Remediation Technologies symposium 2007

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MOBILITY ASSESSMENT OF A PAHs CONTAMINATED SOIL BY COLUMN TESTS

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- *INTRODUCTION*
- *AIM*
- *MATERIALS AND METHODOLOGY*
- *RESULTS*
- *CONCLUSIONS*

INTRODUCTION

- **Numerous organic pollutants are persistent in contaminated sites.**
- **Among them polycyclic aromatic hydrocarbons (PAHs), originate from many pyrolysis processes, are widespread environmental pollutants.**
- **Due to their persistence, the remediation of these sites is an important environmental issue.**

The high hydrophobicity of these compounds resulting in strong sorption to soil organic matter, reducing its availability for microorganisms and hence limiting biodegradation rate

Normally is assumed that the slow biodegradation of such compounds in soils is caused by the extremely slow desorption or dissolution rates of these hydrophobic organic contaminants.

AIM

- To evaluate the mobility of PAHs by comparative induced desorption, using a resin (Amberlite XAD-2) and free desorption by a column leaching method

- To quantify the desorbable PAHs and possibilities to increased desorption and bio-availability using a non ionic surfactant, Ivey-sol ® 106.

MATERIALS

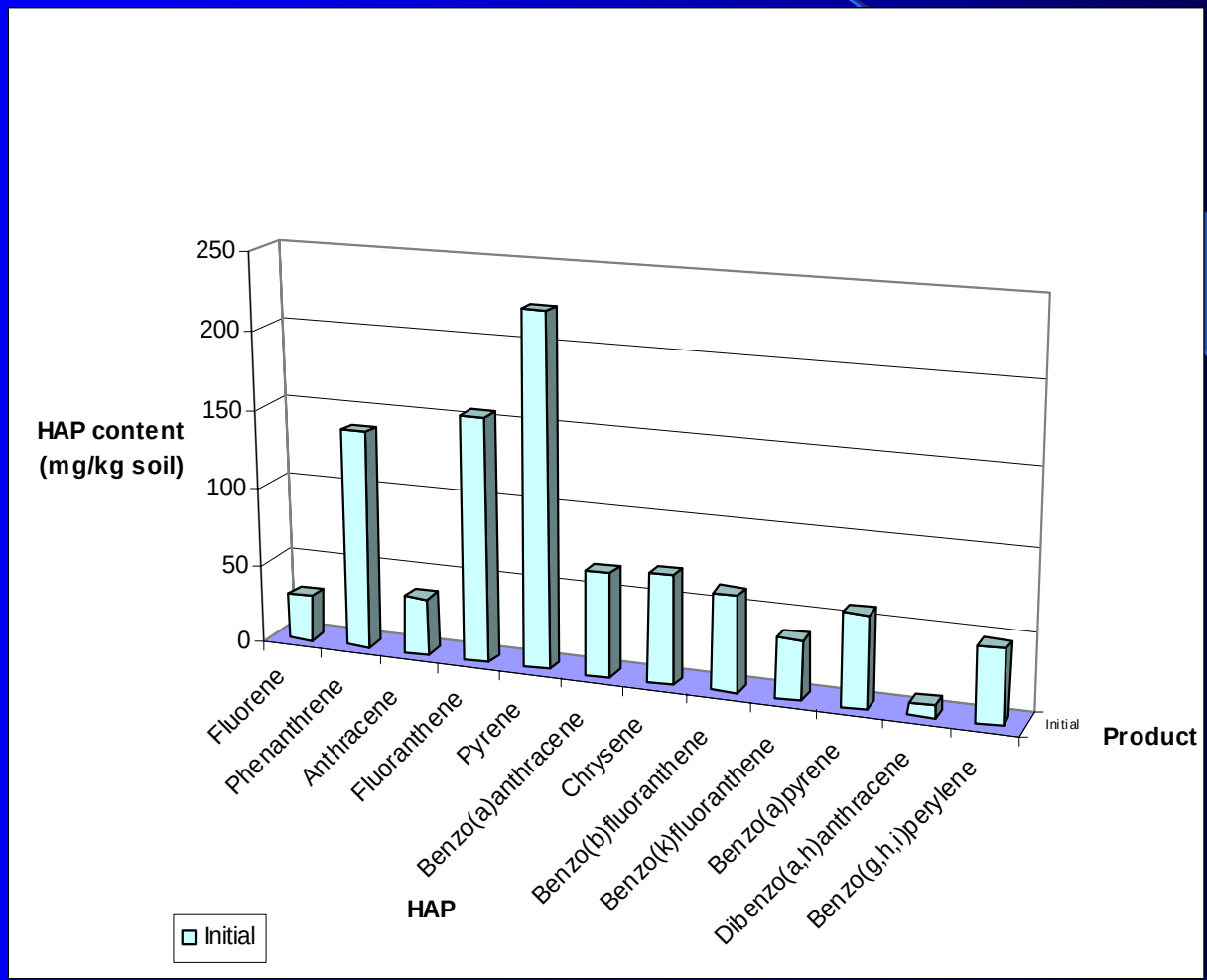
Contaminated soil came from an old gaswork

PARAMETER		GC-01
Humidity	(%)	0.92
Water holding capacity	g H_2O 100 g^{-1}	23.06
pH H_2O		8.3
Conductivity	µS cm^{-1}	390
Carbon	Total C (%)	19.1
	Black C (%)	7.7
	Total Organic C (%)	5.7
	Total Inorganic C (%)	5.7
Nitrogen	(%)	0.35
Phosphorus	mg/Kg	210

Soil sample < 4 mm

MATERIALS

PAHs distribution



Soil sample < 4 mm

MATERIALS

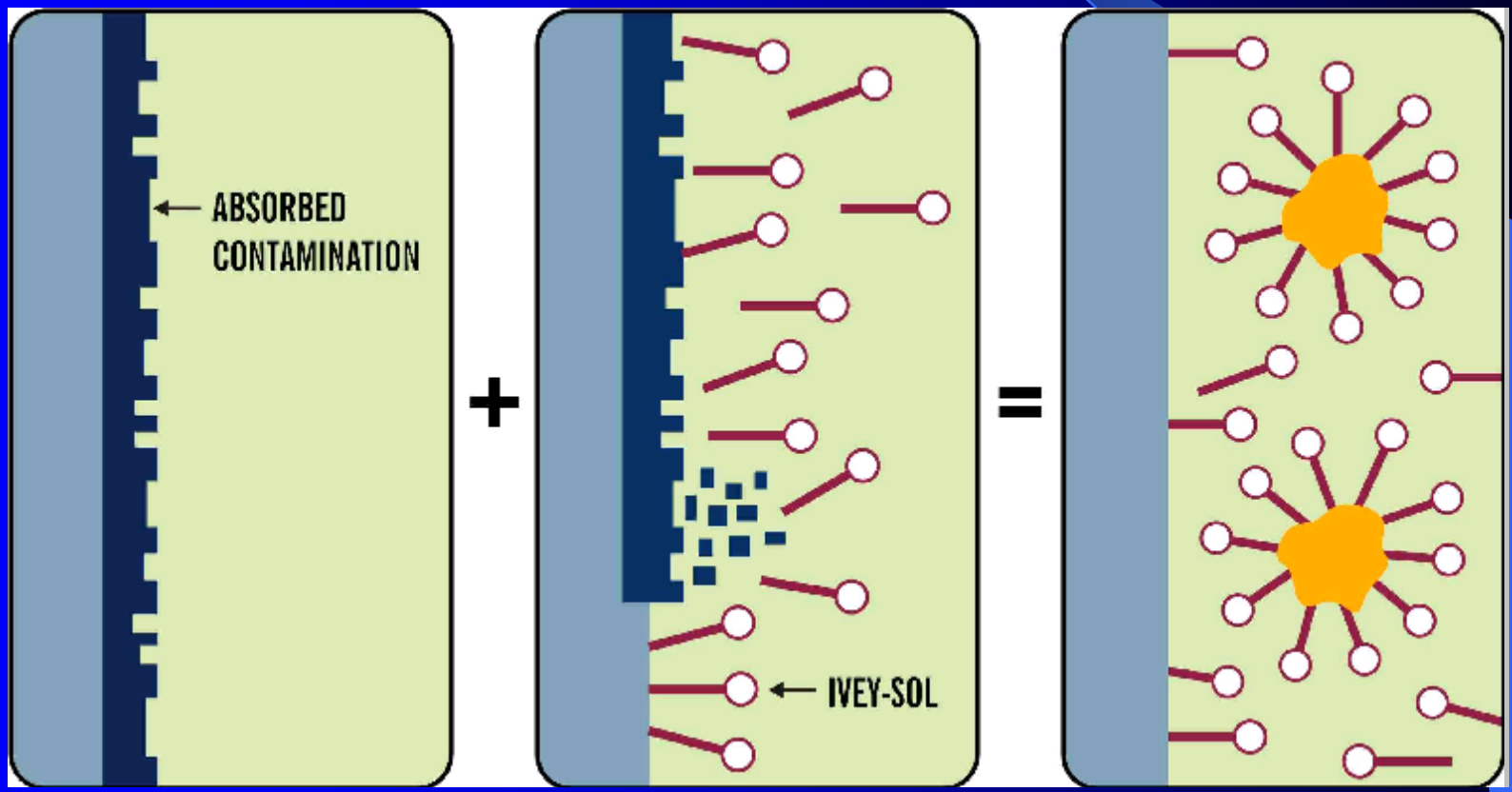
- Resin Amberlite XAD-2
  - Styrenedivinylbenzene
  - strong affinity to aromatic compounds
- Non ionic surfactant Ivey-sol ® 106.

The adding of resin is to provide an infinite sorption sink to maintain near-zero aqueous-phase PAH compound concentrations in order to maximize the rate of PAH compound mass transfer out of soil particles

The use of the surfactant Ivey-sol 106 is to increase the desorption of the contaminants making them more bio-available

MATERIALS

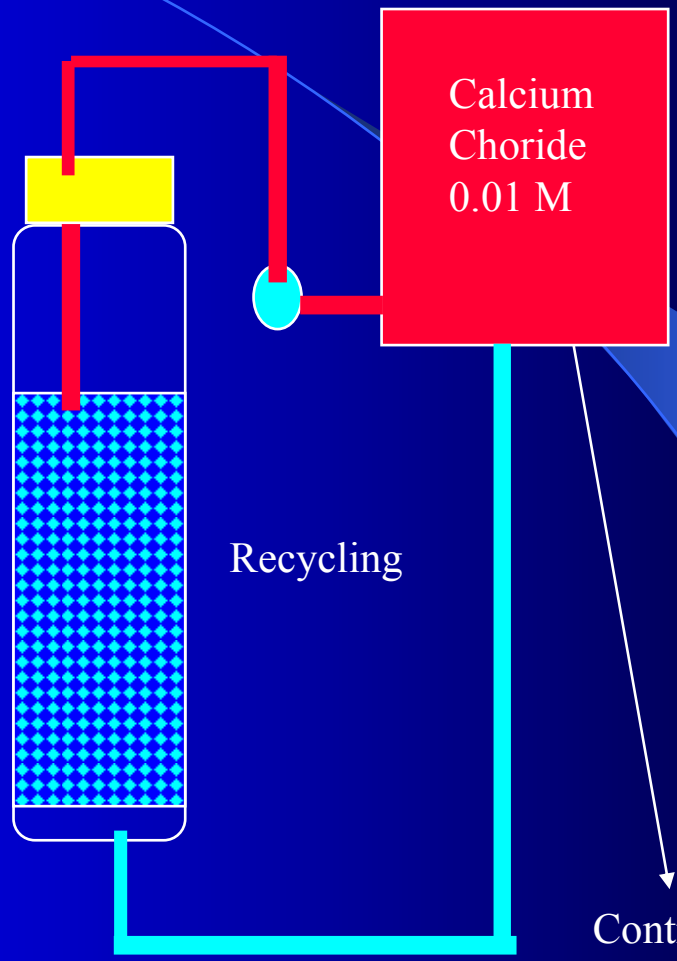
How Ivey-sol works?



METHODOLOGY

Free desorption

Material of column	Glass
Diameter of column (mm)	75
Filling heights (cm)	35
Tubing materials	Viton
Flow rate (ml/min)	0.46
Test conditions	Room temperature
Leaching solution (mL)	500
Soil sample (g)	250
Duration of test (days)	15

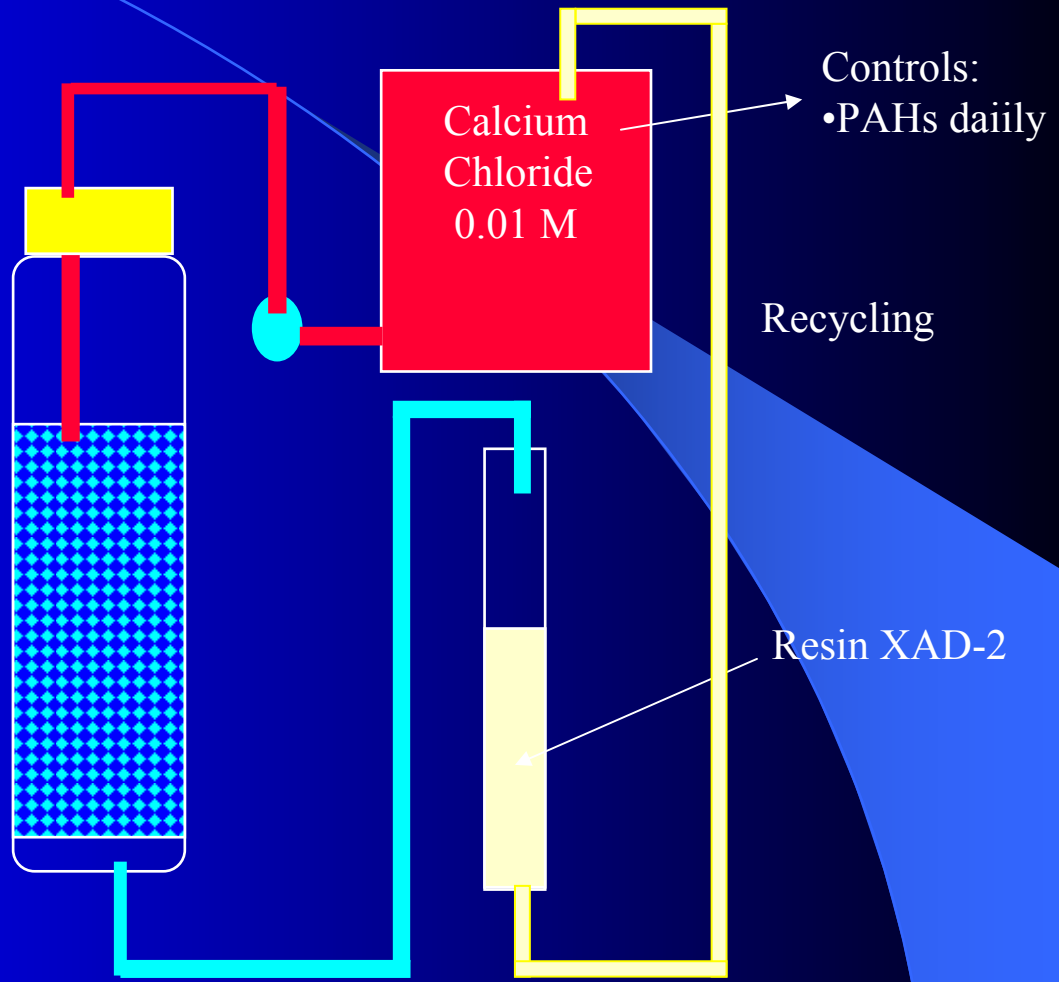


Controls:
- PAHs daily
- Daily reposition of solution

METHODOLOGY

Induced desorption

Material of column	Glass
Diameter of column (mm)	75
Filling heights (cm)	35
Diameter of resin column (mm)	25
Resin:soil ratio	1:2
Tubing materials	Viton
Flow rate (ml/min)	0.46
Test conditions	Room temperature
Leaching solution (mL)	500
Soil sample (g)	250
Duration of test (days)	15

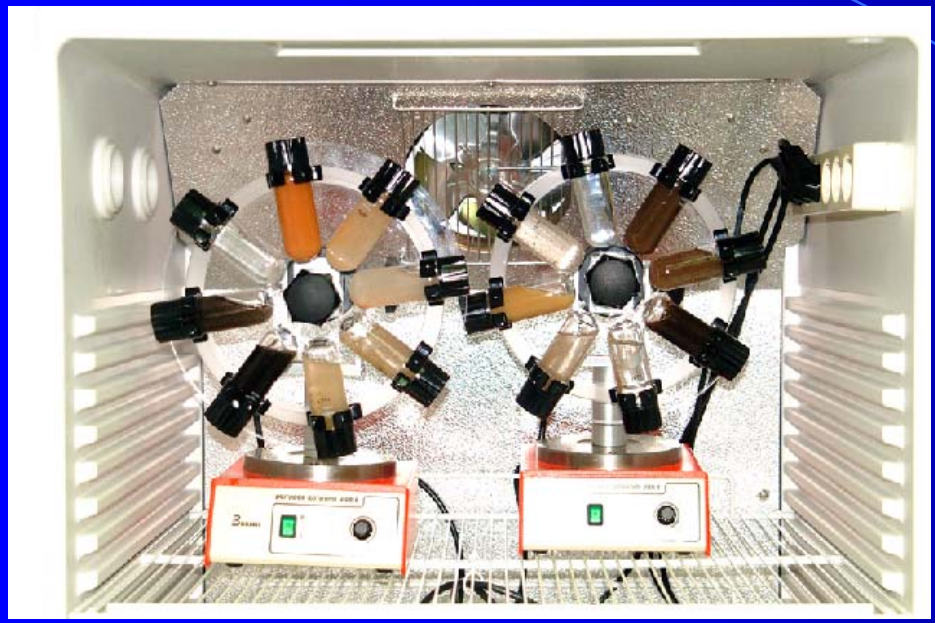


METHODOLOGY

Free desorption

Induced desorption

METHODOLOGY



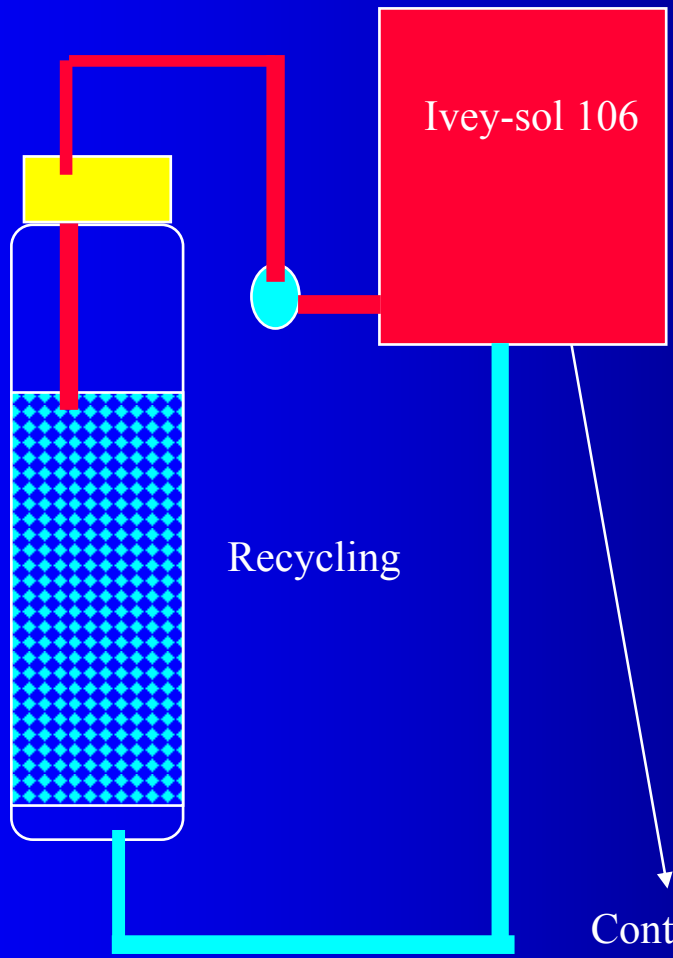
Surfactant aided desorption

- ✓Batch experiments at 25°C
- ✓Ivey-sol 106 solutions + contaminated soil for a contact time 4 days
- ✓Surfactant solution: 0.01 M $CaCl_2$ plus surfactant
- ✓Aqueous contact solution/ contaminated soil ratio = 20 (v/w)

✓PAHs quantification: HPLC/fluorescence

METHODOLOGY

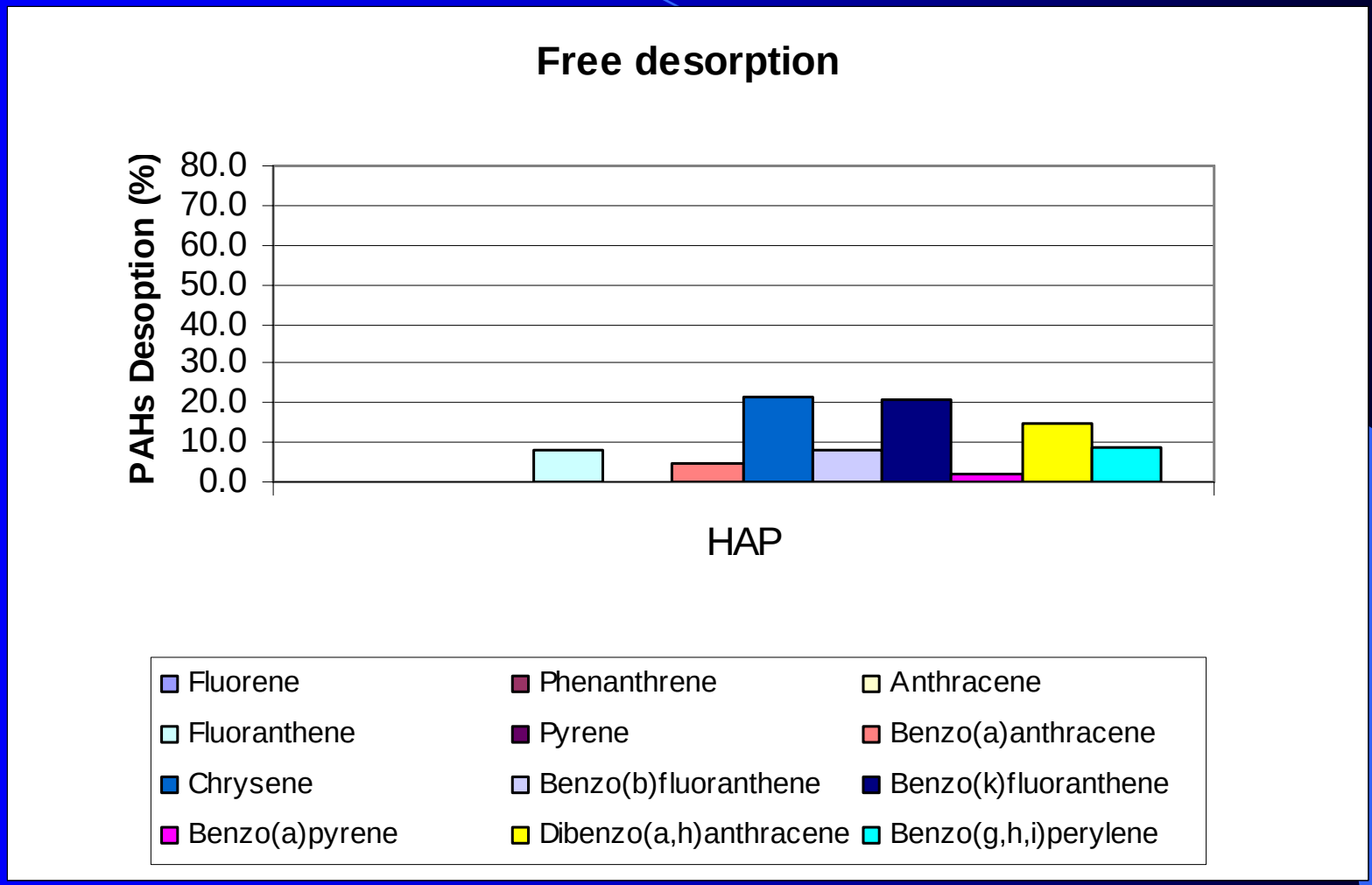
Surfactant aided desorption



Controls:

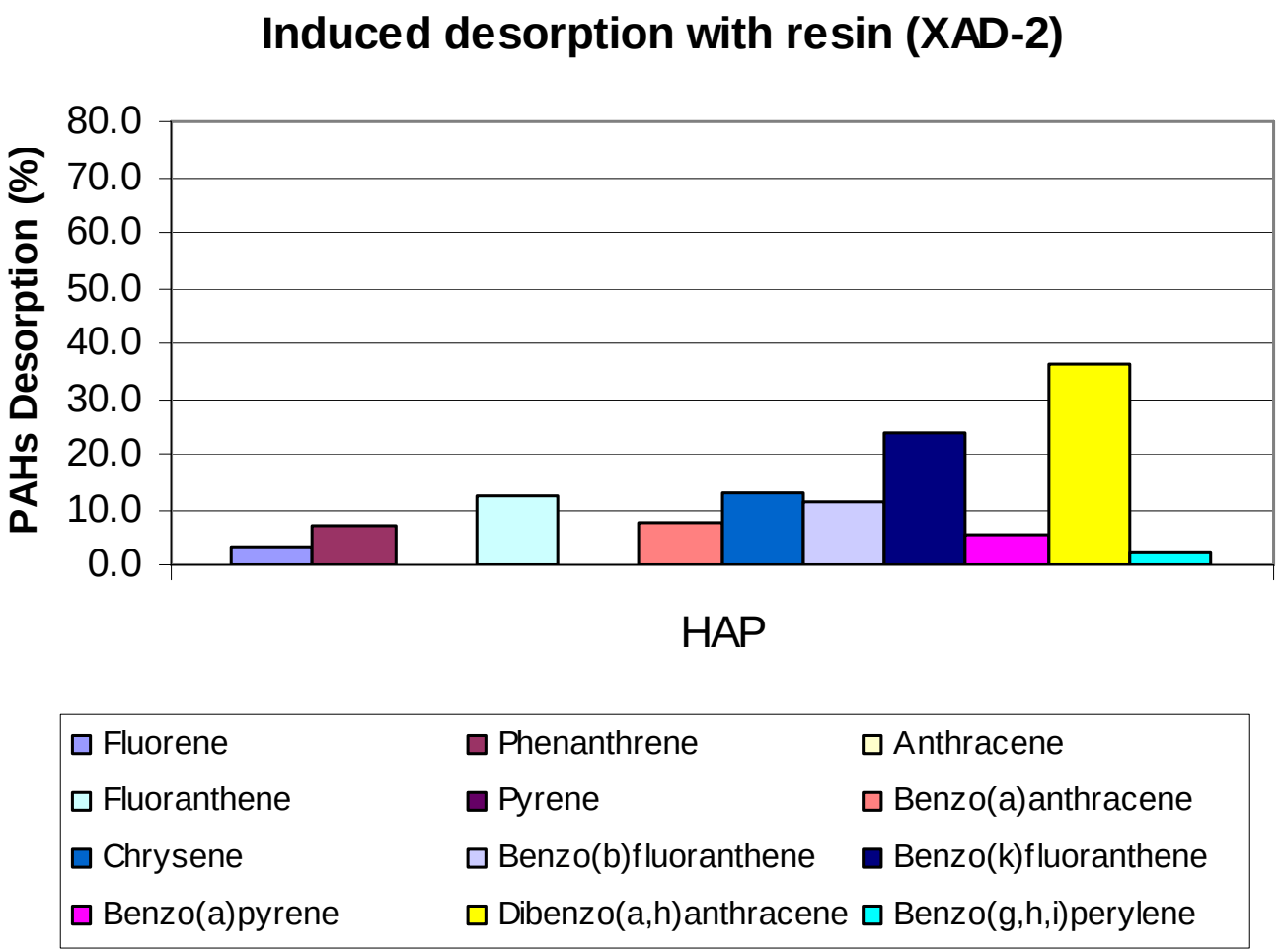
- 4 days of leaching step with Ivey-sol 106
- 4 days of washing step with $CaCl_2$ 0.01 M

RESULTS



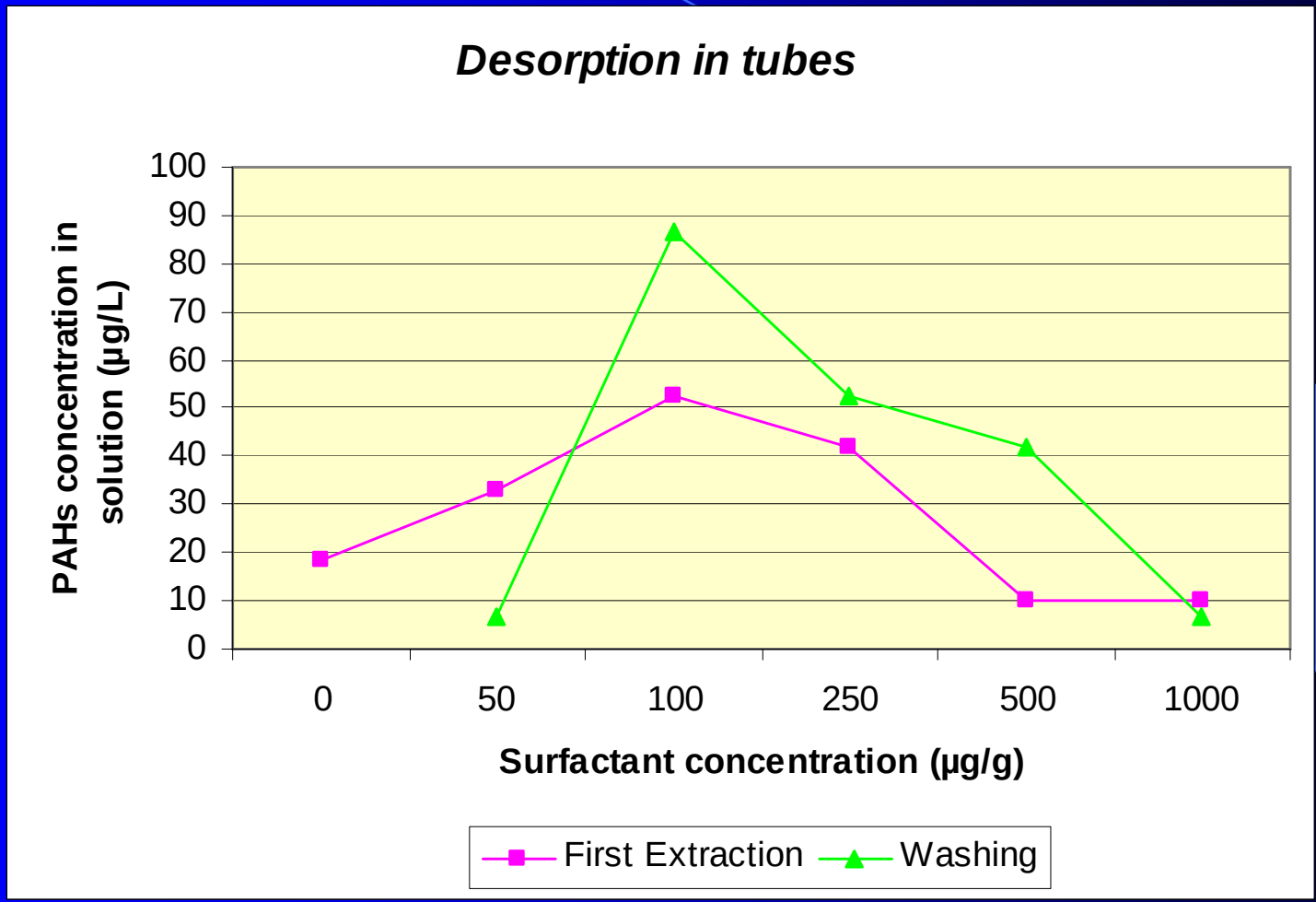
PAHs desorption in free desorption test

RESULTS



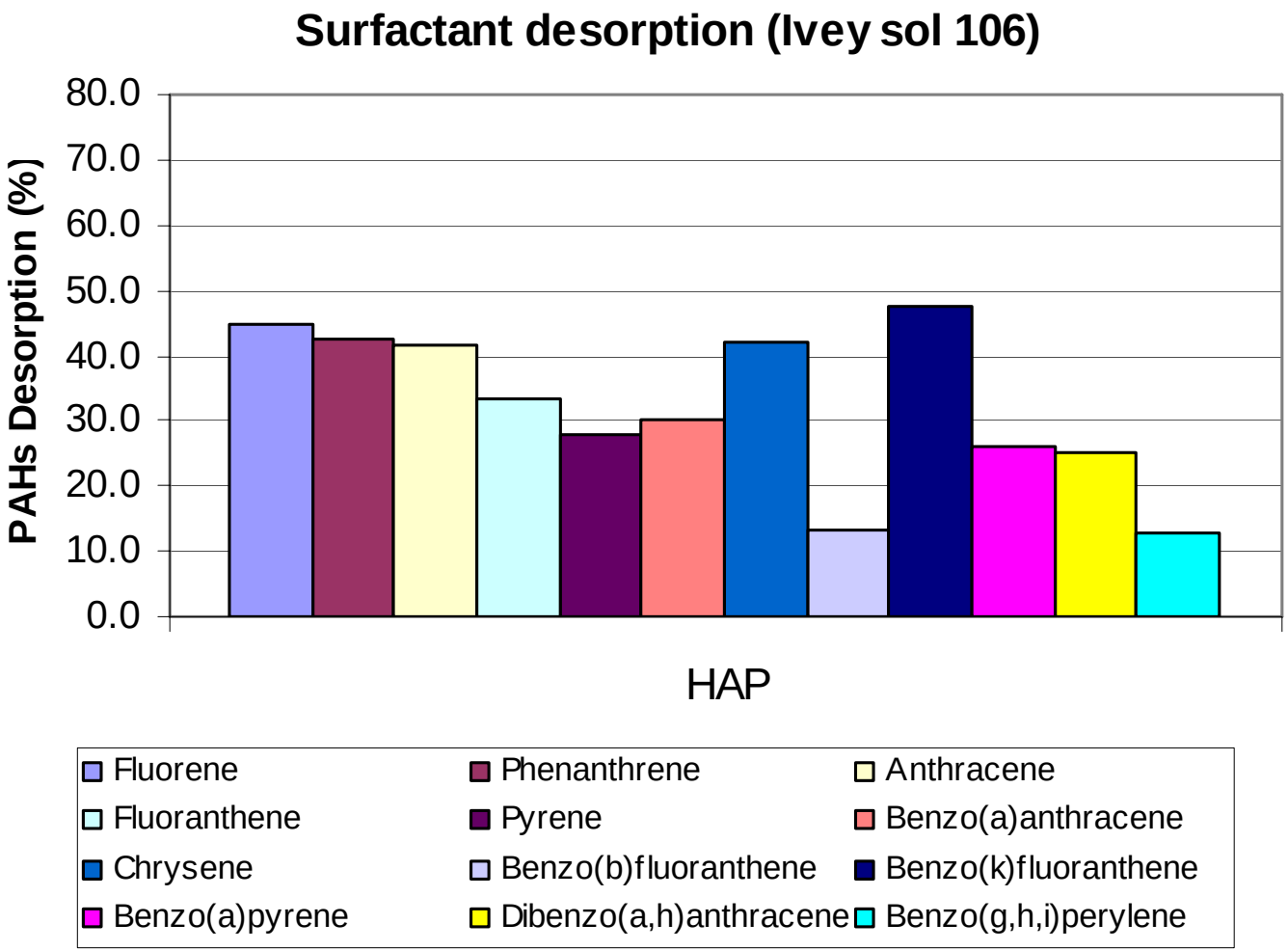
PAHs desorption in induced desorption test

RESULTS



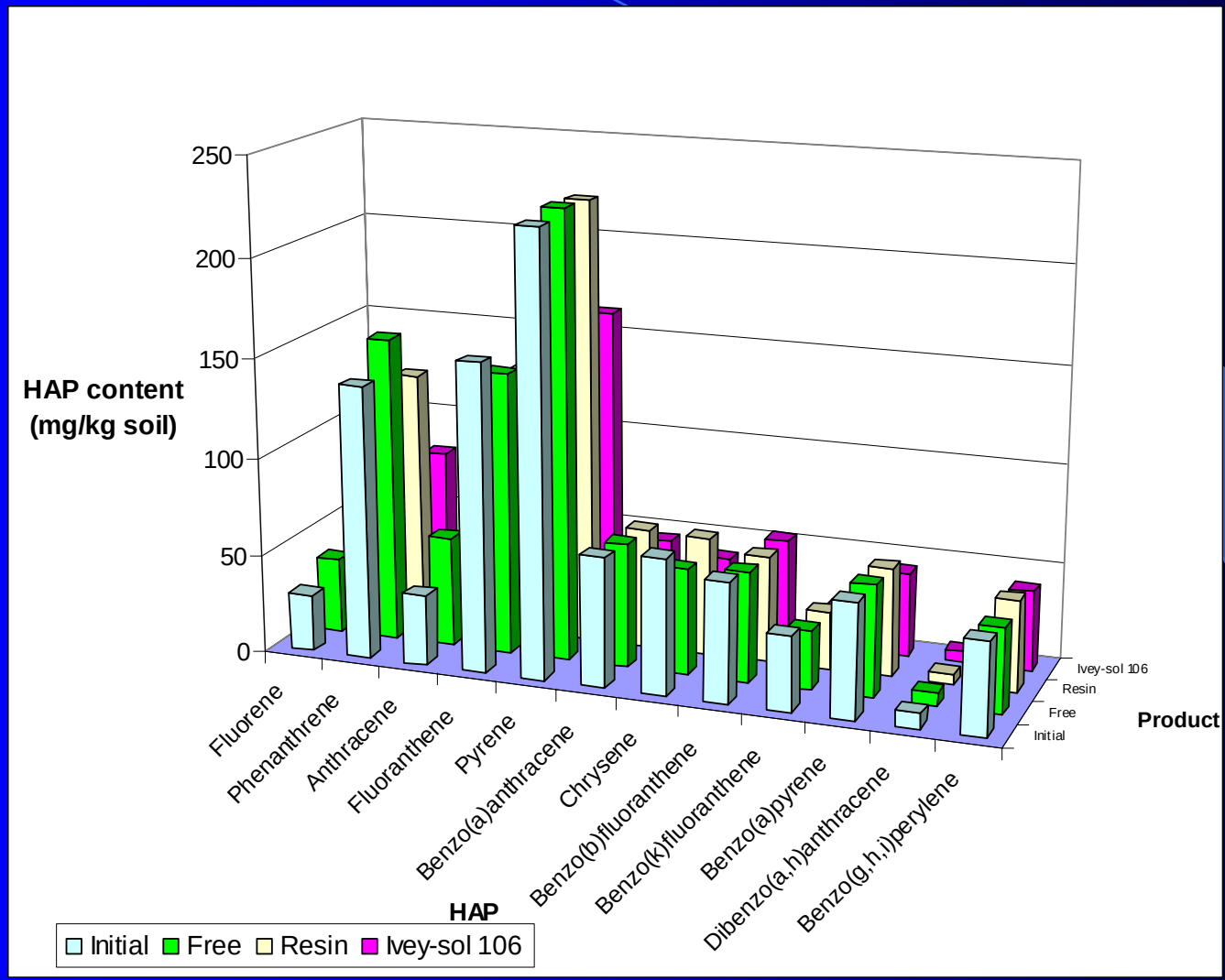
Optimisation of Ivey-sol 106 surfactant dose

RESULTS



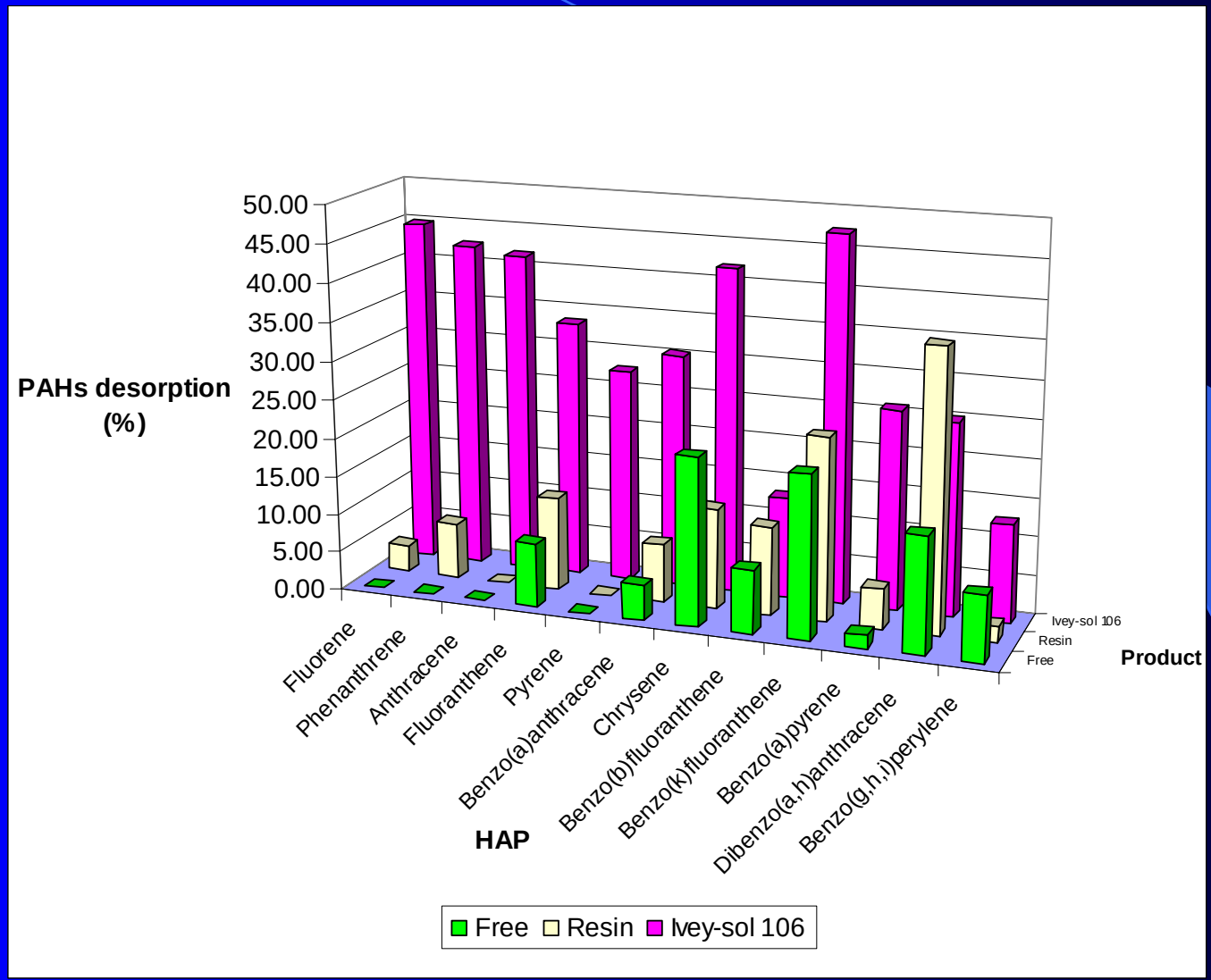
PAHs desorption in surfactant aided desorption test

RESULTS



Comparative results of analysis of PAHs (final solids) for desorption column tests

RESULTS



Comparative PAHs desorption (%) for all tests

RESULTS

Comparative t-PAHs for all desorption tests

Test	Initial Initial conc. (µg/g)	Free Final conc. (µg/g)	Resin Final conc. (µg/g)	Ivey-sol 106 Surfactant Final conc. (µg/g)	Free Desorption (%)	Resin Desorption (%)	Ivey-sol 106 Surfactant Desorption (%)
PAHs	931	928.8	869.1	632	0.24	6.65	32.12

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CONCLUSIONS

- Column leaching methods seem to be appropriate means to performance prognosis of mobility of organic pollutants.
- Tests also are adequate to select optima conditions to increased availability and consequently bio-availability, as showed in this study with the use of the non-ionic Ivey-sol 106 surfactant.
- This could predict promising bioavailability and consequently possibilities of bioremediation if optima conditions were established.

AKNOWLEDGEMENTS

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Thank you very much

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