Application Note #2006

Testing for Fluorine-Based Persistent Organic Pollutants

Persistent Organic Pollutants, or POPs, are products and by-products released to the environment as waste. POPs, referred to as "forever chemicals", are almost impossible to get rid of when they get into our watersources and soil. PFOS (perfluoro-octane-sulphonate) and PFOA (perfluoro-octanoic acid), referred to as fluorine-based PFAS, are in the Stockholm Convention's POPs list of harmful substances.

PFAS treatments change the surface tension of liquids which come in contact with them enabling objects to repel water and oil. PFAS are used as surfactants and surface treatments for semiconductors, protective clothing, medical devices, filters, and fire-fighting foams. They are also used in popular consumer products including kitchenware, raingear, tents, and sleeping bags. PTFE (Polytetrafluoroethylene), a particular type of PFAS with the characteristic of being slippery, is a common ingredient in many oils and lubricants used for bike chains and in ski waxes to help reduce professional skiers race times, even if by seconds.

Non-Destructive Fluorine Analysis with TRACER 5g

The snow sports sector took a lead in the phase-out of PFAS by developing alternative, performance driven, fluoro-free ski and snowboard waxes,and by promoting awareness of the environmental issues involved with fluoro POPs. One of the challenges in phasing out PFAS is the ability to ensure fluor-waxes are not sold at retail stores or used on the slopes.

There is a need for a straightforward, portable device to test products in-situ, either in the wax container or on the equipment. Handheld X-ray fluorescence (XRF) is ideal with its portability, in-situ measurement capability, ease of use, nondestructive nature, and its ability to provide results quickly.

Handheld XRF analyzers are fast, multi-element analyzers which are straightforward to use and can be taken anywhere testing is needed, from retail shops to the slopes. Most handheld XRF analyzers can measure elements as light as magnesium up to those as heavy as uranium.

However low atomic number elements like fluorine (#9) are very challenging for conventional handheld XRFs to detect. The TRACER 5g is specifically designed to dramatically improve sensitivity for light elements which enables measurements of sodium and fluorine, as well as for lower concentration measurements of magnesium and aluminum.

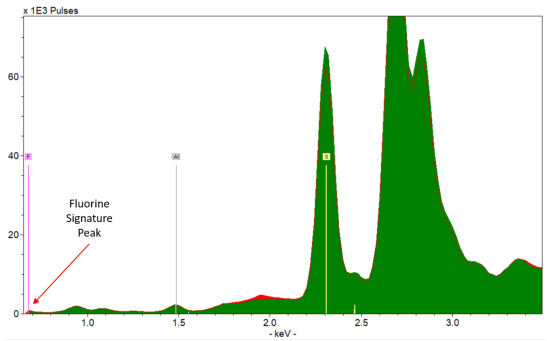
Fluorine Analysis with TRACER 5g Handheld XRF

Five samples with ski base and different wax compounds were measured with handheld XRF to test if fluorinated ski wax samples can be reliably identified from fluorine-free ski wax samples. All the ski base samples were identical, but four of them had different types of fluorinated ski wax and one of the ski base samples had fluorine-free ski wax.

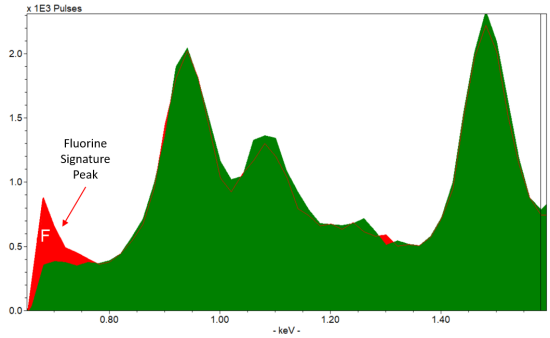
Since fluorine is a very low atomic number element, its XRF signal is weak and absorbed by all materials including air. Therefore, with a measurement depth of only about 1µm, helium must be used to remove air between the XRF detector and the sample for fluorine detection.

TRACER 5g's XRF test spectra showed a small, but clear fluorine (F) signal in all ski base samples containing fluorine based ski wax. In comparison to other elements, such as aluminum (Al), sulfur (S), calcium (Ca) and iron (Fe), the fluorine signal is small. However, magnification shows a clear F peak in all fluorinated ski wax samples which makes it possible to clearly distinguish them from fluorine-free ski wax.

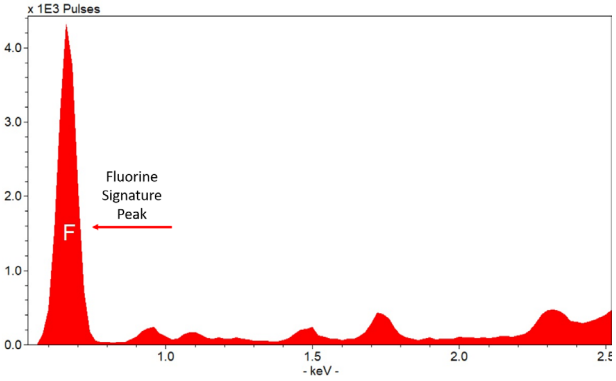
TRACER 5g conditions were: helium purge, 8 mm measurement spot size, 180 sec measurement time, 10kV/180uA, and no protective window.



Fluorine peaks are small compared to other elements present, but when the Y axis is magnified, the peaks become clear.



Tracer 5g measurement can successfully distinguish fluorinated ski wax from fluorine-free ski wax.



Polytetrafluoroethylene (PTFE) tape measurement with TRACER 5g

TRACER 5g Handheld XRF for Fluorine Analysis

Complete User Control

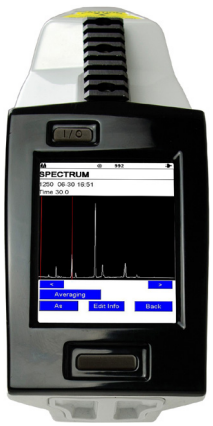
- Complete user control of excitation conditions - current, voltage, automated filter, manual filter, sample spot size, and atmosphere (vacuum, helium, or air)

Fast, Accurate Spot Positioning

- Internal camera for full view of sample spot with target area and reticle positioning for precision
- Remote view projection for challenging object positioning

Features

- Rh 50kV tube excitation source
- 1 µm Graphene window high resolution SDD detector
- Detector Shield™
- SharpBeam™ Geometry for minimized distance between sample and detctor
- 3 and 8 mm sample spot sizes
- Automated 4 filter wheel AND/ OR manual filter slot
- Integrated display embedded operating and analytical software
- Control, save, and send with USB, Wi-Fi, or Bluetooth
- Secure encrypted data storage
- Lightweight - only 1.9 kg / 4.1 lbs, including battery
- Non-destructive measurement



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