Aqueous Degreasing Replacement of Solvent Based Cleaning Process for Environmental Reasons – SIMS Reveals the Pitfalls

In recent years, tighter environmental protection and health and safety regulations mean that many industries are under pressure to replace solvent–based component cleaning/degreasing processes with aqueous-based processes. Although aqueous degreasers are safer for operators, they tend not to be as effective. They can leave remnants on the material surfaces, affecting a component's fitness for use or the reliability of paint coatings.

In this study the surfaces on Ni-Cr tubes were analysed with SIMS (Secondary Ion Mass Spectroscopy) before and after a solvent degreasing process and a candidate aqueous degreasing replacement. SIMS is a surface sensitive technique and is an extremely powerful organic chemical analytical technique with very high sensitivity. It can also be used to produce chemical maps to show the distribution of chemical species across the surface, which, in this case, is useful for determining the root cause of the surface contaminants.

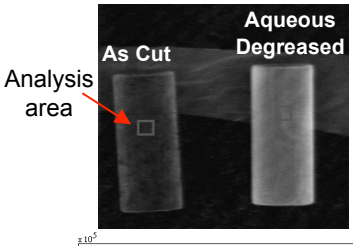

Fig.1. SIMS generated SEM image showing 2 tube samples and an example analytical area. Images 4.5mm×4.5mm.

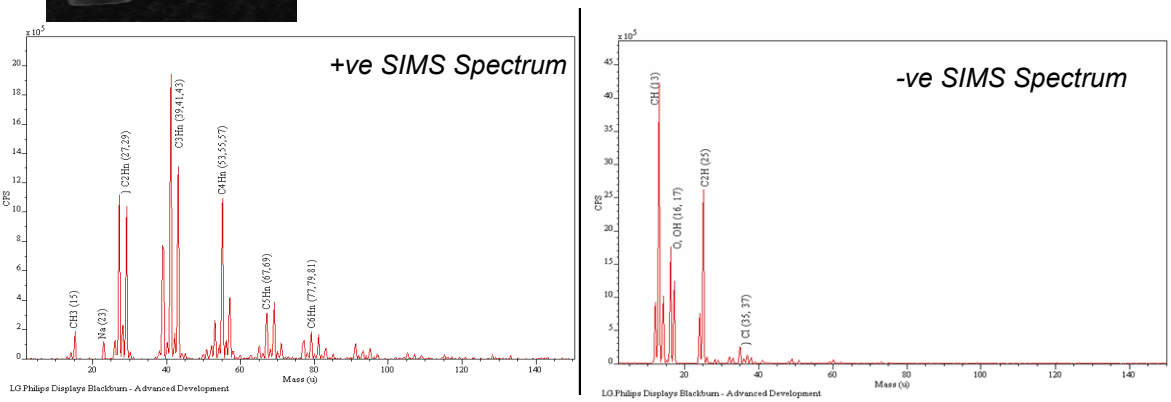

Fig.2. The as-cut tube surfaces before cleaning are covered in hydrocarbon-based cutting lubricant to such an extent that there is little evidence of the Nickel/Chromium tube material.

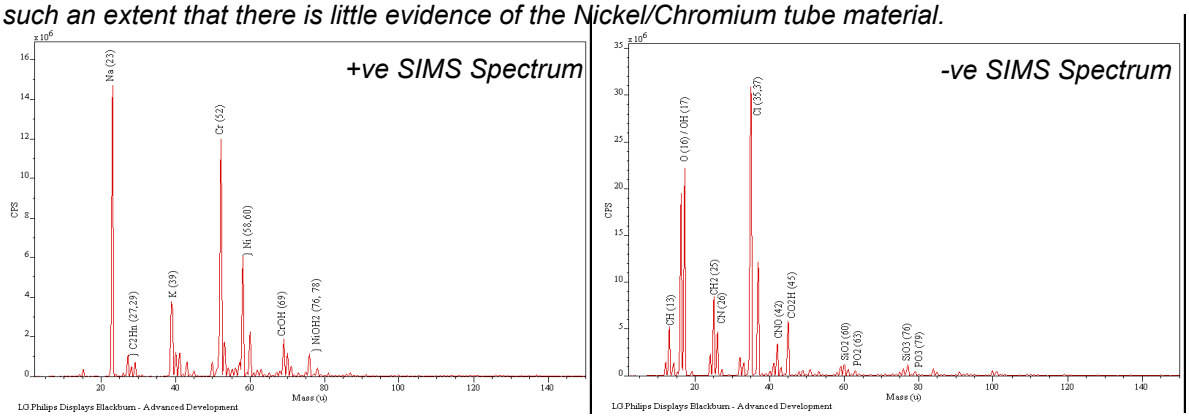

Fig.3. The solvent (IPA/acetone) degreasing of the cut tubes has removed the hydrocarbon material so the underlying nickel and chromium are exposed. There is some sodium and potassium visible, but at much lower levels than observed from the aqueous degreasing process.

(* denotes UKAS accredited test)

LPD Lab Services Limited

– a unique combination of analytical equipment, techniques, and investigative experience

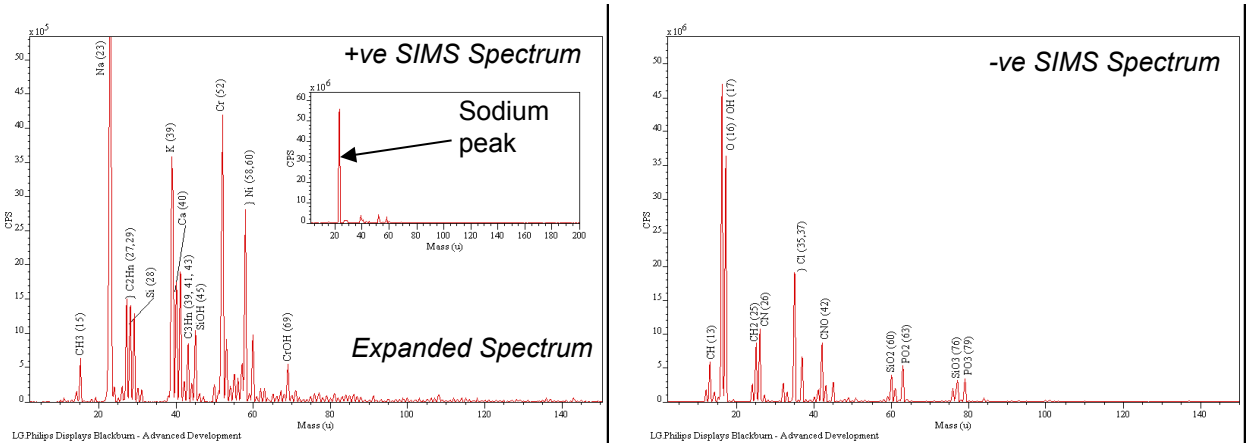

Fig.4. Aqueous degreasing has removed most of the cut tubes' hydrocarbon revealing the underlying nickel and chromium. However high levels of sodium, silicon, potassium and calcium have appeared. These, together with the chlorine, phosphates, silicates and nitrates largely originated from the aqueous degreasing solution.

SIMS imaging has been used to rapidly map the distribution of species across the aqueous degreased component surface (30s/ map). Most remnants of the aqueous degreasing solution such as the phosphates and its hydrocarbon chains are seen to be uniform across the surface of the component. However the sodium is clearly present as locally distributed contamination. The shape suggests that this is a drying stain, proving that the sodium originates from the degreasing agent rather than arising from surface segregation in the metal itself.

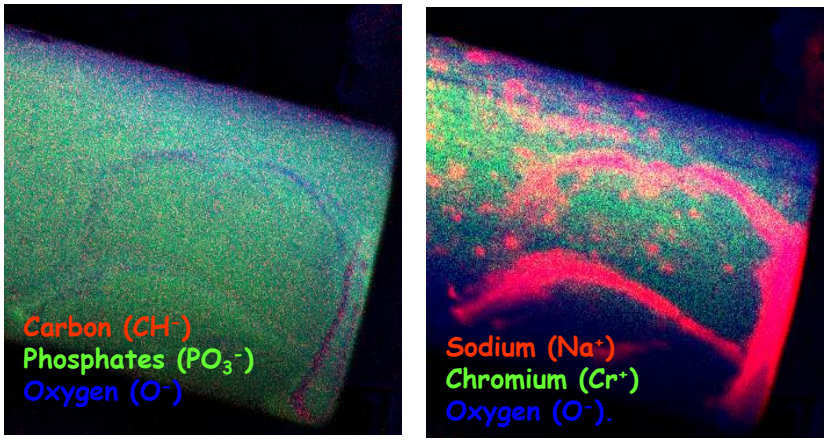

Fig.5. SIMS Chemical Images of Aqueous Degreased Sample. Images 2.5mm × 2.5mm

Summary

The SIMS analyses demonstrates the potential contamination risk of changing from a solvent based degreasing process to an aqueous process for environmental impact and health and safety at work reasons.

The solvent process is clearly a better alternative in terms of its cleaning effectiveness.

The Aqueous process leaves more remnants behind on the production component surface which potentially could cause component functional problems.

Contact us today

Find out how we can help solve your problems in process improvement, process control and materials analysis

LPD Lab Services
Phone: +44 (0)1254 676074
E-mail: enquiries@lpdlabservices.co.uk
Web: www.lpdlabservices.co.uk