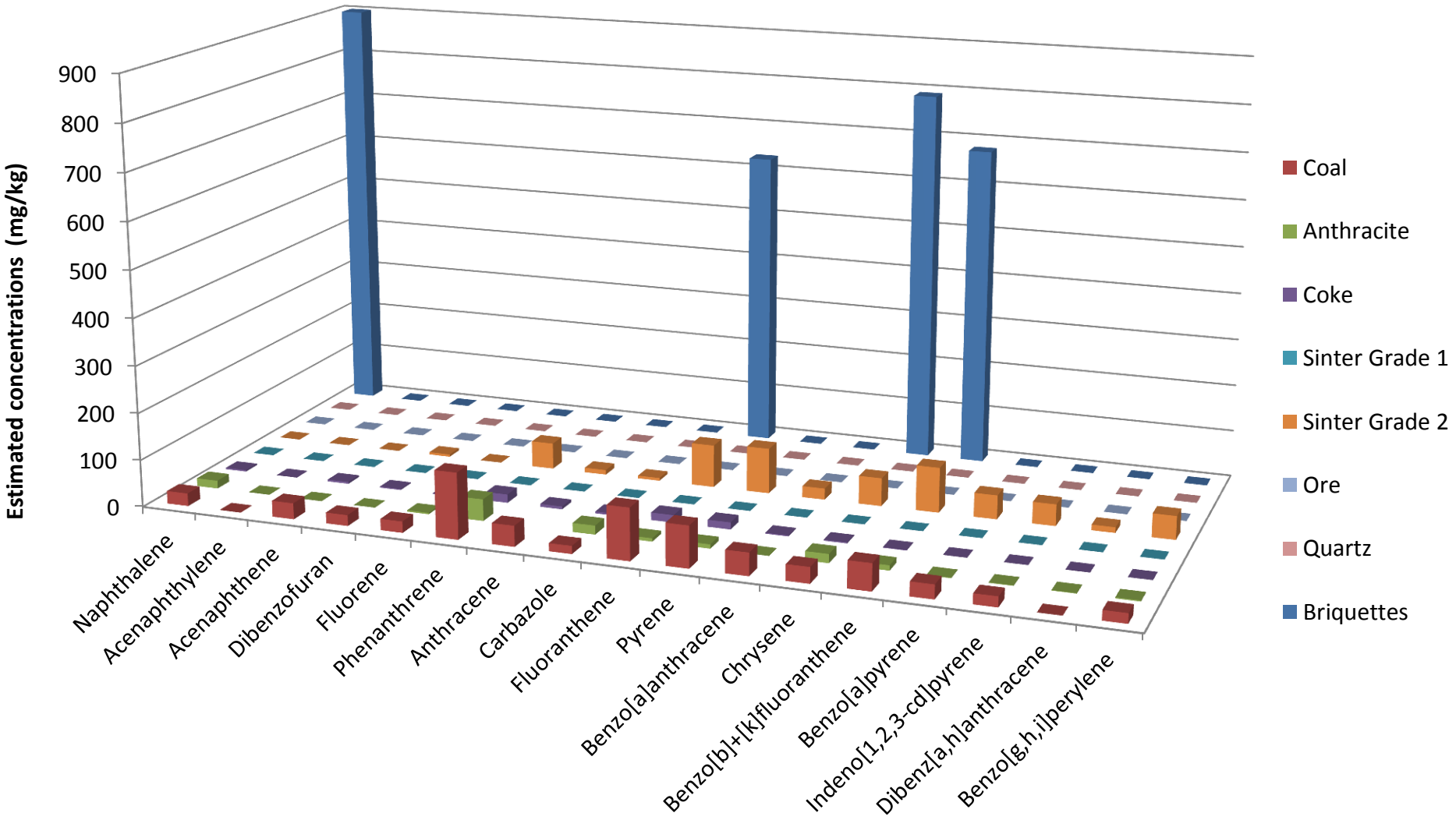
INPUTS: ELECTRODE PASTE

- Two types of electrode pastes were compared
- Both are coal tar based
- Similar composition and ratio
- Quantities used per process is approximately 20 kg

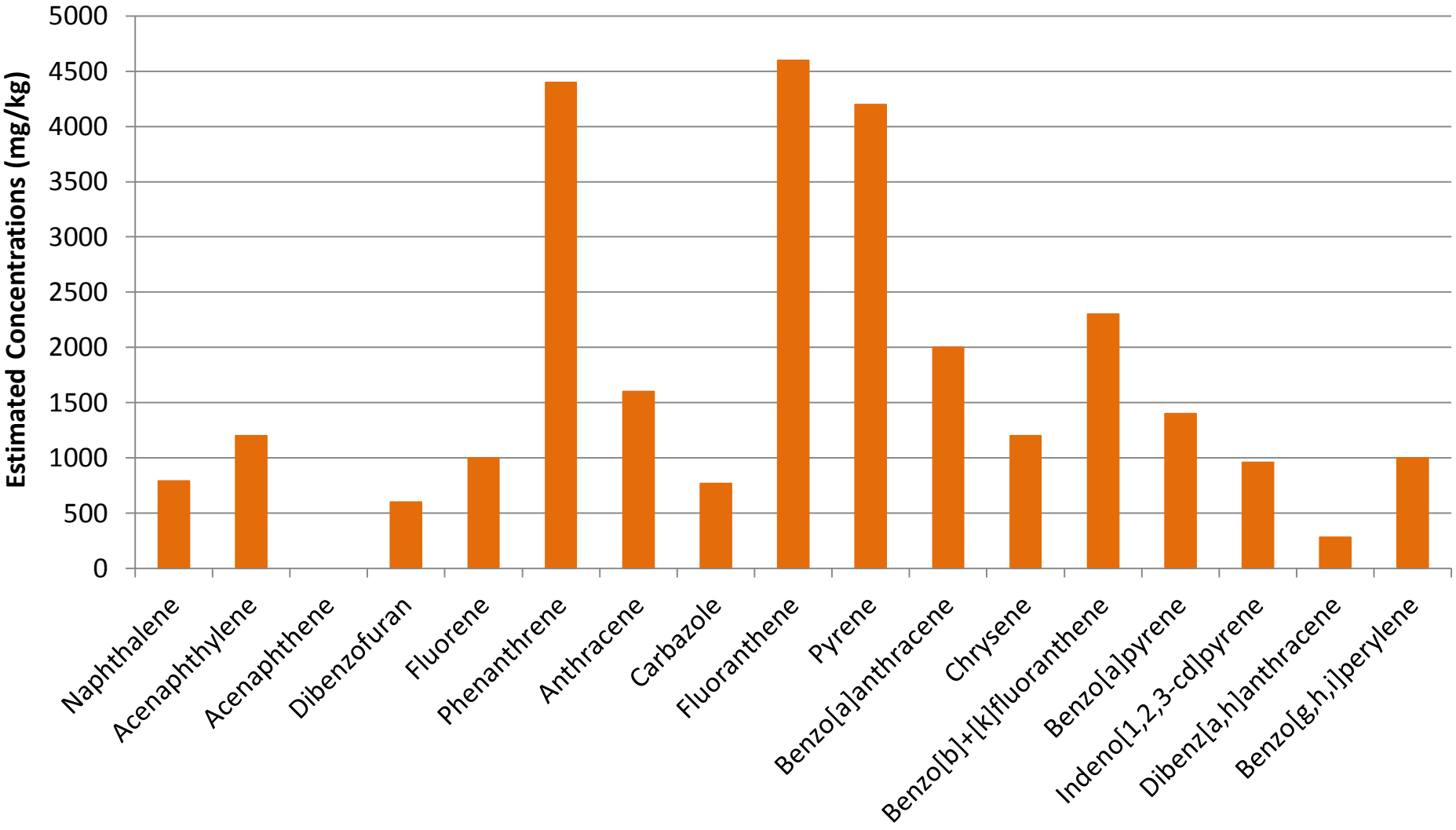
METHODOLOGY

- Bulk samples of all raw materials were submitted for analysis
- Semi-quantitative analysis for 17 priority PAHs
- Gas Chromatograpy Mass Spectroscopy (GC-MS)

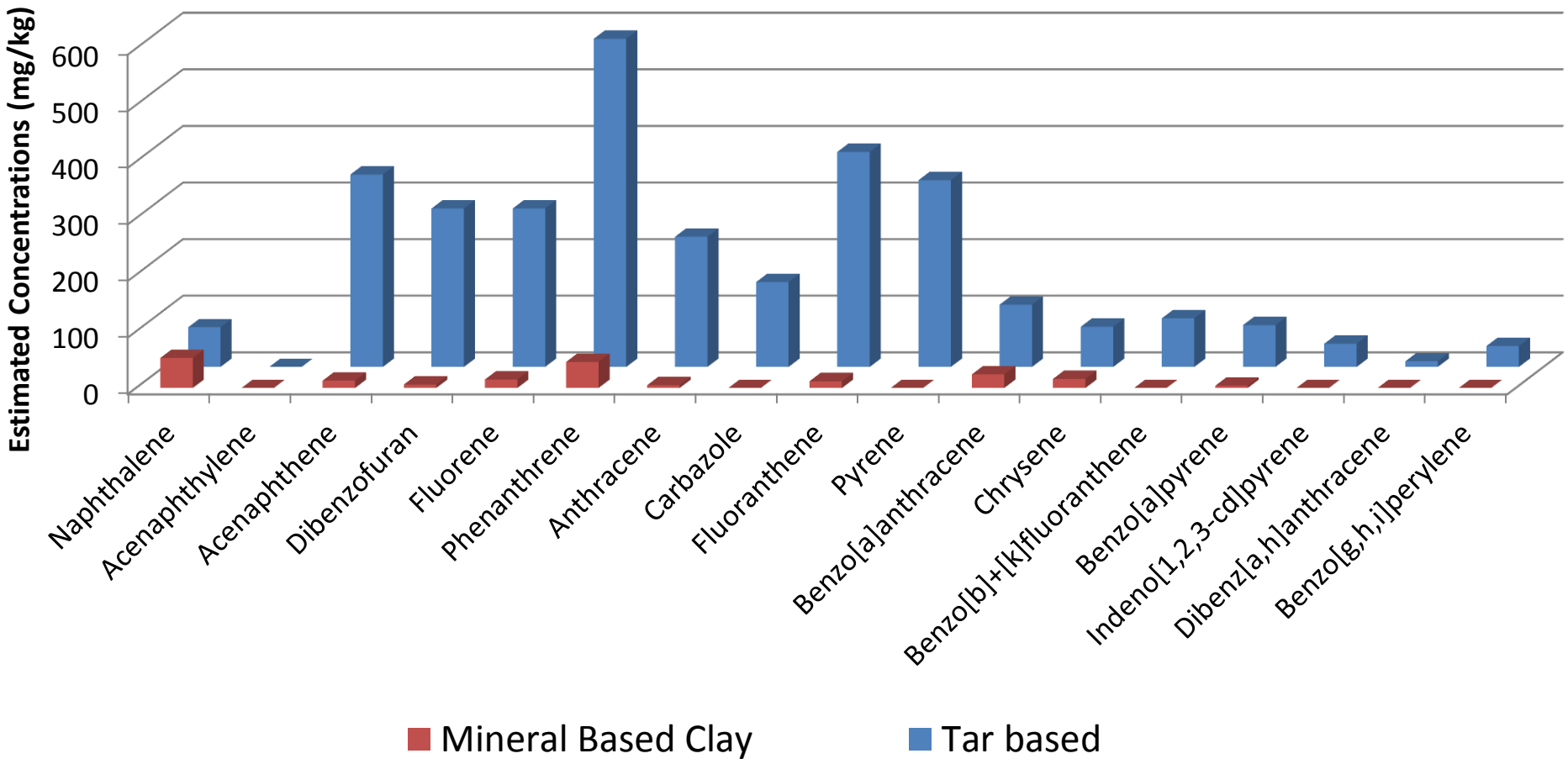
RESULTS: Raw materials



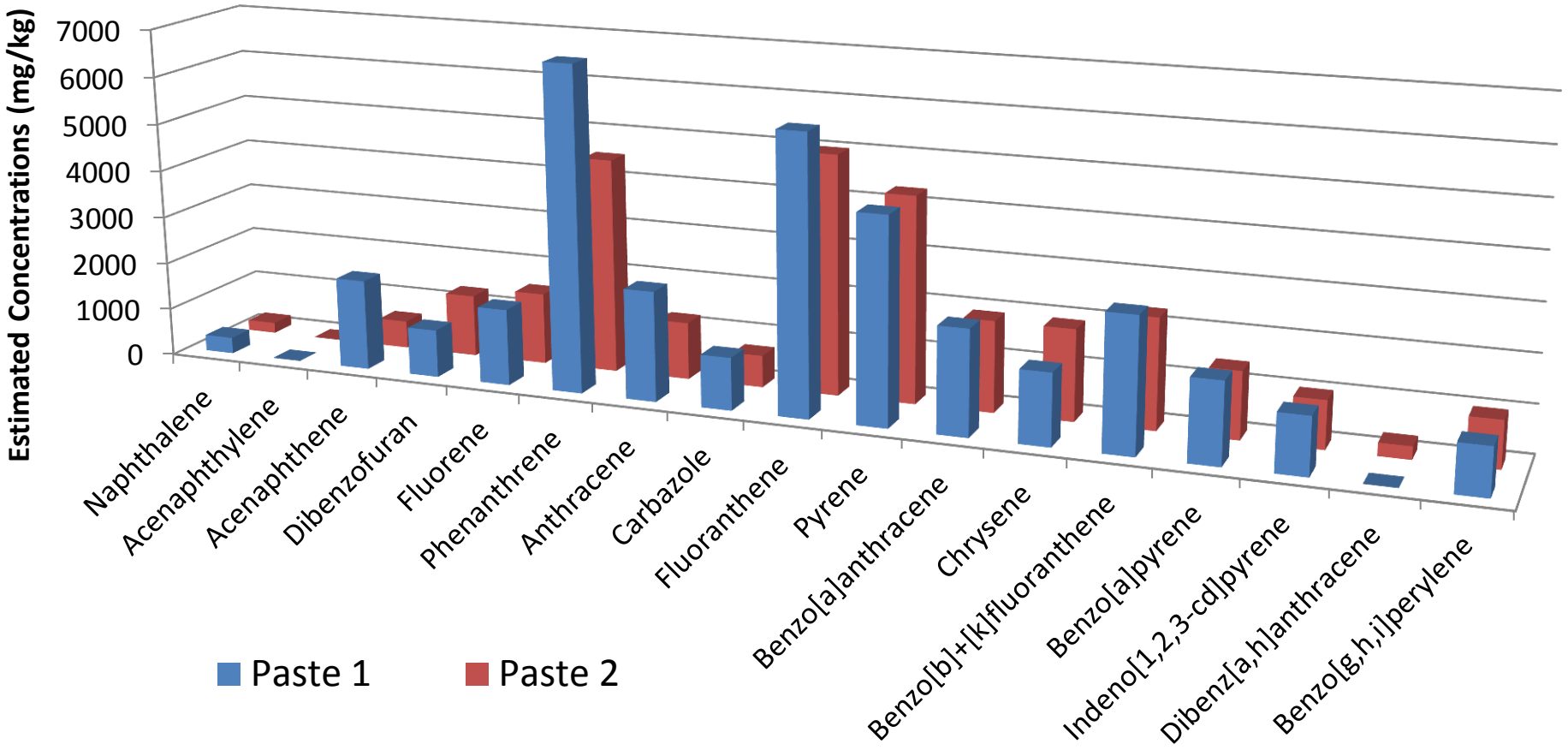
RESULTS: Sludge (molten mix)



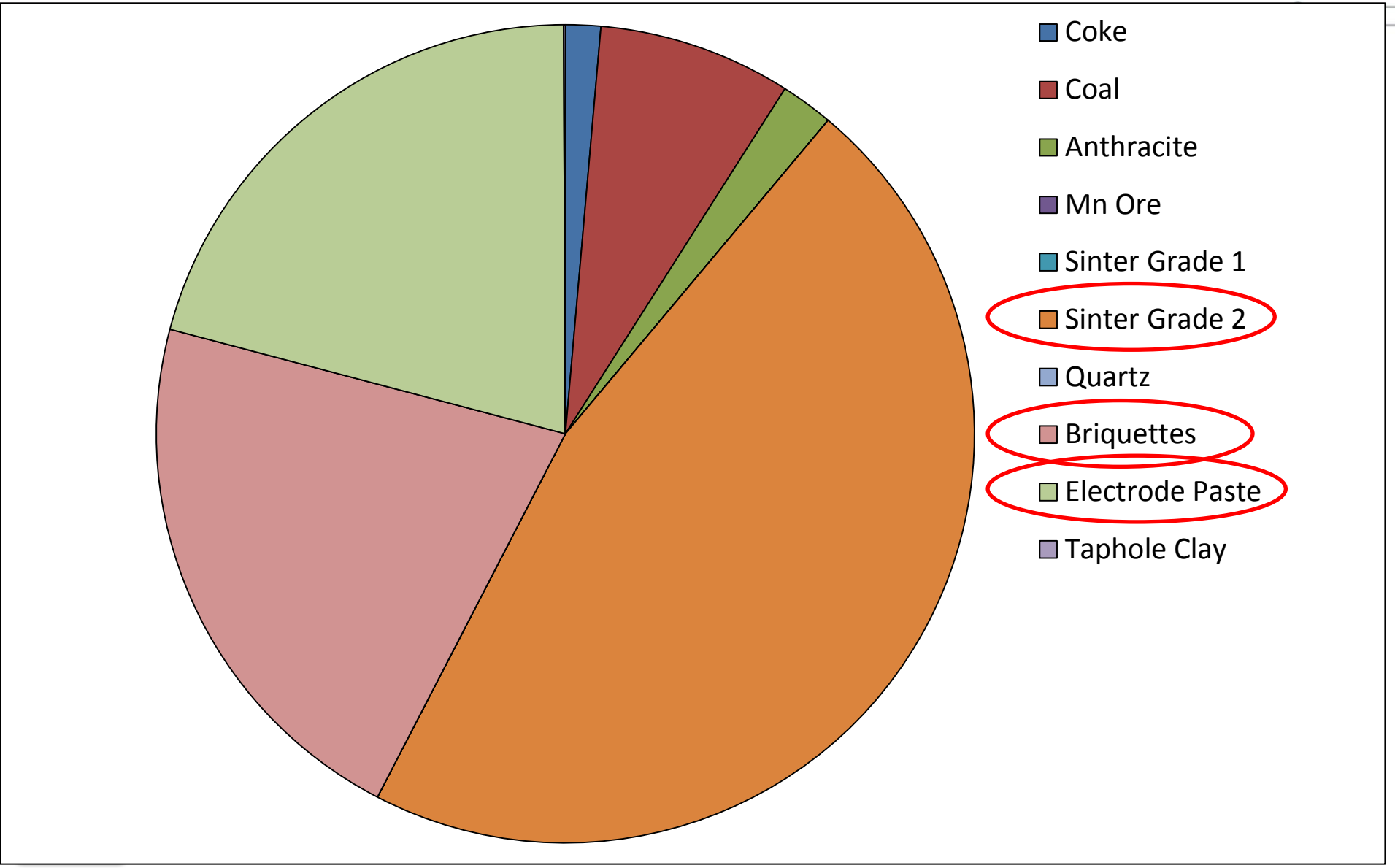
RESULTS: Taphole clays



RESULTS: Electrode paste



RESULTS: PAH contribution per ton



DISCUSSION

- Mineral taphole clay had lower CTPV concentrations than the tar based clay
- CTPV contribution from the taphole clay to the process was insignificant
- No significant differences in CTPV concentration of the electrode pastes
- CTPV contribution by the electrode pastes were significant given the small quantities used in the process
- CTPV contribution of the Sinter Grade 1 and the briquettes were significant

CONCLUSION

- Understand how the OEL is defined – informs risk assessment
- Characterisation of pollutant is essential – informs sampling, measuring and analysis
- Correctly identify the source – informs control measures

ACKNOWLEDGEMENTS

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Questions

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