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ENFSI collaborative testing programme for ignitable liquid analysis: A review

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Abstract

The Fire and Explosion Investigation Working Group of the European Network of Forensic Science Institutes (ENFSI) is the organiser of a collaborative testing programme for ignitable liquid analysis. The testing programme was initiated in 1998. Initially to inventory the analytical methods used in this field of analysis, but with the ultimate goal to establish a European testing programme for fire debris analysts. As of today, five tests have been conducted.

This article will provide an overview of the first five ENFSI collaborative tests for ignitable liquid analysis. The background, objectives and characteristics of the testing programme are summarised, followed by an overview of the sample composition employed, the participants' performance, the difficulties and the lessons learned in each test.

Keywords: Collaborative testing programme; Ignitable liquid analysis

1. Introduction

In 1998, the Fire and Explosion Investigation Working Group of the European Network of Forensic Science Institutes (ENFSI) initiated a collaborative testing programme for ignitable liquid analysis as one of the activities to meet the objectives of ENFSI, which are: sharing knowledge, exchanging experiences and coming to mutual agreements in the field of forensic science.[1]

The testing programme was established stepwise, with the ultimate objective being to test the participants' skills in the analysis of various debris samples and in the interpretation of the analytical results obtained.

Between 1998 and 2005, five collaborative tests have been conducted. Test I was used to provide an inventory of the analytical techniques employed by the different analysts and laboratories. In Test II, the detection limits of these techniques were determined. As of Test III, artificial debris samples were distributed for testing purposes.

The tests are summarised in Table 1.

The ENFSI collaborative testing programme for ignitable liquid analysis is characterised by:

1. Qualitative analysis; qualitative analysis that confirm the presence or prove the absence of ignitable liquids is sufficient in fire investigations.
2. Blind testing; the participants know it is a test sample but do not know the sample composition.
3. No prescription of methods; the participants should perform the analyses using their standard laboratory procedures.
4. Detailed reporting of results; the analysis results must be supported with both a method description and the analytical data obtained.
5. Generous timeline for analysis; the participants usually have about three months to complete the analysis and to submit the results for evaluation.

2. Sample composition

The sample composition employed in the first five ENFSI collaborative tests for ignitable liquid analysis is summarised in Table 2.

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[1] http://www.enfsi.org.

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Table 1
Time schedule of testing programme

Test	Year	Objective
I	1998	Determine analytical methods used by each participating laboratory
II	2000	Determine accepted detection limits of each participating laboratory
III	2002	Proficiency test
IV	2004	Proficiency test
V	2005	Proficiency test

Table 2
Sample composition employed in Tests I–V

Test	Sample composition
I	Liquid, mixture of gasoline and diesel oil (ratio 1:2)
II	RESTEK reference 'Fire Debris mixture: E1387-95 Column Resolution Check Mix', containing five aromatic and eight aliphatic hydrocarbons, 2000 μg/ml each in methylene chloride
III	A. Sand spiked with mixture of gasoline and diesel oil (ratio 2:1) B. Sand spiked with denaturated spirits C. Sand blank
IV	A. Liquid diesel oil, type standard B. Liquid diesel oil, Type V-power C. Charred pinewood spiked with pyrolysis products of polyethylene D. Charred pinewood blank
V	A. Unburnt carpet spiked with pyrolysis products of rubber B. Unburnt carpet spiked with traces of evaporated gasoline C. Unburnt carpet blank

3. Test participants

The ENFSI collaborative testing programme for ignitable liquid analysis is organised among (mainly) forensic laboratories in Europe. The testing programme is however not limited to European laboratories and one laboratory from outside Europe has been a regular participant from the beginning.

3.1. Number of participants

The interest among laboratories in the collaborative testing programme has grown steadily since the first test. This is shown in the increasing number of participants who have become involved from Test III onwards (Fig. 1). For unknown reasons, participation in Test II was considerably lower than the other tests.

3.2. Performance of participants

In Tests III–V, the participants received artificial debris samples with the objective to test their analysis and interpretation skills. An overview of the participants' performance in these tests is presented in Fig. 2. The results of the blank samples (III-C, IV-D and V-C) are not included in this figure, as these blanks were provided to the participants for reference purposes only.

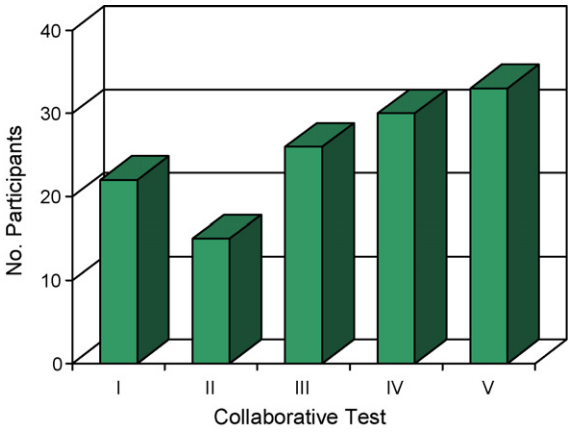

Fig. 1. Number of participants in collaborative testing programme.

Each test posed different challenges to the participants; these challenges are discussed in more detail in the test overview.

4. Test overview

4.1. Test I

Test I, conducted in 1998, had the objective of providing an inventory of the analytical techniques employed by fire debris analysts in the participating laboratories. For this test, a liquid sample containing a mixture of gasoline and diesel oil was distributed for analysis. The results indicated that gas chromatography was the method of choice amongst the laboratories either with flame ionisation detection (GC–FID) (64%), mass spectrometry (GC–MS) (27%), or both (9%).

Most participants analysed the liquid sample directly or as a dilution. Only one participant analysed the headspace. Headspace analysis has the disadvantage of discriminating the higher boiling compounds against the lower boiling compounds. In particular for a sample containing diesel oil this may easily lead to misinterpretation of the chromatographic data and, as a consequence, result in misclassifying this product as for example kerosene.

4.2. Test II

Test II was organised in 2000 with the objective of determining the detection limits of the analytical techniques employed by the participating laboratories and to check whether the performance of their instrumentation could be compared. The participants were requested to procure the RESTEK reference 'Fire Debris mixture: E1387-95 Column Resolution Check Mix' (composition, see Table 3), and subsequently to analyse a dilution series of this mixture to a concentration level of 1 μg hydrocarbon/mL in methylene chloride.

All participants were able to detect the lowest concentration level of 1 μg/mL RESTEK reference. This concentration level was best reached via a direct liquid injection (injection volume