

Ash sensitivity study



- Work carried out in America
- Utilising a Detroit Diesel Series 60 engine
- Run for 200 hrs transient cycle (max power & max speed)
- CRT – Cordorite type

- Oil consumption monitored
- Weight of ash deposit calculated

- Candidates
 - 5W30 High Ash Top tier European
 - 15W40 Med Ash Market general American (CH-4)
 - 5W30 Low Ash Experimental low ash

DPF work - Formulations

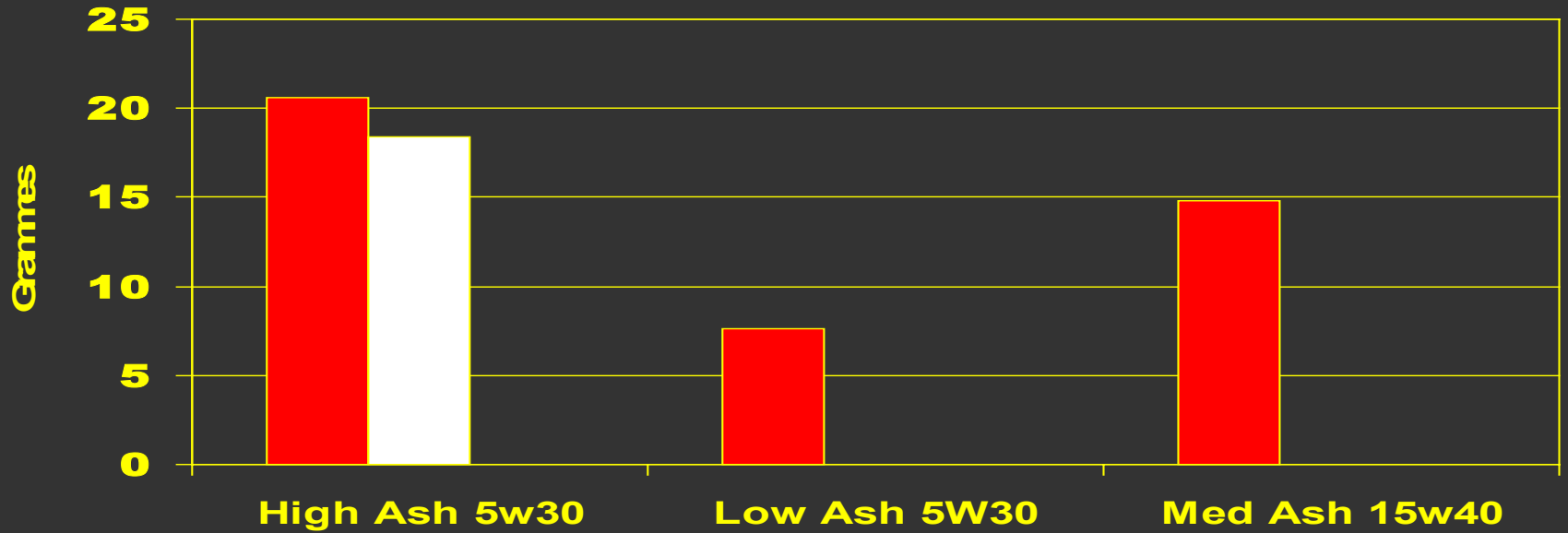


Lube number	1	2	3
Sulph. Ash	1.6	1.3	0.8
Phos	1260	1360	370
Sulphur	4010	5410	1290
Calcium	3200	3250	1770
Magnesium	370	11	350
Zinc	1380	1460	390

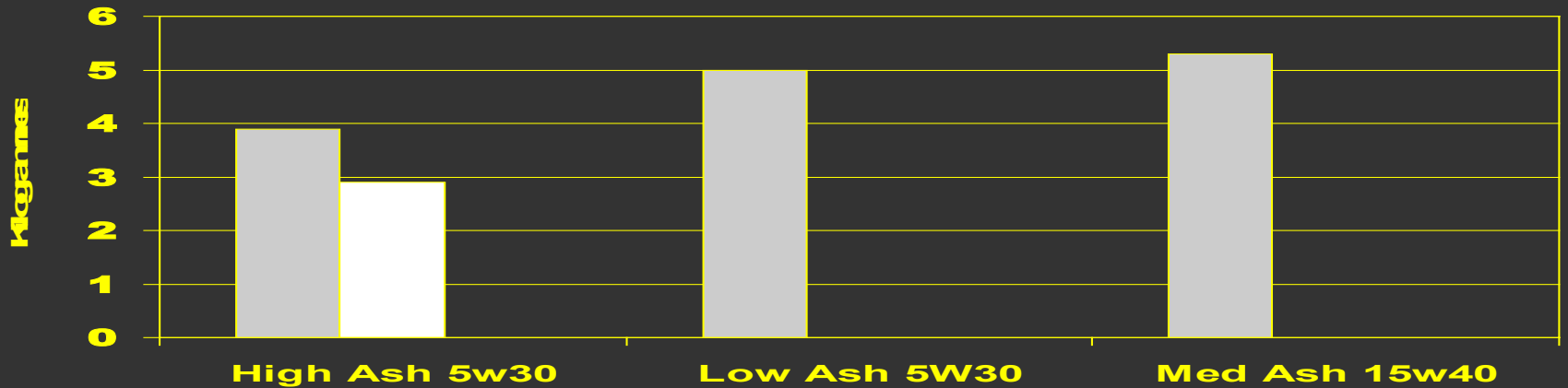
Ash Accumulation testing



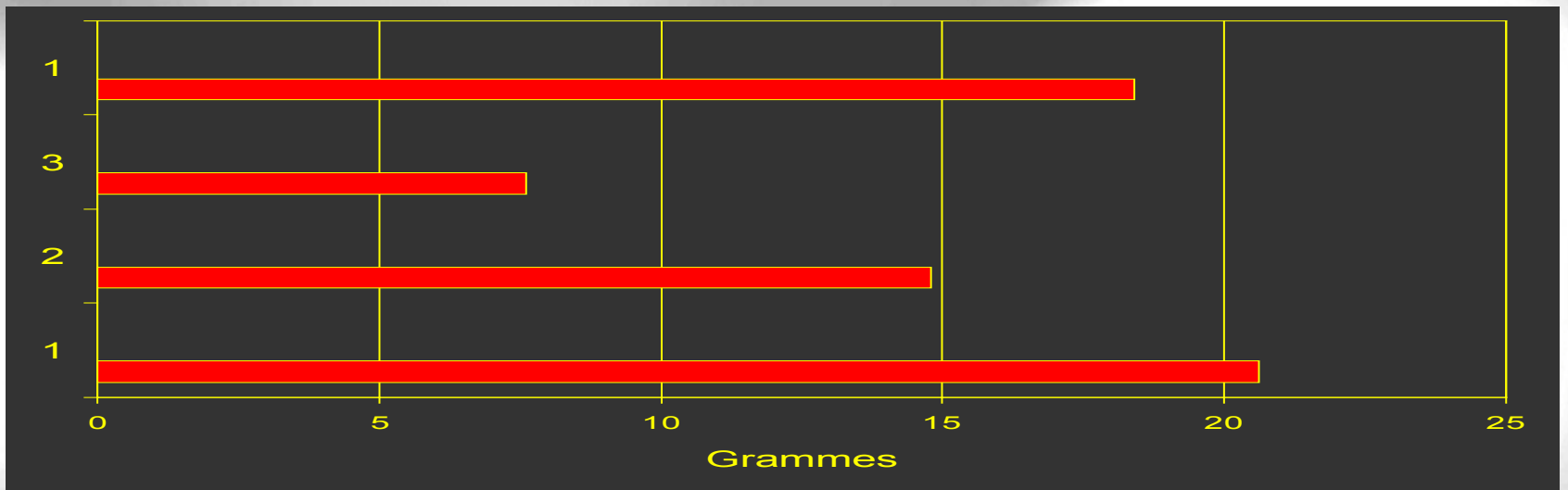
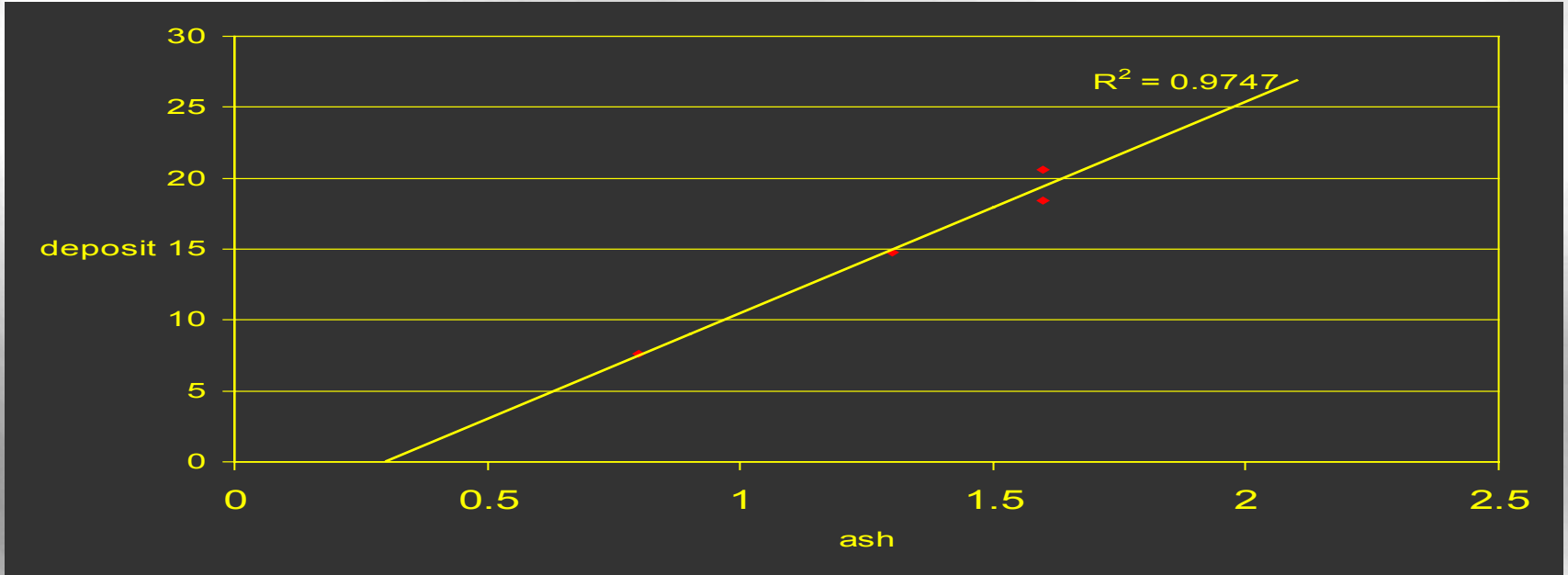
Ash Accum in 200 hours



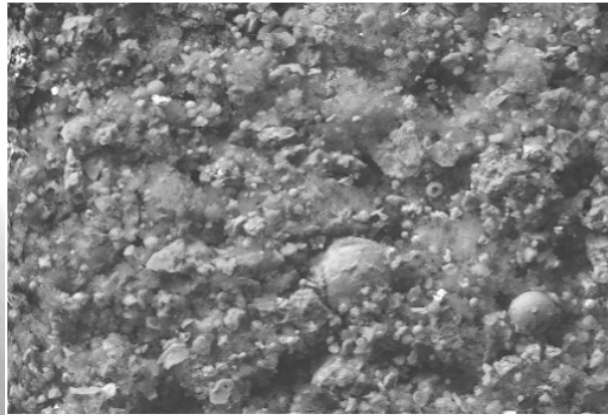
Oil Consumed in 200 hours



Ash Accumulation testing

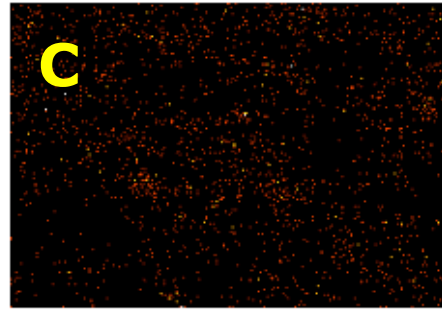


Elemental distribution in ash

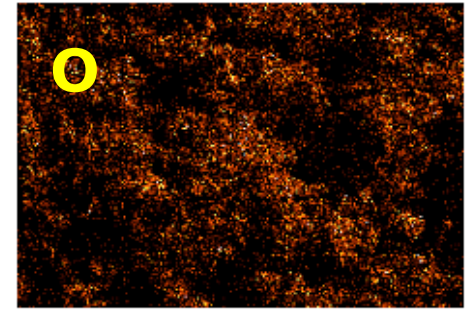


70µm Electron Image 1

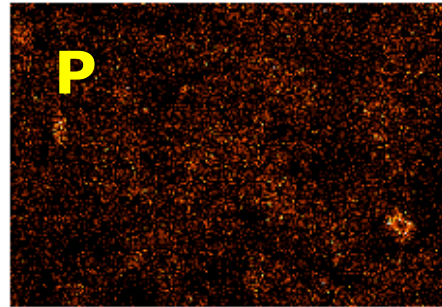
SEM micrograph of ash
and individual elemental
distribution maps



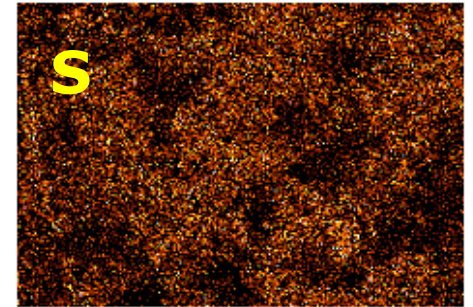
Carbon Ka1_2



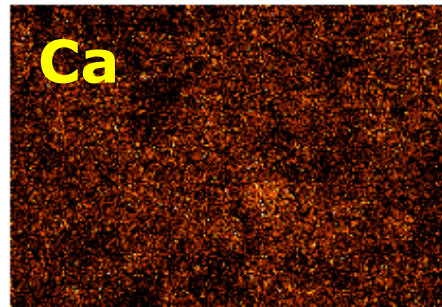
Oxygen Ka1



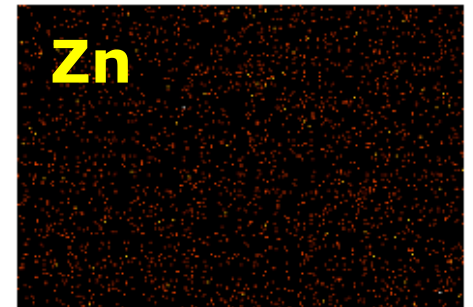
Phosphorus Ka1



Sulfur Ka1



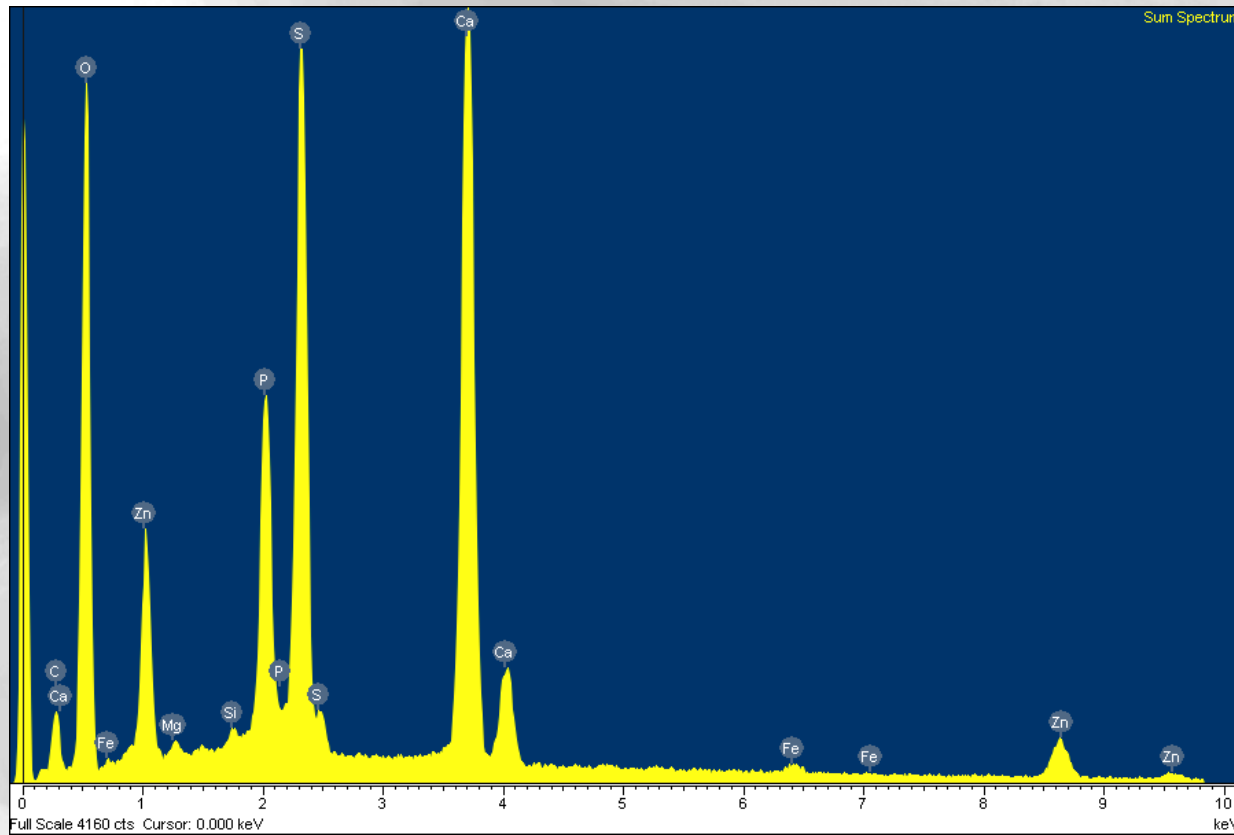
Calcium Ka1



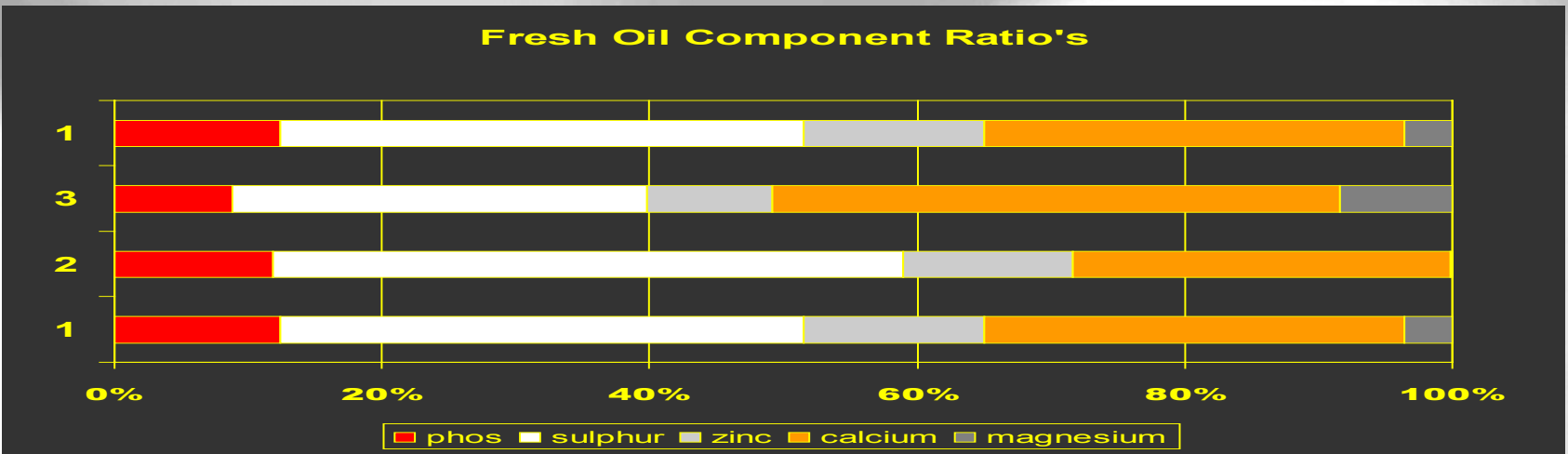
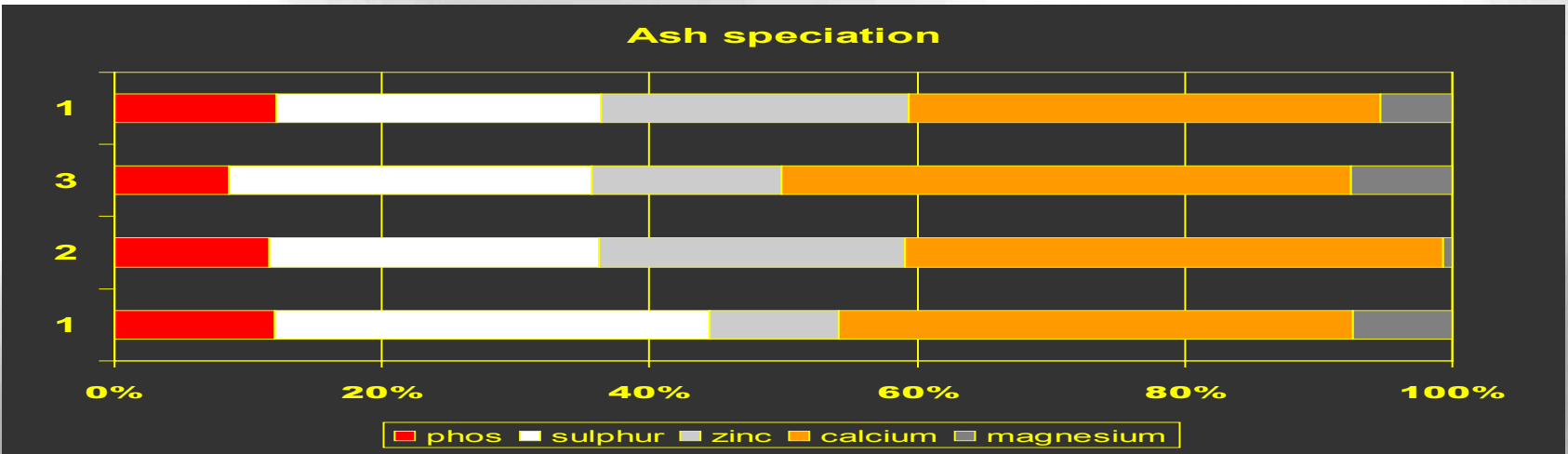
Zinc Ka1

Lighter colour = more

Typical EDS spectrum of ash , used to calculate semi-quantitative composition



Ash Accumulation testing





- Lubricant Sulphated Ash corresponds to trap deposits.
- Oil consumption does not appear to be related to deposit weight?
- Ratio's of ash speciation remained fairly constant to fresh oil component ratio's
- Testing confirmed pre-conceived ideas.