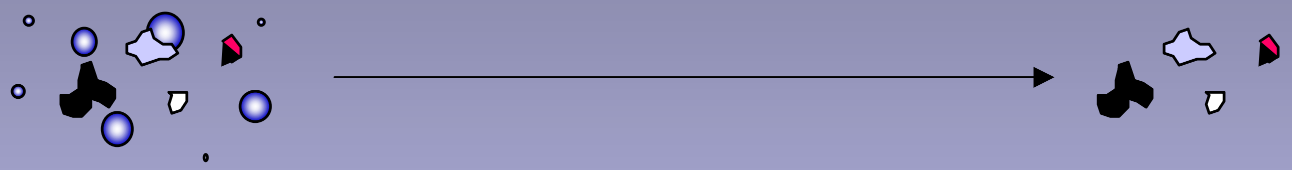
RESOLVER Presentation @ Energy Institute – 15th June 2009

Resolver

The Problem:

To separately determine particulate and water contaminants in fuel from light obscuration measurements.



Make water droplets smaller than detectable limit - 2 Options:

1. Solvate using a Cosolvent

2. “Micro-emulsify”

Cosolvent approach – Principle

Solubility of Water in fuel

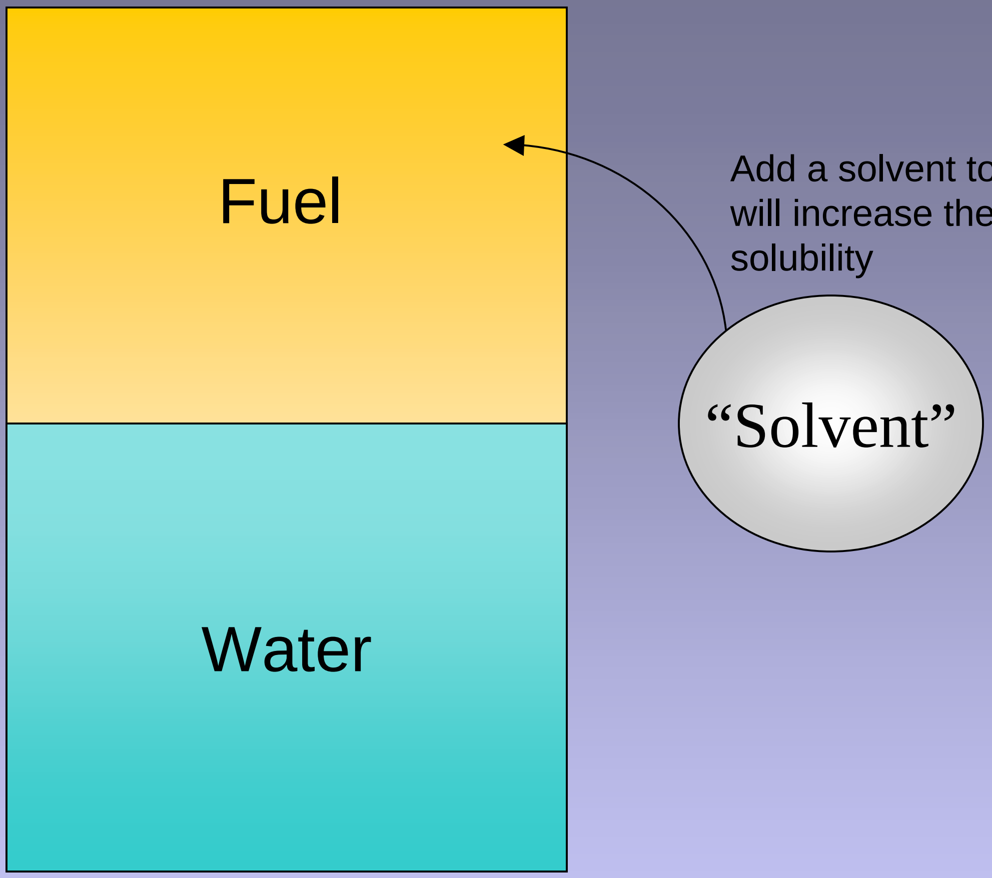
Water is soluble in hydrocarbon fuels (~40ppm at 20C) but the level of solubility is a function of:

•Fuel composition (aromatics have higher solubilities)

•RMM (lower RMM alkanes have almost no solubility)

•Relative humidity (Henry's Law applies)

•Temperature



Add a solvent to the fuel that will increase the water solubility

But:

To get more water into the fuel the solvent has to be more polar than the fuel, and, the more polar the solvent the less soluble it will be in the fuel – compromise!

Cosolvent approach – Choices:

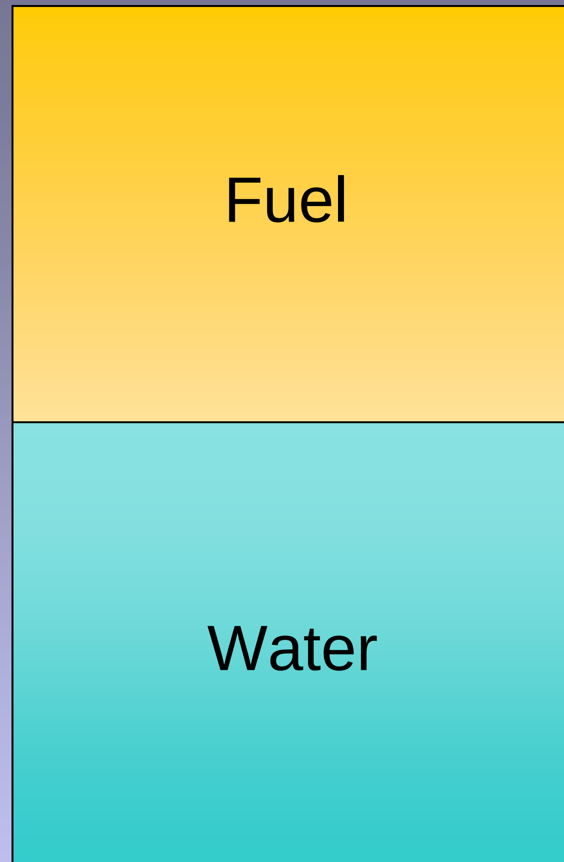
High RMM Alcohol

Mono-EGME

Higher glycols, e.g Di-EGME and Tri-EGME

Low RMM Ketone

Low RMM Alcohol



S. I. Sinegubova, K. K. Il’in and D. G. Cherkasov

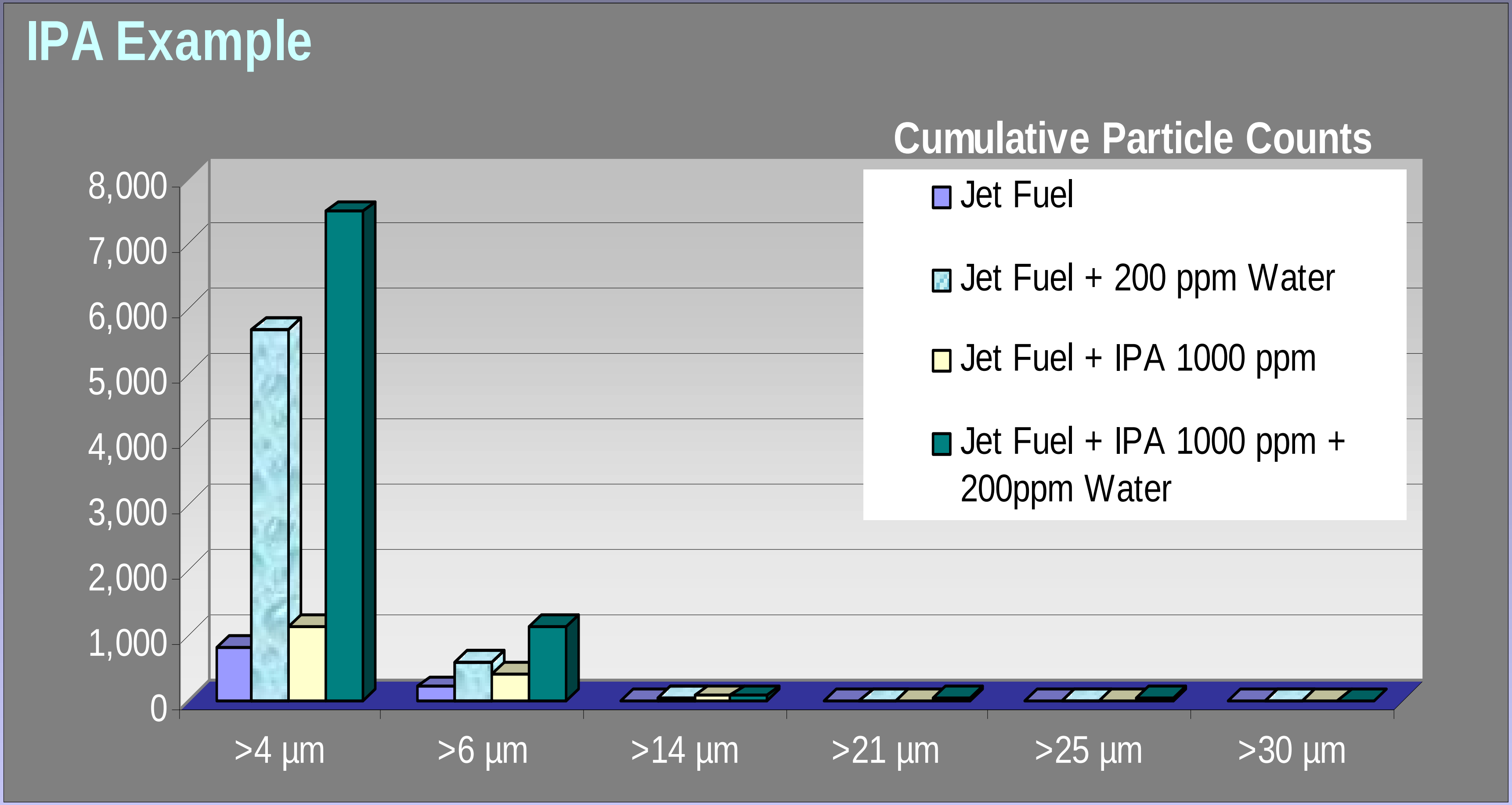
Mutual Solubility of Components and Critical Solution Points in the System Water-Isopropyl Alcohol-*n*-Dodecane in the Temperature Range 5–120°C
Russian Journal of Applied Chemistry
Volume 78, Number 3 / March, 2005
In this ternary system, the miscibility point is determined by relative concentrations and temperature.

Relative partitioning

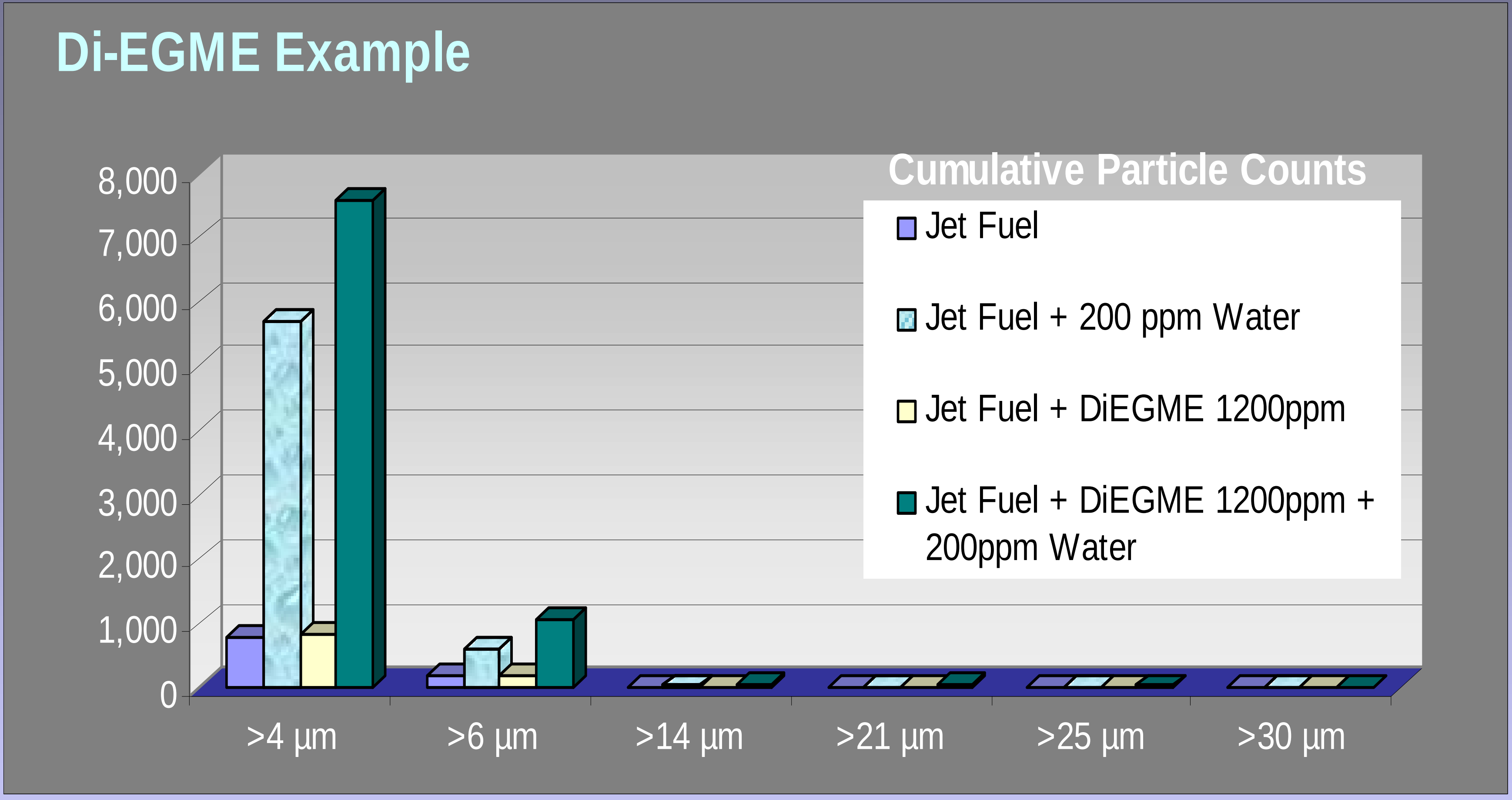
$$\log P_{\frac{oil}{water}} = \log\left(\frac{[cosolvent]_{oil}}{[cosolvent]_{water}}\right)$$

e.g. P (methanol) = -0.83 between water and octanol

Cosolvent approach – Results: **IPA**



Cosolvent approach – Results: **Di-EGME**



Di-EGME dissolves in the fuel but in the presence of free water, migrates to that phase resulting in increased counts (surfactancy issue?). Glycols have greater partitioning in the polar water phase than the apolar fuel phase.

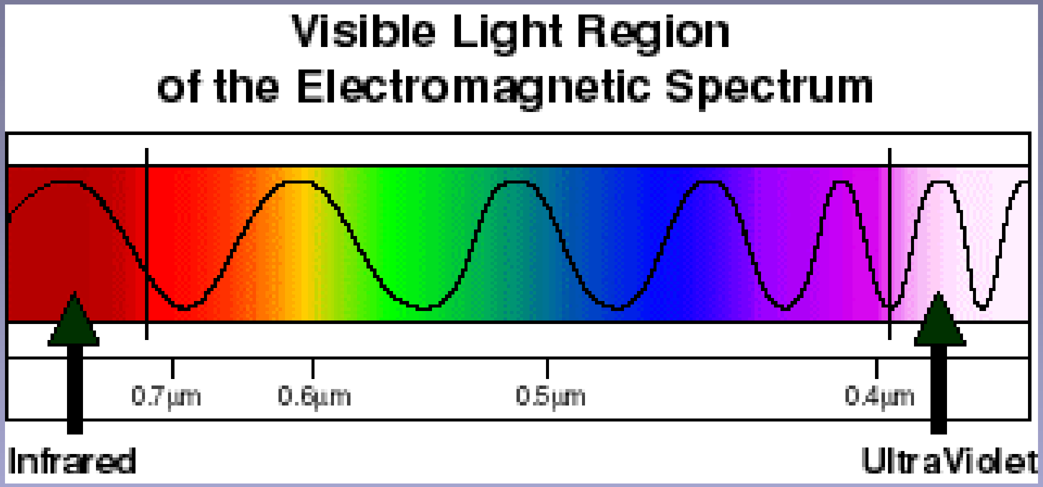
Cosolvent approach – Summary:

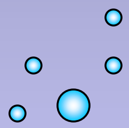
The cosolvent approach depends on partitioning coefficients remaining constant across range of applicable fuels.

The actual free water solubilising capacity will be finite for a given Temperature/Cosolvent/Fuel condition (will need to be determined).

An EI RR for 564 and 565 give mixed results in terms of statistical robustness for the use of IPA (the most promising cosolvent).

Micro-emulsification approach – Resolver Principle:





Water droplets and particles <<wavelength of light will appear isotropic

Water droplets and particles >>wavelength of light will obscure the light. Droplets within an order of magnitude of the wavelength of light will scatter it.

Microemulsions typically comprise structures that are <0.1µm

Resolver – Description:

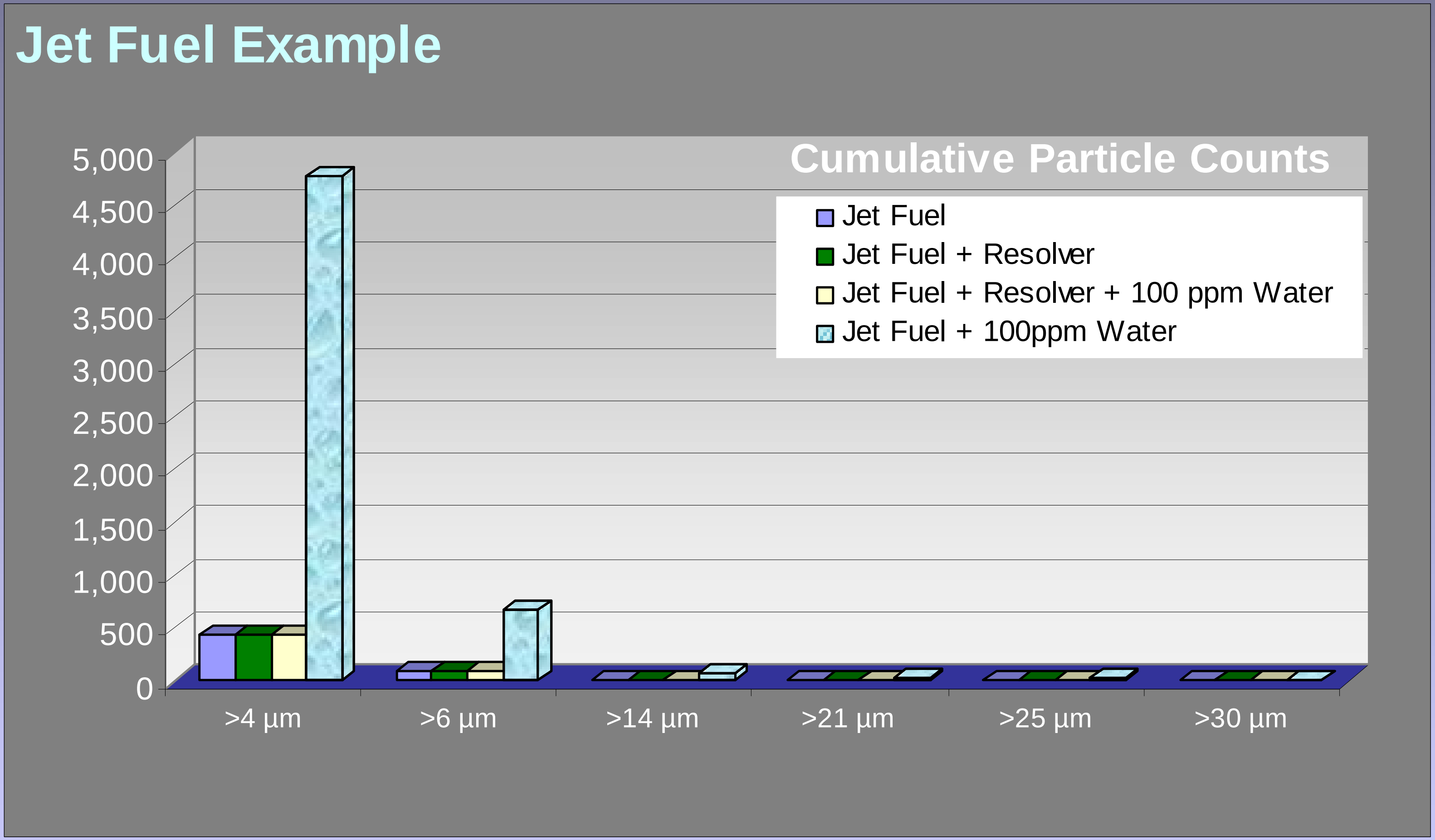
Optional video

Resolver is a unique formulation of non-hazardous chemicals that have a high affinity for free water.

Resolver will readily dissolve in a hydrocarbon liquid.

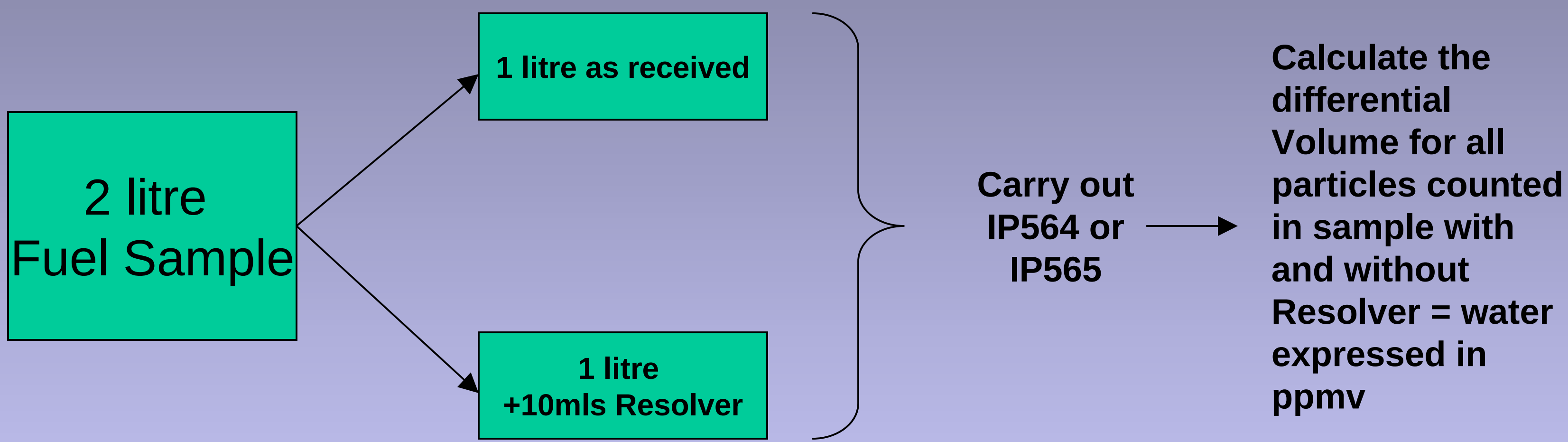
Resolver will effectively “solubilize” any free water that may be present by creating an isotropic system.

Resolver in use:



Water Calculator (will be available at www.particlesolutions.co.uk) :

For separate free water and particulate assay, carry out particle counting analysis on two samples, one of which has been treated with Resolver. The sample with Resolver will yield the particulate assay, the difference between the two analyses will yield the free water assay.



Counts for sample with Resolver is particulate only

Hyperlink to calculator here

In summary:

1. Resolver removes counts due to water.
2. For fuels without water, there is no (or minimal) affect on precision.