

**GAS CHROMATOGRAPHY  
COUPLED WITH ION TRAP  
MASS SPECTROMETRY  
(GC-MS AND GC-MS-MS)  
FOR ARSON DEBRIS ANALYSIS**

By

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## **SUMMARY**

Gas chromatography - mass spectrometry (GC-MS) is an established instrumental technique used for the analysis of fire debris for accelerant detection. However, matrix problems, such as pyrolysis product interference, are still encountered. These interferences often lead to inconclusive interpretation of the chromatographic results.

This study describes methods for analysing arson accelerants using gas chromatography coupled with ion trap mass spectrometry. The latter technique lends itself to both conventional (GC-MS) as well as tandem mass

spectrometry (GC-MS-MS). Since petrol (gasoline) is one of the more common distillate blends used by arsonists, especially in South Africa, the identification of petrol in fire debris samples was investigated. In order to overcome pyrolysis product interference and improve detection selectivity of the aromatic hydrocarbons in petrol residues, tandem mass spectrometry was used in combination with capillary gas chromatography. The added parameter of the third dimension of selectivity proved to be superior to conventional GC-MS in obtaining characteristic aromatic hydrocarbon profiles for petrol without interference from pyrolysis artefacts.

**GASCHROMATOGRAFIE GEKOPPEL MET  
IOONVALMASSASPEKTROMETRIE  
(GC-MS EN GC-MS-MS)  
IN BRANDSTIGTINGPUIN-ANALISE**

Deur

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## **SAMEVATTING**

Gekoppelde gaschromatografie en massaspektrometrie (GC-MS) is 'n gevestigde instrumentele tegniek vir die analise van brandstigtingpuin en die opsporing van brandversnelstowwe. Daar word egter nog matriksprobleme ondervind, soos piekooorvleuling vanaf pirolise-produkte. Hierdie oorvleuling verhinder die eenduidige interpretasie van chromatografiese resultate.

Hierdie studie omskryf 'n metode vir die analise van brandversnelstowwe wat in brandstigting gebruik word deur gebruik te maak van gaschromatografie, gekoppel met ioonval-massaspektrometrie.

Laasgenoemde tegniek is gebruik vir konvensionele (GC-MS) sowel as tandem massaspektrometrie (GC-MS-MS). Aangesien petrol een van die algemeenste distillaatmengsels is wat deur brandstigers gebruik word (veral in Suid-Afrika), is die identifisering van petrol in brandpuin-monsters ondersoek.

Om die oorvleuling van pirolise-produkte te oorkom, en om die selektiewe waarneming van aromatiese koolwaterstofverbindings in petrol-residu te verbeter, is tandem-massaspektrometrie as opsporingsmetode in kombinasie met kapilêre gaschromatografie gebruik. Die addisionele parameter van die derde dimensie van selektiwiteit oortref konvensionele GC-MS in die verkryging van karakteristieke aromatiese koolwaterstof-profiel van petrol sonder die steurings vanaf pirolise-verskynsels.

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# CONTENTS

	<b>Page</b>
<b>SUMMARY</b>	i
<b>SAMEVATTING</b>	iii
<b>ACKNOWLEDGEMENTS</b>	v
<b>CONTENTS</b>	vi
<b>ABBREVIATIONS</b>	xii
<b>LIST OF TABLES</b>	xiv
<b>LIST OF FIGURES</b>	xvi
<b>CHAPTER 1 INTRODUCTION</b>	<b>1</b>
1.1 FIRE, COMBUSTION AND PYROLYSIS	1
1.2 THE CRIME OF ARSON	3
1.3 MOTIVE	4
1.4 FIRE INVESTIGATION	6
1.5 ANALYTICAL FIRE INVESTIGATION	7
1.6 FIRE STATISTICS IN SOUTH AFRICA	10
1.7 FIRE INVESTIGATION IN SOUTH AFRICA	12
1.8 THE USE OF CANINES FOR ACCELERANT DETECTION	13
1.9 FORENSIC ARSON LABORATORY	14
1.10 THE FIRE INVESTIGATOR AND ANALYST AS A FORENSIC TEAM	15
1.11 RESEARCH IN ARSON DEBRIS ANALYSIS	16
<b>CHAPTER 2 ARSON INVESTIGATION</b>	<b>18</b>
2.1 WHAT IS AN ACCELERANT?	18
2.2 ARSON INVESTIGATION METHODOLOGY	20

	<b>Page</b>
<b>2.3 PETROLEUM-BASED DISTILLATES</b>	22
2.3.1 Natural Gas	23
2.3.2 Liquified Petroleum Gas	23
2.3.3 Petroleum	23
2.3.4 Petroleum Naphthas	24
2.3.5 Petrol (Gasoline)	24
2.3.6 Aviation Fuel	25
2.3.7 Paraffin	25
2.3.8 White Spirits	25
2.3.9 Diesel	26
2.3.10 Oils, Lubricants, Greases, Waxes, Asphaltines and Resins	26
2.3.11 Absolute Alcohol	27
2.3.12 Methylated Spirits	27
<b>2.4 IGNITABLE LIQUID CLASSIFICATION SCHEME</b>	29
<b>2.5 IS IT A PETROLEUM PRODUCT?</b>	32
<b>2.6 AIDS USED FOR DETECTING ACCELERANTS AT FIRE SCENES</b>	34
<b>2.7 SUITABLE MATRICES FOR FIRE DEBRIS SAMPLES</b>	37
<b>2.8 SAMPLING CONTAINERS TO USE</b>	37
<b>2.9 CONTROL SAMPLES AND BLANKS</b>	38
<b>2.10 ANALYTICAL PROFICIENCY</b>	39
 <b>CHAPTER 3 FIRE DEBRIS PREPARATION AND ANALYSIS</b>	 42
<b>3.1 THE ANALYTICAL PROBLEM</b>	42
<b>3.2 SAMPLE PREPARATION</b>	43
3.2.1 Distillation	44
3.2.2 Solvent Extraction	45
3.2.3 Direct Headspace	45
3.2.4 Dynamic Headspace	46

	<b>Page</b>
3.2.5 Static headspace	47
<b>3.3 GAS CHROMATOGRAPHY AND SPECTROSCOPY</b>	49
<b>3.4 GAS CHROMATOGRAPHY-MASS SPECTROMETRY</b>	51
<b>3.5 DIFFERENCES BETWEEN CONVENTIONAL GAS CHROMATOGRAPHY AND GC-MS</b>	60
<b>3.6 HOW SPECIFIC IS THE MASS SPECTROMETER AS AN ACCELERANT DETECTOR IN THE PRESENCE OF MATRIX INTERFERENCES?</b>	65
 <b>CHAPTER 4: TANDEM MASS SPECTROMETRY</b>	 73
4.1 WHAT IS TANDEM MASS SPECTROMETRY?	73
4.2 QUADRUPOLE OPERATION	74
4.3 ION TRAP MASS SPECTROMETER	74
4.4 ION TRAP THEORY	77
4.5 TANDEM-IN-SPACE VS TANDEM-IN-TIME	81
4.6 TANDEM MASS SPECTROMETRY THEORY	82
4.6.1 Resonant Excitation	84
4.6.2 Non-Resonant Excitation	85
4.7 INFORMATION CONTENT OF TANDEM MS	88
 <b>CHAPTER 5 TANDEM MS OPTIMIZATION</b>	 91
5.1 MS-MS AS AN ANALYTICAL TOOL	91
5.2 INITIAL APPLICATION	92
5.3 AUTOMATED METHOD DEVELOPMENT	96
5.4 AMD MASS SPECTRA	102

	<b>Page</b>
5.4.1 Effect of Incorrect Storage Level Selection	113
5.4.2 Initial "Toolkit" Mass Spectra	119
5.5 TANDEM MASS SPECTRA	124
5.6 TANDEM MASS SPECTRA OF IGNITABLE LIQUIDS	129
 <b>CHAPTER 6 FIRE DEBRIS ANALYSIS BY GC-MS-MS</b>	 <b>136</b>
6.1 APPLICATION	136
6.2 FLOOR SCREED DEBRIS SAMPLE	137
6.3. CHARRED PINE FLOOR PLANKING DEBRIS SAMPLE	143
6.4. SHOE STORE WAREHOUSE DEBRIS SAMPLE	150
6.5. GYMNASIUM FLOOR DEBRIS SAMPLE	154
6.6 CARPET AND BEDDING DEBRIS SAMPLE FROM A PRIVATE HOME	156
6.7 BURNT PLASTIC DEBRIS SAMPLE TAKEN FROM A FACTORY	159
6.8 CHARRED CARPET DEBRIS SAMPLE FROM A SMALL BUSINESS	162
6.9 ROUTINE ANALYSIS BY GC-MS-MS	168
 <b>CHAPTER 7 ALTERNATIVE METHODS OF ANALYSIS</b>	 <b>171</b>
7.1 CHEMICAL IONIZATION-MS-MS	171
7.2 AROMA DETECTION TECHNOLOGY	177
7.3 MULTIDIMENSIONAL GAS CHROMATOGRAPHY	179

	<b>Page</b>
7.4 THERMAL DESORPTION AND GC-MS FOR ARSON ANALYSIS	180
7.5 "DNA" TECHNOLOGY FOR FIRE INVESTIGATION	181
7.6 FIRE DEBRIS ANALYSIS: THE FUTURE	182
<b>CHAPTER 8 DISCUSSION AND CONCLUSION</b>	<b>185</b>
<b>REFERENCES</b>	<b>190</b>
<b>ANNEXURE A INITIAL AUTOMATED METHOD DEVELOPMENT CONDITIONS</b>	<b>200</b>
<b>ANNEXURE B ADDITIONAL FIGURES FOR AMD AND MS-MS DEVELOPMENT</b>	<b>207</b>
<b>ANNEXURE C NOTES FOR THE FIRE INVESTIGATOR</b>	<b>235</b>
C.1 AN IMPORTANT DEVELOPMENT IN FIRE DEBRIS ANALYSIS	235
C.2 SHOES OF AN ARSONIST - CLUE OR CONFUSION?	236
C.3 LIMITATIONS ENCOUNTERED IN CASE-WORK DUE TO MATRIX DEGRADATION	235
C.4 VEHICLE TEST BURNS	239
C.5 COLLECTION OF SOOT SAMPLES AFTER A FIRE	240
C.6 VOLATILE RESIDUES IN POST MORTEM SAMPLES FROM AN ARSONIST	241

	<b>Page</b>
<b>C.7 CANINE ACCELERANT DETECTION – HOW RELIABLE IS IT?</b>	242

# ABBREVIATIONS

AC	=	Alternating Current
ABS	=	Acrylonitrile:Butadiene:Styrene
AGC	=	Automatic Gain Control
AMD	=	Automated Method Development
AMU	=	Atomic Mass Units
ASTM	=	American Society of Testing and Materials
CFI	=	Certified Fire Investigator
CI	=	Chemical Ionisation
CID	=	Collision Induced Dissociation
CSIR	=	Council for Scientific and Industrial Research
DAC	=	Digital-to-Analog Converter
DC	=	Direct Current
EI	=	Electron Impact Ionisation
FID	=	Flame Ionisation Detector
GC	=	Gas Chromatography
GC-IRMS	=	Gas Chromatography-Isotope-Ratio-Mass Spectrometry
GC-MS	=	Gas Chromatography-Mass Spectrometry
GC-MS <sup>n</sup>	=	Gas Chromatography-Tandem Mass Spectrometry
GLP	=	Good laboratory Practices
HPD	=	Heavy Petroleum Distillate
IAAI	=	International Association of Arson Investigators
ICR	=	Ion Cyclotron Resonance
IPB	=	Isopropyl Benzene
IPM	=	Ion Preparation Method
ISS	=	Intermediate Scan Segments
ITD	=	Ion Trap Detector
KAPAK	=	Kapak Corporation
kCounts	=	Number of counts in thousands
LDMS	=	Laser Desorption Mass Spectrometry
LPD	=	Light Petroleum Distillate
LPG	=	Liquid Petroleum Gas

mCounts	=	Number of counts in millions
MPD	=	Medium Petroleum Distillate
MS	=	Mass Spectrometry
MS-MS	=	Mass Spectrometry-Mass Spectrometry
ms	=	millisecond
MTBE	=	Methyl <i>tert</i> -Butyl Ether
m/z	=	Mass-to-Charge Ratio
NICB	=	National Insurance Crime Bureau
NML	=	National Metrology Laboratory
PB	=	Propylbenzene
PDMS	=	Polydimethoxysiloxane
PROBE	=	Program for Organic, Biological and Environmental Analyses
RIC	=	Reconstructed Ion Chromatogram
RF	=	Radio Frequency
RT	=	Retention Time
SADC	=	Southern African Development Community
SAPS	=	South African Police Services
s	=	second
SERS	=	Surface Enhanced Raman Spectroscopy
SIM	=	Single Ion Monitoring
SPME	=	Solid Phase Micro-Extraction
SRM	=	Single Reaction Monitoring
TD	=	Thermal Desorption
TD-GC	=	Thermal Desorption-Gas Chromatography
TIC	=	Total Ion Chromatogram
TMB	=	Trimethylbenzene
μA	=	micro Ampere
μl	=	micro litre
μScans	=	micro scans
WCOT	=	Wall-Coated Open Tubular

# LIST OF TABLES

	<b>Page</b>	
<b>Table 1.1</b>	Fire Losses in South Africa: 1989-2000	11
<b>Table 1.2</b>	Financial Losses in South Africa (fire Services in attendance)	11
<b>Table 2.1</b>	Principle Fractions from Crude Oil	23
<b>Table 2.2</b>	Ignitable Liquid Classification Scheme	30
<b>Table 3.1</b>	Representative Ions Normally Present in Mass Spectra of Common Accelerants	53
<b>Table 3.2.1</b>	Typical Mass Fragments for Benzene, C2 and C3-Alkylbenzene Aromatic Compounds	57
<b>Table 3.2.2</b>	Typical Mass Fragments for C4 and C5-Alkylbenzene Aromatic Compounds	58
<b>Table 3.2.3</b>	Typical Mass Fragments for C5 and C6-Alkylbenzene Aromatic Compounds	59
<b>Table 3.2.4</b>	Typical Mass Fragments for Polycyclic Aromatic Compounds	60
<b>Table 5.1</b>	Characteristic Aromatic Ions Selected for Petrol	97
<b>Table 5.2</b>	GC, MS and AMD Conditions	98
<b>Table 5.3.1</b>	Initial AMD conditions required for CID voltage Determination (m/z = 91 for Toluene)	100
<b>Table 5.3.2</b>	Initial AMD conditions required for CID voltage Determination (m/z = 78 for Benzene)	200
<b>Table 5.3.3</b>	Initial AMD conditions required for CID voltage Determination (m/z = 106 for Ethyl Benzene and Xylenes)	201
<b>Table 5.3.4</b>	Initial AMD conditions required for CID voltage Determination (m/z = 120 for Isopropyl Benzene and Propyl Benzene)	201
<b>Table 5.3.5</b>	Initial AMD conditions required for CID voltage Determination (m/z = 120 for C3-Alkylbenzenes)	202
<b>Table 5.3.6</b>	Initial AMD conditions required for CID voltage Determination (m/z = 117 for Indane)	202
<b>Table 5.3.7</b>	Initial AMD conditions required for CID voltage Determination (m/z = 134 for C4-Alkylbenzenes)	203

		<b>Page</b>
<b>Table 5.3.8</b>	Initial AMD conditions required for CID voltage Determination (m/z = 148 for C5-Alkylbenzenes)	203
<b>Table 5.3.9</b>	Initial AMD conditions required for CID voltage Determination (m/z = 162 for C6-Alkylbenzenes)	204
<b>Table 5.3.10</b>	Initial AMD conditions required for CID voltage Determination (m/z = 128 for Naphthalene)	204
<b>Table 5.3.11</b>	Initial AMD conditions required for CID voltage Determination (m/z = 142 for C1-Naphthalenes)	205
<b>Table 5.3.12</b>	Initial AMD conditions required for CID voltage Determination (m/z = 156 for C2-Naphthalenes)	205
<b>Table 5.3.13</b>	Initial AMD conditions required for CID voltage Determination (m/z = 170 for C2-Naphthalenes)	206
<b>Table 5.4</b>	AMD Timing Sequence for Data Collection	101
<b>Table 5.5</b>	GC, MS and MS-MS Conditions	125
<b>Table 5.6</b>	CID Voltages for each Selected Mass	126
<b>Table 7.1</b>	CID Voltages for each Selected Parent Ion Mass (Chemical Ionization)	176
<b>Table 8.1</b>	Arson Sample Analyses by GC-MS and GC-MS-MS	186

# LIST OF FIGURES

		<b>Page</b>
<b>Figure 3.1</b>	Examples of a Traceair organic vapour monitor badge and solid phase micro-extraction (SPME) holder and fibre laboratory for sample preparation.	48
<b>Figure 3.2</b>	Total ion chromatograms for some of the more common ignitable liquid accelerants.	55
<b>Figure 3.3</b>	Selected ion profiles (mass chromatograms) for the aliphatic hydrocarbon compounds.	55
<b>Figure 3.4</b>	Selected ion profiles (mass chromatograms) for the C1 to C4-alkylbenzene compounds.	56
<b>Figure 3.5</b>	Selected ion profiles (mass chromatograms) for the C1 to C3-alkylnaphthalene compounds.	56
<b>Figure 3.6</b>	Total ion chromatogram (upper trace) and selected ion profiles for o-xylene (m/e = 91 + 105 – middle trace) and styrene (m/e = 104 – lower trace). The corresponding spectra are also given for peaks no. 1 and no. 2 to differentiate between o-xylene and styrene.	62
<b>Figure 3.7</b>	Total chromatographic ion profiles for unevaporated petrol, unevaporated paraffin and unevaporated kerosene	64
<b>Figure 3.8</b>	Total chromatographic ion profiles for unevaporated petrol and 75 percent evaporated petrol.	64
<b>Figure 3.9</b>	Comparison of the total chromatographic ion profiles for ABS plastic, carpet backgrounds and unevaporated petrol.	66
<b>Figure 3.10</b>	Comparison of the selected ion profiles for the C2 and C3-alkylbenzenes (m/e = 91 and 105) for ABS plastic, carpet backgrounds and unevaporated petrol.	67
<b>Figure 3.11</b>	Total ion chromatograms for the burnt debris sample and a petrol standard.	69
<b>Figure 3.12</b>	Selected ion profiles for the C2 and C3-alkylbenzene aromatic compounds for the burnt debris sample and a petrol standard.	69

		<b>Page</b>
<b>Figure 3.13</b>	Selected ion profiles for the C4-alkylbenzene aromatic compounds for the burnt debris sample and a petrol standard.	70
<b>Figure 3.14</b>	Selected ion profiles for the C5 and C6-alkylbenzene aromatic compounds for the burnt debris sample and a petrol standard.	70
<b>Figure 3.15</b>	Selected ion profiles for naphthalene and the C1, C2 and C3-methylnaphthalene polycyclic-aromatic compounds for the burnt debris sample and a petrol standard.	71
<b>Figure 3.16</b>	Selected ion profiles for the aliphatic hydrocarbon compounds for the burnt debris sample and a petrol standard.	71
<b>Figure 4.1</b>	The Varian Saturn Ion Trap, with the exit end-cap electrode visible, courtesy of VarianInc Chromatography Systems.	75
<b>Figure 4.2</b>	The Varian Saturn Ion Trap disassembled, courtesy of VarianInc Chromatography Systems.	75
<b>Figure 4.3</b>	Schematic representation of the Ion Trap, courtesy of VarianInc Chromatography Systems.	76
<b>Figure 4.4</b>	The Automatic Gain Control (AGC) Scan Function (MS), courtesy of VarianInc Chromatography Systems.	77
<b>Figure 4.5</b>	Stability diagram for the Ion Trap plotted in ( $a_z, Q_z$ ) space, courtesy of Todd, J.F.J. (60, 62).	80
<b>Figure 4.6</b>	Automatic Gain Control (AGC) Scan Function showing the location of the Intermediate Scan Segments (ISS) for MS-MS, courtesy of VarianInc Chromatography Systems.	83
<b>Figure 4.7</b>	Parameters in the Saturn GC-MS-MS Scan Function, Courtesy of VarianInc Chromatography Systems.	84
<b>Figure 4.8</b>	Mass range vs CID bandwidth for an excitation rf storage level of 48 m/z, Courtesy of VarianInc Chromatography Systems.	87
<b>Figure 4.9</b>	Mass range vs CID bandwidth for an excitation rf storage level of 143 m/z, Courtesy of VarianInc Chromatography Systems.	87

		<b>Page</b>
<b>Figure 4.10.1</b>	Parameters required for calculating the information content of MS and MS <sup>n</sup> , courtesy of Dr Bob Brittain, Varian Inc.	88
<b>Figure 4.10.2</b>	Calculations showing the information content of MS, courtesy of Dr Bob Brittain, Varian Inc.	89
<b>Figure 4.10.3</b>	Calculations showing the information content of MS <sup>n</sup> . Courtesy of Dr Bob Brittain, Varian Inc.	90
<b>Figure 5.1</b>	Varian Star 3800CX gas Chromatograph coupled with a Varian Saturn 2000 GC-MS-MS Ion Trap Mass Spectrometer, courtesy of Varian Inc.	93
<b>Figure 5.2.1</b>	Comparison between the MS selected ion Profile chromatogram for m/z = 91 and the MS-MS product ion chromatogram for selected parent ion 91.	94
<b>Figure 5.2.2</b>	Comparison between the MS selected ion Profile chromatogram for m/z = 91 and the Reconstructed MS-MS product ion chromatogram for selected parent ion 91 using m/z = 91.	95
<b>Figure 5.3</b>	Comparison between the MS spectrum for Propylbenzene and the MS-MS spectrum for propylbenzene using parent ion 91.	96
<b>Figure 5.4.1</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 1 = 25 volts CID excitation amplitude.	103
<b>Figure 5.4.2</b>	AMD product ion mass spectrum for 1,2,4- trimethylbenzene (parent ion mass = 120), channel 2 = 30 volts CID excitation amplitude.	103
<b>Figure 5.4.3</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 3 = 35 volts CID excitation amplitude.	104
<b>Figure 5.4.4</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 4 = 40 volts CID excitation amplitude.	104
<b>Figure 5.4.5</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 5 = 45 volts CID excitation amplitude.	105

		<b>Page</b>
<b>Figure 5.4.6</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 6 = 50 volts CID excitation amplitude.	105
<b>Figure 5.4.7</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 7 = 55 volts CID excitation amplitude.	106
<b>Figure 5.4.8</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 8 = 60 volts CID excitation amplitude.	106
<b>Figure 5.4.9</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 9 = 65 volts CID excitation amplitude.	107
<b>Figure 5.4.10</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 10 = 70 volts CID excitation amplitude.	107
<b>Figure 5.5.1</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 1 = 43 volts CID excitation amplitude.	108
<b>Figure 5.5.2</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 2 = 44 volts CID excitation amplitude.	109
<b>Figure 5.5.3</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 3 = 45 volts CID excitation amplitude.	109
<b>Figure 5.5.4</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 4 = 46 volts CID excitation amplitude.	110
<b>Figure 5.5.5</b>	AMD product ion mass spectrum for 1,2,4- trimethylbenzene (parent ion mass = 120), channel 5 = 47 volts CID excitation amplitude.	110
<b>Figure 5.5.6</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 6 = 48 volts CID excitation amplitude .	111
<b>Figure 5.5.7</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 7 = 49 volts CID excitation amplitude.	111

	<b>Page</b>
<b>Figure 5.5.8</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 8 = 50 volts CID excitation amplitude. 112
<b>Figure 5.5.9</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 9 = 51 volts CID excitation amplitude. 112
<b>Figure 5.5.10</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (parent ion mass = 120), channel 10 = 52 volts CID excitation amplitude. 113
<b>Figure 5.6</b>	The AMD product ion chromatogram for an excitation storage level incorrectly set at 75 m/z (upper trace) and correctly set at 48m/z (lower trace). (1) benzene, (2) toluene, (3) ethylbenzene, (4) m,p-xylene, (5) o-xylene, (6) isopropylbenzene, (7) 1,2,4-trimethylbenzene, (8) indane, (9) naphthalene, (10) 2-methylnaphthalene. 115
<b>Figure 5.7.1</b>	AMD product ion chromatographic peak and mass spectrum for benzene (78 m/z, CID voltage for channel 1 = 59). The upper trace product mass spectrum is obtained when the excitation storage level is set too high. The expected product mass spectrum is reflected in the lower trace with an excitation storage level of 48 m/z. 116
<b>Figure 5.7.2</b>	AMD product ion mass spectrum for toluene (m/z = 92, CID amplitude voltage = 57 for channel 1) and ethylbenzene (m/z = 106, CID amplitude voltage = 57 for channel 1). 117
<b>Figure 5.7.3</b>	AMD product ion mass spectrum for 1,2,4-trimethylbenzene (m/z = 120, CID amplitude voltage = 53 for channel 1) and Indane (m/z = 117, CID amplitude voltage = 53 for channel 1). 117
<b>Figure 5.8.1</b>	AMD product ion mass spectrum for benzene (m/z = 78) and toluene (m/z = 92) using the minimum advised excitation storage of 48 m/z. 118

		<b>Page</b>
<b>Figure 5.8.2</b>	AMD product ion mass spectrum for ethylbenzene ( $m/z = 106$ ) with the excitation storage level selected as 48 $m/z$ and isopropylbenzene ( $m/z = 120$ ) with an excitation storage level of 52.7 $m/z$ as calculated using the "q" calculator.	207
<b>Figure 5.8.3</b>	AMD product ion mass spectrum for propylbenzene ( $m/z = 120$ ) and mesitylene ( $m/z = 120$ ) with the excitation storage level selected as 52.7 $m/z$ as calculated using the "q" calculator.	208
<b>Figure 5.8.4</b>	AMD product ion mass spectrum for naphthalene ( $m/z = 128$ ) and 2-methylnaphthalene ( $m/z = 142$ ) with the excitation storage level selected as 56.2 $m/z$ and 62.4 $m/z$ as calculated using the "q" calculator.	208
<b>Figure 5.9.1</b>	AMD product total ion chromatogram for petrol using "toolkit". The data points have not been merged.	119
<b>Figure 5.9.2</b>	AMD product ion chromatogram for ethylbenzene and the xylenes. The chromatogram in the upper trace is the raw data. The chromatogram in the lower trace has been merged.	120
<b>Figure 5.9.3</b>	The total product ion chromatogram for petrol using toolkit. The chromatogram in the upper trace is the raw data. The chromatogram in the lower trace has been merged.	120
<b>Figure 5.9.4</b>	Comparison between the MS chromatogram for petrol and the MS-MS toolkit product ion chromatogram for petrol (merged).	121
<b>Figure 5.10.1</b>	Selected AMD product ion mass chromatogram for the C4 and C5-alkylbenzenes.	122
<b>Figure 5.10.2</b>	Selected AMD product ion mass chromatogram for the C4 and C5-alkylbenzenes.	122

	<b>Page</b>	
<b>Figure 5.11.1</b>	The AMD product ion mass chromatogram for a simulated aromatic mixture (upper trace) with the AMD product ion mass chromatogram for petrol (lower trace). [(1) benzene, (2) toluene, (3) ethylbenzene, (4) p-xylene, (5) o-xylene, (6) isopropylbenzene, (7) propylbenzene, (8) mesitylene, (9) p-isopropyltoluene, (10) indane, (11) naphthalene, (12) hexylbenzene, (13) 2-methylnaphthalene].	123
<b>Figure 5.11.2</b>	Comparison between a simulated aromatic mix (upper trace) and a petrol standard (lower trace) of the AMD product ion mass spectra for benzene ( $m/z = 78$ ), before finalizing the CID voltages.	209
<b>Figure 5.11.3</b>	Comparison between a simulated aromatic mix (upper trace) and a petrol standard (lower trace) of the AMD product ion mass spectra for toluene ( $m/z = 92$ ), before finalizing the CID voltages.	209
<b>Figure 5.11.4</b>	Comparison between a simulated aromatic mix (upper trace) and a petrol standard (lower trace) of the AMD product ion mass spectra for ethylbenzene and the xylenes using o-xylene ( $m/z = 106$ ), before finalizing the CID voltages.	210
<b>Figure 5.11.5</b>	Comparison between a simulated aromatic mix (upper trace) and a petrol standard (lower trace) of the AMD product ion mass spectra for isopropylbenzene ( $m/z = 120$ ), before finalizing the CID Voltages.	210
<b>Figure 5.11.6</b>	Comparison between a simulated aromatic mix (upper trace) and a petrol standard (lower trace) of the AMD product ion mass spectra for propylbenzene ( $m/z = 120$ ), before finalizing the CID voltages.	211
<b>Figure 5.11.7</b>	Comparison between a simulated aromatic mix (upper trace) and a petrol standard (lower trace) of the AMD product ion mass spectra for mesitylene ( $m/z = 120$ ), before finalizing the CID voltages.	211

		<b>Page</b>
<b>Figure 5.11.8</b>	Comparison between a simulated aromatic mix (upper trace) and a petrol standard (lower trace) of the AMD product ion mass spectra for p-iso propyltoluene ( $m/z = 120$ ), before finalizing the CID voltages.	212
<b>Figure 5.11.9</b>	Comparison between a simulated aromatic mix (upper trace) and a petrol standard (lower trace) of the AMD product ion mass spectra for indane ( $m/z = 117$ ), before finalizing the CID voltages.	212
<b>Figure 5.11.10</b>	Comparison between a simulated aromatic mix (upper trace) and a petrol standard (lower trace) of the AMD product ion mass spectra for naphthalene ( $m/z = 128$ ), before finalizing the CID voltages.	213
<b>Figure 5.11.11</b>	Comparison between a simulated aromatic mix (upper trace) and a petrol standard (lower trace) of the AMD product ion mass spectra for hexylbenzene ( $m/z = 162$ ), before finalizing the CID voltages. This indicates the need for correcting the voltages, since the hexylbenzene peak is minute in petrol.	213
<b>Figure 5.11.12</b>	Comparison between a simulated aromatic mix (upper trace) and a petrol standard (lower trace) of the AMD product ion mass spectra for 2-methylnaphthalene ( $m/z = 142$ ), before finalizing the CID voltages.	214
<b>Figure 5.12.1</b>	Comparison between the initial and final AMD product ion mass spectra for benzene.	124
<b>Figure 5.12.2</b>	Comparison between the initial and final AMD product ion mass spectra for toluene.	215
<b>Figure 5.12.3</b>	Comparison between the initial and final AMD product ion mass spectra for ethylbenzene, m,p-xylene and o-xylene using m,p-xylene as an example.	215
<b>Figure 5.12.4</b>	Comparison between the initial and final AMD product ion mass spectra for isopropylbenzene and propylbenzene, using propylbenzene as an example.	216

	<b>Page</b>
<b>Figure 5.12.5</b>	Comparison between the initial and final AMD product ion mass spectra for the C3-alkylbenzenes, using 1,2,4-trimethylbenzene as an example. 216
<b>Figure 5.12.6</b>	Comparison between the initial and final AMD product ion mass spectra for Indane. 217
<b>Figure 5.12.7</b>	Comparison between the initial and final AMD product ion mass spectra for the C4-alkylbenzenes, using 1,2,4,5-tetramethylbenzene as an example. 217
<b>Figure 5.12.8</b>	Comparison between the initial and final AMD product ion mass spectra for the C5-alkylbenzenes, using 1-methyl-4-(1-methylpropyl)benzene as an example. 218
<b>Figure 5.12.9</b>	Comparison between the initial and final AMD product ion mass spectra for the C6-alkylbenzenes, using 1-ethyl-1-methylpropylbenzene as an example. 218
<b>Figure 5.12.10</b>	Comparison between the initial and final AMD product ion mass spectra for naphthalene. 219
<b>Figure 5.12.11</b>	Comparison between the initial and final AMD product ion mass spectra for the C1-alkylnaphthalenes, using 2-methylnaphthalene as an example. 219
<b>Figure 5.12.12</b>	Comparison between the initial and final AMD product ion mass spectra for the C2-alkylnaphthalenes, using dimethylnaphthalene as an example. 220
<b>Figure 5.12.13</b>	Comparison between the initial and final AMD product ion mass spectra for the C3-alkylnaphthalenes, using trimethylnaphthalene as an example. 220
<b>Figure 5.13.1</b>	MS-MS product ion mass spectrum for benzene. 127
<b>Figure 5.13.2</b>	MS-MS product ion mass spectrum for toluene. 221
<b>Figure 5.13.3</b>	MS-MS product ion mass spectrum for ethylbenzene. 221
<b>Figure 5.13.4</b>	MS-MS product ion mass spectrum for o-xylene. 222
<b>Figure 5.13.5</b>	MS-MS product ion mass spectrum for isopropylbenzene. 222
<b>Figure 5.13.6</b>	MS-MS product ion mass spectrum for propylbenzene. 223
<b>Figure 5.13.7</b>	MS-MS product ion mass spectrum for mesitylene. 223

		<b>Page</b>
<b>Figure 5.13.8</b>	MS-MS product ion mass spectrum for 1,2,4-trimethylbenzene.	224
<b>Figure 5.13.9</b>	MS-MS product ion mass spectrum for 1-methyl-3-propylbenzene (C4-alkylbenzene).	224
<b>Figure 5.13.10</b>	MS-MS product ion mass spectrum for 1,2,3,5-tetramethylbenzene (C4-alkylbenzene).	225
<b>Figure 5.13.11</b>	MS-MS product ion mass spectrum for 1-ethyl-1-methylpropylbenzene (C5-alkylbenzene).	225
<b>Figure 5.13.12</b>	MS-MS product ion mass spectrum for 1-ethyl-2,4,5-trimethylbenzene (C5-alkylbenzene).	226
<b>Figure 5.13.13</b>	MS-MS product ion mass spectrum for 1-ethyl-methylpropylbenzene (C6-alkylbenzene).	226
<b>Figure 5.13.14</b>	MS-MS product ion mass spectrum for naphthalene.	227
<b>Figure 5.13.15</b>	MS-MS product ion mass spectrum for 2-methylnaphthalene.	227
<b>Figure 5.13.16</b>	MS-MS product ion mass spectrum for dimethylnaphthalene.	228
<b>Figure 5.13.17</b>	MS-MS product ion mass spectrum for trimethylnaphthalene.	228
<b>Figure 5.14.1</b>	Comparison between the MS mass spectrum and the MS-MS product ion mass spectrum for benzene.	128
<b>Figure 5.14.2</b>	Comparison between the MS mass spectrum and the MS-MS product ion mass spectrum for toluene.	229
<b>Figure 5.14.3</b>	Comparison between the MS mass spectrum and the MS-MS product ion mass spectrum for o-xylene.	229
<b>Figure 5.14.4</b>	Comparison between the MS mass spectrum and the MS-MS product ion mass spectrum for propylbenzene.	230
<b>Figure 5.14.5</b>	Comparison between the MS mass spectrum and the MS-MS product ion mass spectrum for 1,2,4-trimethylbenzene.	230
<b>Figure 5.14.6</b>	Comparison between the MS mass spectrum and the MS-MS product ion mass spectrum for indane.	231
<b>Figure 5.14.7</b>	Comparison between the MS mass spectrum and the MS-MS product ion mass spectrum for 1,2,3,5-tetramethylbenzene.	231
<b>Figure 5.14.8</b>	Comparison between the MS mass spectrum and the MS-MS product ion mass spectrum for 1-ethyl-1-methylpropylbenzene.	232

	<b>Page</b>	
<b>Figure 5.14.9</b>	Comparison between the MS mass spectrum and the MS-MS product ion mass spectrum for 1-ethyl-methylpropylbenzene.	232
<b>Figure 5.14.10</b>	Comparison between the MS mass spectrum and the MS-MS product ion mass spectrum for naphthalene.	233
<b>Figure 5.14.11</b>	Comparison between the MS mass spectrum and the MS-MS product ion mass spectrum for 2-methylnaphthalene.	233
<b>Figure 5.14.12</b>	Comparison between the MS mass spectrum and the MS-MS product ion mass spectrum for dimethylnaphthalene.	234
<b>Figure 5.14.13</b>	Comparison between the MS mass spectrum and the MS-MS product ion mass spectrum for trimethylnaphthalene.	234
<b>Figure 5.15.1</b>	MS-MS product ion mass chromatogram for lacquer thinners.	130
<b>Figure 5.15.2</b>	MS-MS product ion mass chromatogram for lighter fluid.	131
<b>Figure 5.15.3</b>	MS-MS product ion mass chromatogram for avgas.	131
<b>Figure 5.15.4</b>	MS-MS product ion mass chromatogram for genuine turpentine.	132
<b>Figure 5.15.5</b>	MS-MS product ion mass chromatogram for mineral turpentine (white spirits).	132
<b>Figure 5.15.6</b>	MS-MS product ion mass chromatogram for unevaporated petrol.	133
<b>Figure 5.15.7</b>	MS-MS product ion mass chromatogram for kerosene.	133
<b>Figure 5.15.8</b>	MS-MS product ion mass chromatogram for paraffin.	134
<b>Figure 5.15.9</b>	MS-MS product ion mass chromatogram for jet fuel.	134
<b>Figure 5.15.10</b>	MS-MS product ion mass chromatogram for diesel.	135
<b>Figure 5.15.11</b>	MS-MS product ion mass chromatogram for fuel oil.	135
<b>Figure 6.1.1</b>	Total chromatographic ion profile for a petrol standard by GC-MS. The reconstructed ion profiles for the aromatic hydrocarbons are depicted below the total ion profile.	138

		<b>Page</b>
<b>Figure 6.1.2</b>	Total chromatographic ion profile for a petrol standard by GC-MS. The reconstructed ion profiles for the aliphatic hydrocarbons, naphthalene and the alkylnaphthalenes depicted below the total ion profile.	139
<b>Figure 6.1.3</b>	Total chromatographic ion profile for a debris sample of floor screed by GC-MS. The reconstructed ion profiles for the aromatic hydrocarbons are depicted below the total ion profile.	140
<b>Figure 6.1.4</b>	Total chromatographic ion profile for a debris sample of floor screed by GC-MS. The reconstructed ion profiles for the aliphatic hydrocarbons, naphthalene and the alkylnaphthalenes are depicted below the total ion profile.	140
<b>Figure 6.1.5</b>	The MS-MS product ion chromatogram (aromatic hydrocarbon profiles – table 5.6) for a petrol standard with the MS-MS product ion chromatogram for the debris sample of floor screed below.	141
<b>Figure 6.1.6</b>	The selected time segment MS-MS product ion chromatogram for a petrol standard with the selected MS-MS product ion chromatogram for the debris sample of floor screed below, to illustrate more clearly the C3 and C4-alkylbenzenes, naphthalene and the C1-naphthalenes.	142
<b>Figure 6.1.7</b>	The GC-MS total chromatographic ion profile for the sample of floor screed with the GC-MS-MS product chromatographic ion profile below. The MS-MS aromatic hydrocarbon profile is clearly less “cluttered” than the MS total ion profile.	143
<b>Figure 6.2.1</b>	Total chromatographic ion profile for a petrol standard by GC-MS with the total chromatographic ion profile for a debris sample of charred pine floor planking below. The terpenoid compounds visible in the pine floor planking sample obscure the aromatic compounds.	144

	<b>Page</b>	
<b>Figure 6.2.2</b>	Reconstructed ion profile for a petrol standard showing the C2-alkylbenzenes by GC-MS (upper trace). The reconstructed ion profiles for the C2 and C3-alkylbenzenes for the charred pine floor planking sample are depicted in the middle trace in which the Y-axis has been expanded to illustrate how the terpenoid compounds interfere with the C2 and C3-alkylbenzenes. In the lower trace the C3 and C4-alkylbenzenes have been selected to show that the terpenoid interference lies mainly within the C3-alkylbenzene region	145
<b>Figure 6.2.3</b>	The MS-MS aromatic product ion profile (table 5.6) for a petrol standard (upper trace) with the MS-MS product ion profile for the debris sample of charred pine floor planking depicted in the lower trace.	146
<b>Figure 6.2.4</b>	Selected time segment MS-MS product ion profile (all product ions of $m/z = 120$ ) for a petrol standard (upper trace) with the selected time segment MS-MS product ion profile for the debris sample of charred pine floor planking (lower trace). The C3-alkylbenzenes are shown with an artefact peak lying adjacent to the mesitylene peak.	147
<b>Figure 6.2.5</b>	Reconstructed MS-MS product ion profile (SRM $120 \rightarrow 105$ ) for a petrol standard using $m/z = 105$ with the reconstructed MS-MS product ion profile for the debris sample of charred pine floor planking (lower trace). The C3-alkylbenzenes are shown with the artefact peak removed.	148
<b>Figure 6.2.6</b>	Product ion spectrum of parent ion $m/z = 120$ for mesitylene in a petrol standard (lower spectrum). The same parent ion was selected for the charred pine floor planking sample and the product ion spectrum obtained is depicted in the upper spectrum.	149

		<b>Page</b>
<b>Figure 6.2.7</b>	The unknown chromatographic peak from the charred pine planking sample adjacent to mesitylene produced the product ion spectrum of $m/z = 120$ (upper spectrum) and the product ion spectrum for the parent ion $m/z = 120$ for mesitylene in a petrol standard (lower spectrum).	150
<b>Figure 6.3.1</b>	Total chromatographic ion profile for a debris sample of shoe debris and carpeting from a shoe store with the total chromatographic ion profile for a petrol standard depicted beneath	151
<b>Figure 6.3.2</b>	Selected ion profile for a debris sample of shoe debris and carpeting from a shoe store with the selected ion profile for a petrol standard depicted beneath, showing the C2, C3 and C4-alkylbenzenes.	151
<b>Figure 6.3.3</b>	The MS-MS product ion profile (RT = 6 – 24 min, parent ions for segment 4; $m/z = 91$ – segment 17; $m/z = 170$ ) for a petrol standard by GC-MS (upper trace) with the product ion MS-MS profile for the debris sample of shoes and carpeting from a shoe store depicted beneath.	152
<b>Figure 6.3.4</b>	Selected time segment MS-MS product ion profile for a petrol standard, with the selected time segment MS-MS product ion profile for a debris sample of shoes and carpeting from a shoe store below, showing the C3 and C4-alkylbenzenes.	153
<b>Figure 6.3.5</b>	Reconstructed MS-MS product ion profile for a petrol standard using $m/z = 105$ with the reconstructed MS-MS product ion profile ( $m/z = 105$ ) for the debris sample of shoes and carpeting from a shoe store below, showing the C3-alkylbenzenes more clearly.	153
<b>Figure 6.4.1</b>	Total chromatographic ion profile for a debris sample of gymnasium floor cover and a petrol standard analysed by GC-MS.	155
<b>Figure 6.4.2</b>	The total GC-MS ion profile depicted in the upper trace with the selected ion profiles for the C2 to C4-alkylbenzenes depicted beneath.	155

		<b>Page</b>
<b>Figure 6.4.3</b>	The MS-MS product ion profile (RT = 12 - 22 min, parent ions for segment 6; m/z = 120 – segment 15; m/z = 142) for a petrol standard, with the MS-MS product ion profile for the debris sample of gymnasium floor covering depicted beneath.	156
<b>Figure 6.5.1</b>	Total chromatographic ion profile for a sample of carpet and bedding from a home and a petrol standard.	157
<b>Figure 6.5.2</b>	Total chromatographic ion profile for a debris sample of carpeting and bedding by GC-MS (upper trace). The selected ion profiles for the C2 to C4-alkylbenzenes are depicted beneath.	157
<b>Figure 6.5.3</b>	The MS-MS product ion profile (RT = 12 - 22 min, parent ions for segment 6; m/z = 120 – segment 15; m/z = 142) for a petrol standard (upper trace), with the MS-MS product ion profile for the debris sample of carpeting and bedding (lower trace), showing the C3, C4, C5-alkylbenzenes, naphthalene and the C1-Naphthalenes.	158
<b>Figure 6.6.1</b>	Total chromatographic ion profile for a sample of burnt plastic from a factory and a petrol standard.	159
<b>Figure 6.6.2</b>	Selected MS ion profiles for a sample of burnt plastic from a factory and a petrol standard, showing the C2, C3 and C4-alkylbenzenes.	160
<b>Figure 6.6.3</b>	Selected MS-MS product ion profiles (RT = 6 – 20 min, Parent ions for segment 5; m/z = 106 – segment 12; m/z = 148) for a sample of burned plastic from a factory and a petrol standard, showing the C2, C3, C4 and C5-alkylbenzenes. Interferences are still visible.	161
<b>Figure 6.6.4</b>	Reconstructed MS-MS product ion profile (SRM 120 → 105) for a sample of burnt plastic using m/z = 105 with the reconstructed MS-MS product ion profile for a petrol standard below. The C3-alkyl-benzenes are clearly shown with the $\alpha$ -methylstyrene interference removed.	162

		<b>Page</b>
<b>Figure 6.7.1</b>	Total chromatographic ion profiles for a sample of charred carpet and a petrol standard, showing the C2, C3 and C4-alkylbenzenes.	163
<b>Figure 6.7.2</b>	Selected MS chromatographic ion profiles for a sample of charred carpet and a petrol standard, showing the C2, C3 and C4-alkylbenzenes.	164
<b>Figure 6.7.3</b>	MS-MS product ion profiles (RT = 6 – 24 min, parent ions for segment 4; m/z = 91 – segment 17; m/z = 170) for a sample of charred carpet and a petrol standard, showing the C2, C3, C4 and C5-alkylbenzenes, naphthalene and methylnaphthalenes.	165
<b>Figure 6.7.4</b>	Reconstructed MS-MS product ion profile (SRM 120 → 105) for a sample of charred carpet using m/z = 105 with the reconstructed MS-MS ion profile for a petrol standard below. The ratios of the C3-alkylbenzenes are evident although there are still interferences present.	166
<b>Figure 6.7.5</b>	MS-MS product ion profiles for burnt debris, burnt carpet and burnt plastic samples and a petrol standard.	167
<b>Figure 6.7.6</b>	Reconstructed MS-MS product ion profiles (SRM 120 → 105) for burnt debris, burnt carpet and burnt plastic samples and a petrol standard, using m/z = 105.	167
<b>Figure 7.1</b>	Comparison between the total chromatographic ion profile for petrol generated by chemical ionization using methanol and conventional electron impact ionisation.	172
<b>Figure 7.2</b>	Comparison between the selected aromatic ion profile for petrol generated by CI using methanol and conventional EI.	173
<b>Figure 7.3</b>	The MS spectrum for toluene from a petrol standard with the upper trace and spectrum generated by CI and the lower trace and spectrum generated with conventional EI.	173

		<b>Page</b>
<b>Figure 7.4</b>	The CI-MS-MS (Table 7.1) and EI-MS-MS (Table 5.6) product ion profiles for a petrol standard.	174
<b>Figure 7.5</b>	Comparison between an MS-MS product ion spectrum for 1,2,4-trimethylbenzene generated by CI (upper trace and spectrum) and conventional EI (lower trace and spectrum).	175
<b>Figure 7.6</b>	Comparison between an MS-MS product ion spectrum for naphthalene generated by CI above and conventional EI below.	175
<b>Figure 7.7</b>	CI-MS-MS product ion spectrum for a petrol standard and a sample of carpet debris (Table 7.1).	177