

Self Absorption

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Introduction

- Self Absorption or Measurement correction factor
- UKAS definition P factor
 - P = ratio of surface activity to surface emission rate
 - $P=2$ for perfect source
- AWE Self Absorption factor (SAF)
 - SAF = ratio of alpha's emerging from source surface in defined geometry to alphas created within source within defined geometry (normally 2π)
- AWE transmission factor ($T_{f\alpha}$)
 - $T_{f\alpha}$ = ratio of alphas emitted from source surface with energy α MeV or above to total alphas created within forward 2π
- $SAF = 1/T_{f\alpha}$ eg a transmission factor of 0.5 equates to a SAF of 2

Measurement correction factor

Calibration takes into account:

Geometry

Sample detector separation

Isotope

Not Matrix matched so we need:

Measurement correction factor

Dust loading

Self-absorption

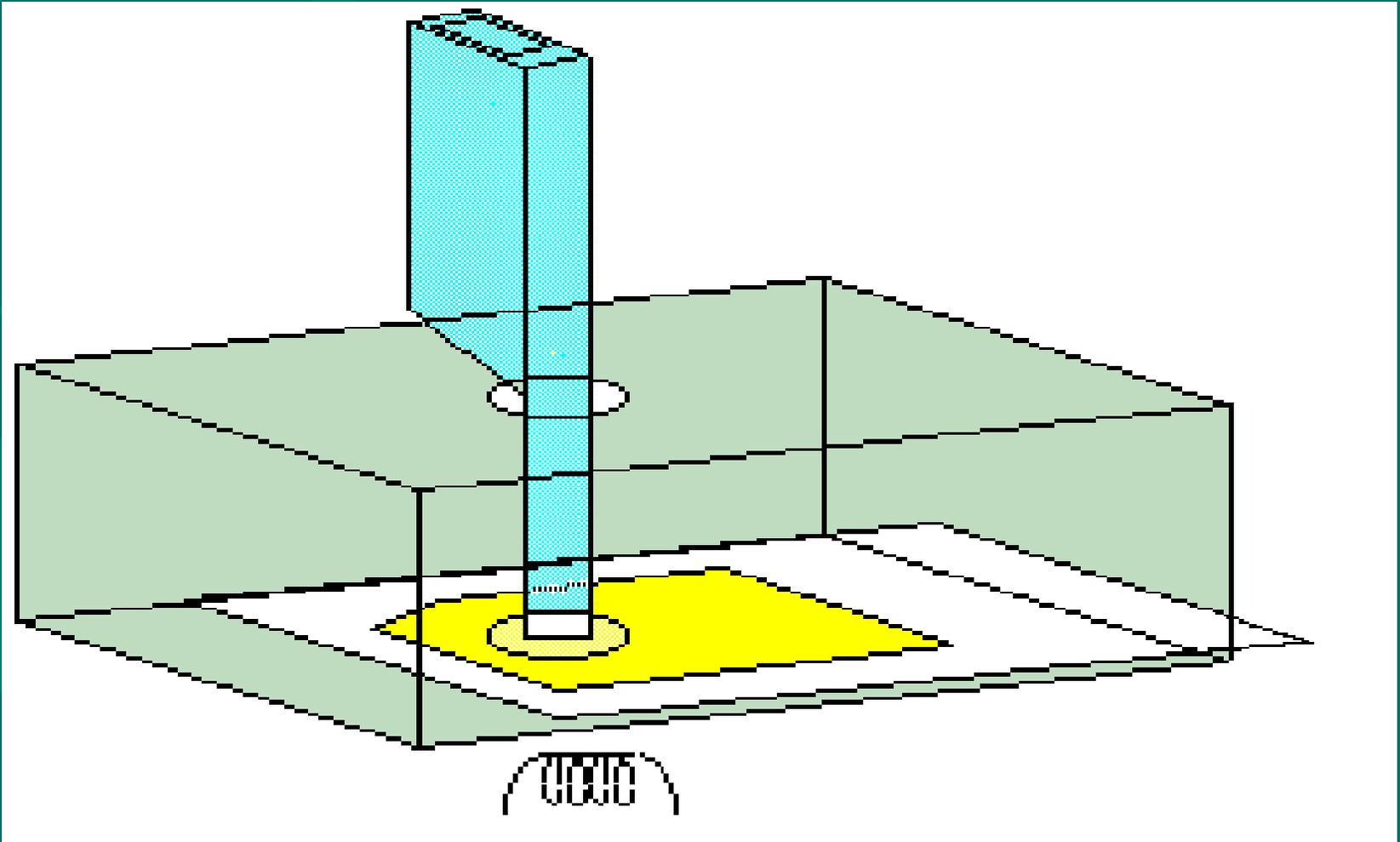
Energy threshold of measurement system

Energy loss in 'air gap'

Filter media attenuation

Methods of estimating dust burdens on filters

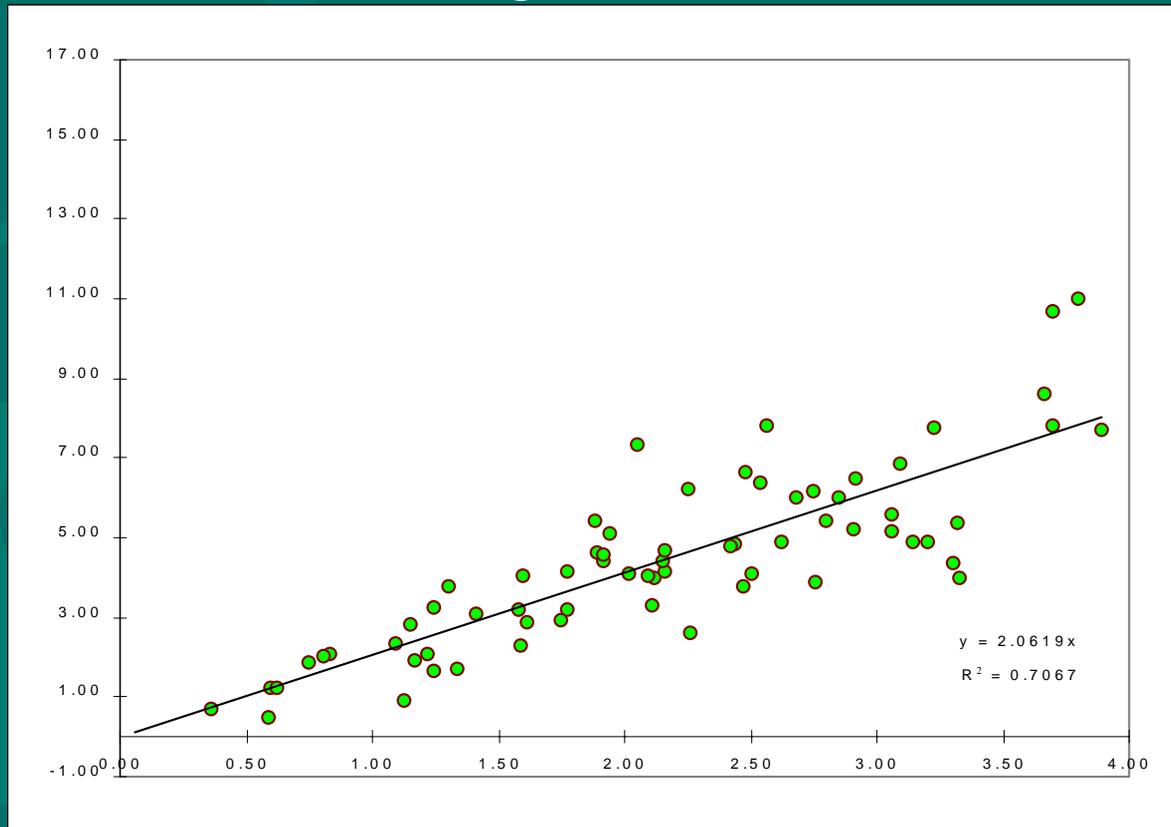
Schematic of a light box



Methods of estimating dust burdens on filters

Graph showing the linear relationship between dust depth and light absorbance.

Matrix
Depth
/microns



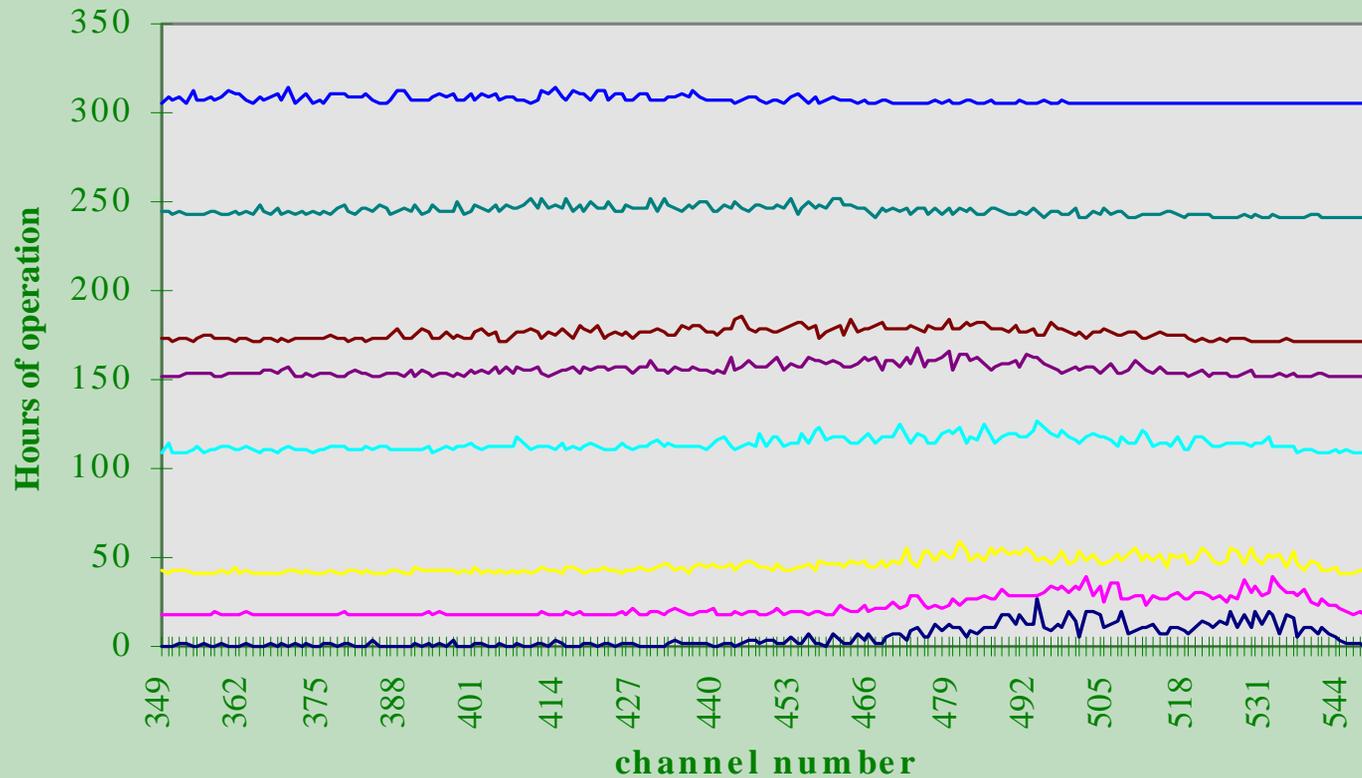
Light Absorbance

Spectral degradation arising as a result of dust build up

- A number of samples containing activity were placed back into air sample pumps, and further layers of dust were added .
- The results show how varying dust thickness' degrade the spectra
- The transmission rate was also estimated for energies above 3MeV (Assumed to be the threshold energy for a CAM)
- The results show that at up to 1.5mg/cm² the transmission rate does not fall below 50%.(i.e. corresponding to a SAF of 2)

Spectral degradation arising as a result of dust build up

Graph showing the gradual spectral degradation as dust is deposited over fine PuAm particulate.



Self Absorption Factors (P and SAF) applied to alpha measurements

Measurement type	SAF applied	P factor
Surface contamination survey	3	6
Personal air sample (plutonium)	1.3	2.6
Personal air sample (uranium)	2	4
Static air sample (< 24 hours plutonium)	1	2
Static air sample (> 24 hours plutonium)	2	4
Static air sample uranium	2	4
Stack air sampler	as per Static air samplers	
All beta measurements	1	2

Current SAF implications

- Alpha Self Absorption factors for airborne samplers due to dust loading are overestimated by up to 100%
- Uranium activity measured by Personal Air Sampling are overestimated, by up to 60%.
- Plutonium activity measured by Personal Air Sampling are overestimated by up to 20%
- Static Air Samplers in HEPA filtered facilities can be deployed for several weeks before alpha degradation becomes limiting
- Stack Discharges are overestimated by gross alpha counting.
- AWE has limits set for regulatory stack sample change frequency
- AWE has internal limits for Static Air Sampler filter change frequency

What's next?

- Measurement technique now available for assessment of alpha degradation without the need for active operational air sample filters.
- Alpha measurement correction factors for PAS and workspace samples to only be calculated for positive samples
- Extended deployment times for PAS - 1 week
- Extended deployment times for workspace samples - Two weeks or more.
 - Extension of deployment time limit will increase measurement sensitivity
 - and improve sample change logistics
 - Extension of time limit has significant measurement and cost benefits
- Stack Discharges - individual points to have measurement correction factor calculated for routine reporting