Conditions and Sample preparation of fuel (Gasoline and diesel) for Gas Chromatography-Mass Spectrometry

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ABSTRACT

To investigate forensic evidence in fire cases and determine whether fuel or flammable chemicals were involved, Gas Chromatography-Mass Spectrometry (GC-MS) Given the need to switch the type of column used in the GC-MS, challenges arose in reusing the original analytical conditions, requiring optimized adjustments for better performance. The conditions were modified, and the method's validation was carried out by evaluating linearity and precision. The results indicated that the adjusted method met all acceptance criteria, confirming its suitability for fuel analysis. Furthermore, this method can be applied to study the behavior of Gasohol 95 and Diesel B7 fuels, providing guidance for forensic teams on the optimal time to collect evidence from the scene. In the behavior study, Gasohol 95 and Diesel B7 fuels from five suppliers PTT Station, Bangchak, PT, Shell, and Caltex were tested. The study of the EIC (Extracted Ion Chromatogram) patterns from the analysis supports the decision-making process when dealing with minimal fuel residues. This ensures that analysts can determine whether the evidence contains fuel. Based on the findings, it is recommended that crime scene investigators collect fuel-related evidence within 8 hours, as this is the window during which the analysis can still reliably identify the fuel according to reference.

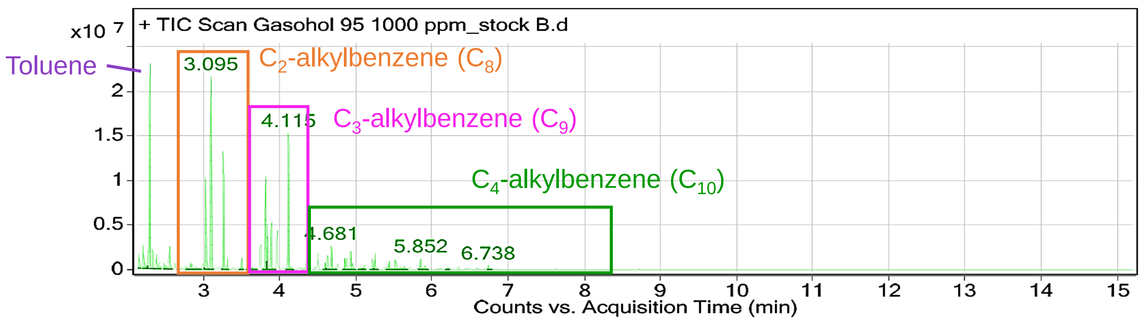
INTRODUCTION

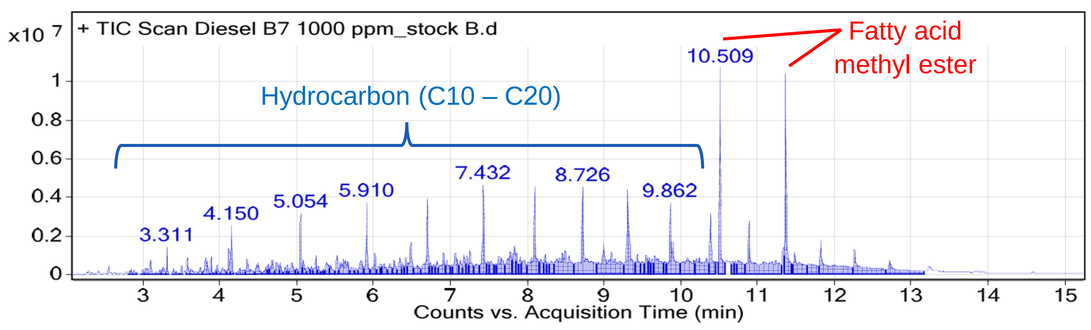
In the process of fuel analysis, the instrument used for analysis is the GC-MS (Gas Chromatography-Mass Spectrometer) which is employed to determine the chemical composition of fuels. Due to a column change from HP-5MS to a wider DB-5MS new analytical conditions were optimized. Method validation was conducted by evaluating linearity and precision. Once the optimal conditions were established, the study focused on the behavioral changes of Gasohol 95 and Diesel B7 fuels. This research provides guidance for crime scene investigators on the appropriate time to collect fuel-related evidence.

MATHOD

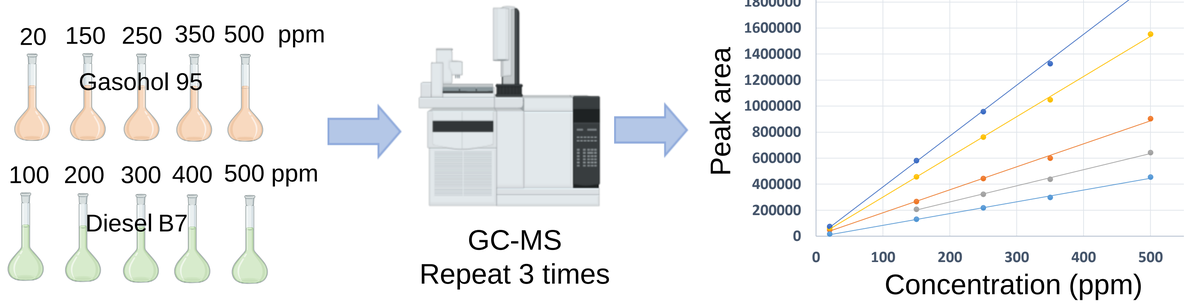
1. Optimize Condition

GC : 78090 B Agilent Technologies Gas Chromatograph-MS (Detector)
Column : DB-5MS, Phenyl arylene polymer (30 m x 0.320 mm x 0.25 micron)
Carrier gas : Helium (99.9995 %)
Carrier gas flow : 2 mL/min
Injector temperature : 50 °C
Temperature program : 50 °C hold time 2 min
: 50 °C to 100 °C rate 50 °C/min hold time 1 min
: 100 °C to 265 °C rate20 °C/min hold time 3 min
Post Run : 290 °C hold time 1 min
Solvent delay : 2 min





2. Linearity



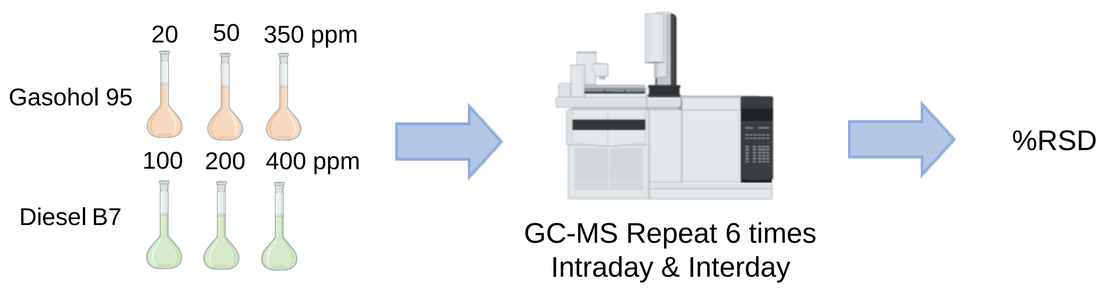
	Elements	Retention time (min)	Equation	R^2
Gasohol 95	Toluene	2.297	y = 3269.7x - 23650	0.9979
	Ethyl benzene	3.031	y = 729.19x - 5232.7	0.9990
	p-Xylene	3.095	y = 2512.4x - 10290	0.9996
	o-Xylene	3.264	y = 1034x + 3095.6	0.9991
	1,2,4-Trimethylbenzene	4.115	y = 1458.7x - 7607	0.9985
Diesel B7	Tetradecane	7.414	y = 319.16x - 11462	0.9968
	Ethyl benzene	10.498	y = 504.86x - 32118	0.9981

ACKNOWLEDGEMENTS

The author would like to express her sincere thank to Assoc. Prof. Dr. Piyarat Nimmanpipug (CMU Advisor) and Pol. Lt.Col Sunattha Tunplook (PFSC5 Advisor) for their advice and support.

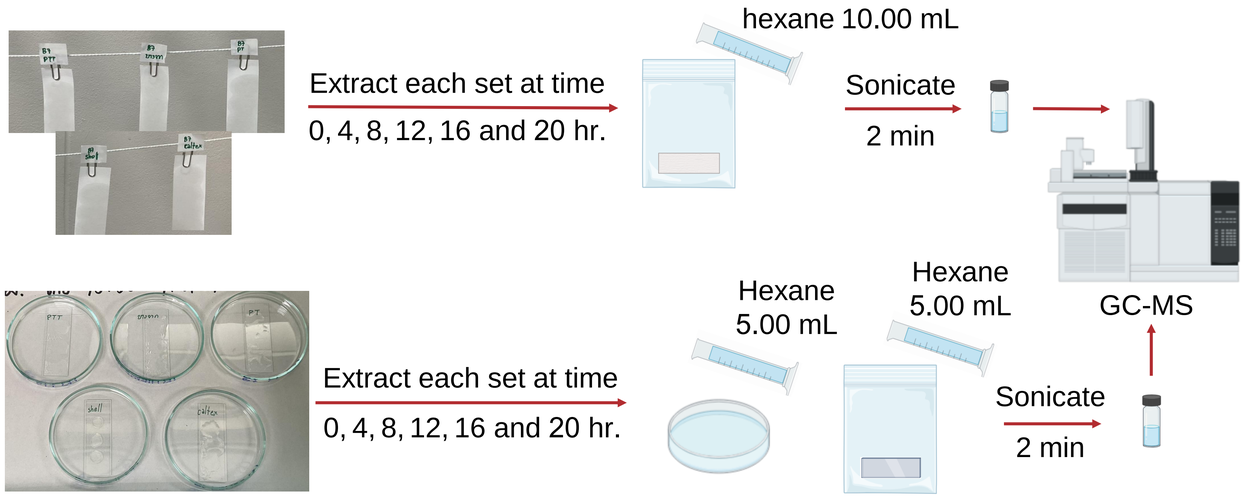
MATHOD

3. Precision



Elements	Concentration (ppm)	Intraday RSD (%)	Interday RSD (%)
Toluene	20	0.915	0.515
	150	1.387	0.634
	350	0.542	1.519
Ethyl benzene	20	1.622	1.522
	150	1.594	1.987
	350	1.419	1.184
p-Xylene	20	1.935	1.721
	150	1.981	1.958
	350	1.793	0.329
o-Xylene	20	1.379	1.697
	150	1.164	1.321
	350	0.826	1.065
1,2,4-Trimethylbenzene	20	0.734	0.701
	150	0.646	1.485
	350	0.620	0.319
Tetradecane	100	1.008	0.601
	200	0.245	1.639
	400	1.079	1.745
Methyl ester	100	0.512	1.630
	200	1.035	1.769
	400	0.571	1.942

4. Study of characteristic changes of fuel



hour	Specific Pattern Profile (ions)																							
	Alkane					Cycloalkane				Aromatic				Indanes					Polynuclear Aromatic					
	57	71	85	99	Total Pattern	55	69	83	Total Pattern	91	105	119	Total Pattern	117	118	131	132	Total Pattern	128	142	153	Total Pattern		
0	+	+	+	+	✓	+	+	+	✓	+	+	+	✓	+	+	+	+	✓	+	+	+	✓		
4	-	-	-	-	✗	-	-	-	✗	+	+	+	✓	-	-	-	-	✗	+	-	-	✗		
8	-	-	-	-	✗	-	-	-	✗	+	+	-	✓	-	-	-	-	✗	+	-	-	✗		
12	-	-	-	-	✗	-	-	-	✗	+	+	-	✗	+	+	+	+	✓	+	+	-	✗		
16	-	-	-	-	✗	-	-	-	✗	+	+	-	✗	-	-	-	-	✗	+	-	-	✗		
20	-	-	-	-	✗	-	-	-	✗	+	+	-	✗	-	-	-	-	✗	+	-	-	✗		

CONCLUSIONS

Study of Optimizing Conditions in GC-MS of Fuel Oils

- Appropriate Condition is Condition OP 8
- Linearity passed the test criteria.
- Precision passed the test criteria.

Study of the changing behavior of fuels over time on paper and glass.

Gasohol 95 and Diesel B7 after 8 hours on paper and glass gave results that were not consistent with the reference. Therefore, it is recommended that the crime scene investigation group should collect evidence within 8 hours.

References:
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