

The GRIM Reaper

The challenge

Forensic glass examination has a well established analytical pathway. Firstly glass fragments are recovered, observed and identified by microscopy. Refractive index measurement of a proportion of these fragments is then undertaken, and these measurements are compared to measurements taken from a control sample, and if matching, and where appropriate, further elemental analysis of these fragments takes place.

If the fragment has potentially come from a source of toughened glass, it is annealed and a further refractive index measurement is taken. If there is a difference between the refractive index measurements of the fragment before and after annealing, the glass fragment is considered likely to be from a source of toughened glass.

Forensic science laboratories approach to glass refractive index analysis is almost entirely uniform. By far the majority use a GRIM (or Glass Refractive Index Machine) produced by Foster and Freeman Ltd. The GRIM is by far, the most tried and trusted instrument for the forensic measurement of a glass fragment's refractive index, indeed it appears to be the only real choice in the market. In terms of technology, it has evolved over the years, although the primary means of measurement has remained the same, it is a microscope with a heated stage and that requires a person to run it.

GRIM has been around now for so long that most laboratories have built up significant pools of data, on which their scientists rely as an aid for interpretation. However recent studies¹ have shown that improvements in manufacturing processes have caused an apparent narrowing in the spread of refractive index values potentially making refractive index measurements less discriminating than observed in the 1970s, 80s and 90s. If this trend continues, the discriminating power of the GRIM will inevitably weaken.

In the UK, there exists considerable market pressures on forensic laboratories to perform quicker, cheaper glass casework services, the challenge for the forensic laboratory is to ensure that this does not impact on the quality of the result.

Yet a GRIM is not cheap and it cannot run 24/7. In short, for the investment required it appears to be poor value really, and that the only thing going for it as an instrument is that there is no real alternative. It is therefore not surprising to learn

¹ <http://www.fbi.gov/hq/lab/fsc/backissu/jan2001/koons.htm>

that the GRIM's place in forensic glass examination is coming under increasing scrutiny.

What if we go straight to analysis?

Elemental glass analysis technology has improved considerably since the GRIM was first launched. It has certainly been shown, in paper after paper, to be more discriminating than GRIM. However, predominantly most of those studies have been done using the GRIM as a screening tool prior to elemental analysis. There is little by way of persuasive statistics showing the likely risk of false positives by elemental analysis where GRIM was not employed as a screening tool. In other words, what is the risk of fragments matching by elemental analysis being discriminated by the GRIM? Anecdotal evidence appears to support the view that false positives in elemental analysis without prior screening by the GRIM is a real issue, albeit incidence appears to be low and is dependant entirely on the type of elemental analysis and the number of elements being used in the comparison process. More information on this is required.

There exist a wide variety of elemental analysis techniques available for elemental analysis of glass, most at present can be classed into SEM/EDX, EMPA, ICP-MS or LA-ICP-MS. All of which are expensive, vary as to the level of sampling preparation required and the level of discrimination offered. But the potential for future developments in this area is impressive.

The obstacles to going straight to analysis will be obvious to glass examiners and they can be generally summarised by the following:

- What do I do about my databases?
- What do I do about toughened glass?

The first, whilst appearing to be a large obstacle is not a real obstacle at all. If you are serious about improving your glass analysis you can find a way to build it up again.

The second is more of an issue – can elemental analysis be used to identify toughened versus non-toughened glass? Its uncertain...but perhaps the question should be how can toughened glass be identified without glass refractive index measurement?

The challenge is therefore clear:

Can we go straight to elemental analysis?

If so, how and what are the risks of false positives?

How do we identify toughened glass without measuring refractive index?

Up for the challenge? Contact us at www.ContactTraces.com