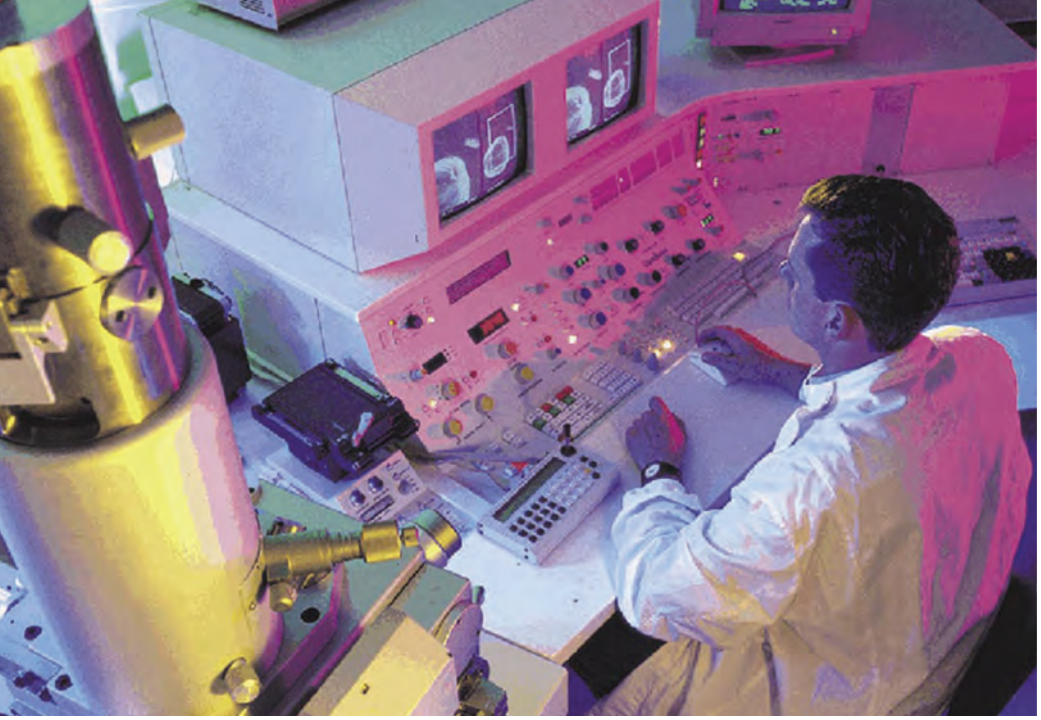

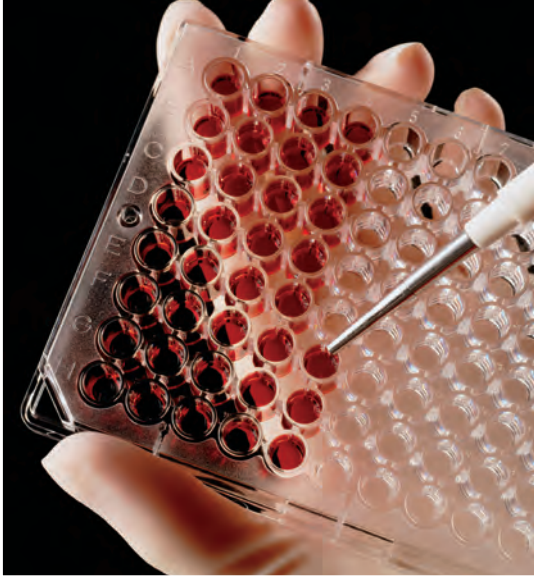

Customer Case Study:

Analysis of Explosives and Firearms Residue Using Thermo Scientific Atlas CDS™ at Forensic Science Northern Ireland

The illegal use of firearms and explosives materials by criminal or terrorist organizations and other groups or individuals is a growing global concern. One of the challenges facing many forensic science institutions is the detection of trace amounts of firearms and explosives residue on the hands, face, hair and clothing of suspects, or their surroundings.

In analyzing crime scene materials, it is essential to establish that any residue detected on these areas has not been as a result of contamination from another source during the handling of the suspect or article prior to swabbing. Forensic Science Northern Ireland (FSNI) has vast experience in the handling and examination of these types of incidents. The knowledge gained by FSNI demonstrates the necessity for any organization connected with this field, to undertake a plan of contamination avoidance measures in screening for firearms discharge and explosives residue.

FSNI Operations and Practices

The Belfast-based laboratory of FSNI offers a comprehensive range of forensic services, covering a variety of crime types. One of these areas incorporates the sampling and analytical identification of firearms and explosives residue, as well as an advisory service on contamination avoidance. These services are typically commissioned by legal, military and police forces for use in court testimony, as well as being availed to anti-terrorist organizations.

A variety of materials are subjected to analysis by the laboratory for identification and comparison including samples of metal, glass, fibers, plastic fragments, chemical and biological substances. The laboratory therefore specializes in the application of a wide range of analytical methods, such as scanning electron microscopy and photomicrography, gas chromatography, mass spectrometry and infrared spectroscopy.

The Microchemistry Laboratory

The microchemistry unit is primarily concerned with the examination of swabs and clothing for the presence of firearms and explosives residue. The reliable and rapid identification of these materials in a clean and thoroughly monitored working environment has been a key element of the unit at FSNI for many years. There are five members of staff employed in microchemistry unit, two of whom are reporting officers responsible for witness statement and presentation of evidence as well as the sample preparation and analysis.

Part of the facilities include a specially controlled accommodation area referred to as the CDR (Cartridge Discharge Residue) suite that is similar to a clean room in the semiconductor industry. Access to this area is strictly monitored, the air is filtered and fully disposable clothing is worn, ensuring that no contamination of the items that are being examined can occur.

The maintenance of this area requires a significant amount of time, as checks are performed at regular intervals, requiring extraction and analysis. The techniques used by the unit include the extraction of the swabs and vacuum filter samples (taken from garments), to produce a liquid (ether) extract and a 1micron filter (12.5mm diameter). The ether extract is analyzed by GC/Thermal Energy Analyzer (TEA) and the filter is attached to an aluminium stub and examined in a scanning electron microscope (SEM) for particles containing the elements lead, antimony and barium.

The microchemistry laboratory has two GCs that are fitted with TEA detectors and a HPLC system attached to a Chromatography Server from Thermo Fisher Scientific. The GCs run overnight, and the data is processed at the end of each batch of samples. There is also an automated routine on the SEM, which searches each of the filter stubs in turn.

FSNI migrated and upgraded its chromatography data system to Thermo Scientific Atlas CDS from its Minichrom™ system. Minichrom was originally specified to replace integrators, however Thermo Scientific Atlas is capable of attaching to FSNI's GCs and controlling them. A network-type solution that allowed two PCs to be connected to the one Chromatography Server was chosen, which would take data from four chromatography systems.

FSNI elected to migrate to Atlas in order to implement a more user-friendly system, based on Windows® standard features, for its laboratory chemists. Atlas was selected because it was simple to set up runs, easy to modify sample names and bottle numbers and a breeze to identify standard peaks in a known standard run. The system also allowed users to obtain printouts of selected data in a suitable manner to perform statistical manipulations on the acquired data.

How Atlas is Used

The arrest of a suspect in a crime involving firearms or explosives would typically generate action from law enforcement to utilize a swab kit to examine three articles of clothing. The swab kit developed by FSNI examines both inorganic and organic residue, thus providing a more complete analytical service and series of results. When the swab kit is extracted and prepared for analysis, the Atlas workbook will contain approximately 30 samples, which includes blanks and standards. One injection per bottle is performed, so the workbook contains 30 chromatograms. Similarly when the three articles of clothing are prepared, a similar sized workbook is produced. If the case were negative, this would be the minimum number of workbooks.

Typically a case may require re-analysis due to the samples being dirty, giving rise to numerous peaks off-scale. In this case the samples will be diluted and run again. One case would typically have three to five workbooks each, consisting of 30 bottles per chromatogram. The current average case load per annum is about 130 of these cases, leading to an estimated 400 to 650 workbooks (12000 to 19500 chromatograms) per year. In addition to the case samples, FSNI would analyze one survey/screening type of workbook per week, thus ensuring the equipment in use and the environment is free of contamination.

Legal issues

FSNI must be able to demonstrate that the integrity of the samples is maintained at all times. Samples are signed in at reception area, before being bar-coded for internal transfers to record keeping. The various staff that worked on these items will record in their notes when and where their examinations are conducted. A computer case management system and bar code readers are used to record transactions of items in and out of sections and stores. The strong security and Audit Trail capabilities of Atlas help FSNI in this regard.

Conclusion

When a forensic laboratory wishes to set up a facility to undertake trace analysis, important information and advice are necessary so that the examinations, ultimately the subject of court proceedings, are not compromised by poor structures and processes.

Forensic Science Northern Ireland has vast experience in the handling and examination of these types of incidents. The staff from the microchemistry laboratory are required to testify about their procedures in court, giving evidence or providing opinions. For this reason, the facts of the analysis must be available and in a presentable format. The installation of Thermo Scientific Atlas CDS at FSNI has allowed the laboratory to continue to develop its commercial services in this specialist field.

Partnering with Thermo Fisher Scientific

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