ALS Environmental

LIBRARY OF PETROLEUM PRODUCTS

AND OTHER ORGANIC COMPOUNDS

Content

Introduction

The GC/FID method is used for analysis of extractable hydrocarbons which are usually products from distillation of crude oil. Refined fractions obtained during petroleum processing are mentioned in the following table:

Fraction	Boiling point (°C)	n-Alkanes
Gas hydrocarbons	< 5	C1 – C4
Light gasoline	30 – 85	C5 – C6
Heavy gasoline	85 - 180	C7 – C10
Paraffin oil	180 – 270	C11 – C15
Gas oil	270 – 370	C16 – C22
Vacuum spirits	370 – 550	C23 – C45
Vacuum waste	over 550	> C46

The GC/FID method is capable of analysing hydrocarbons in boiling point range between 85 and 350°C. Low boiling fractions like Gas hydrocarbons or Light gasoline cannot be determined using by method GC/FID similar to heavy hydrocarbons like Vacuum Spirits and Vacuum Waste.

Characterization of Some Petroleum Products

Petroleum

Petroleum or crude oil is a naturally occurring, toxic, flammable liquid consisting of a complex mixture of hydrocarbons of various molecular weights, and other organic compounds, that are found in geologic formations beneath the Earth's surface. Petroleum is recovered mostly through oil drilling. It is refined and separated, most easily by boiling point, into a large number of consumer products, from petrol and kerosene to asphalt and chemical reagents used to make plastics and pharmaceuticals.

Gasoline

Gasoline or petrol is a petroleum-derived liquid flammable mixture consists mostly of hydrocarbons and enhanced with isooctane or aromatics hydrocarbons toluene and benzene to increase octane ratings. Gasoline is primarily used as a fuel in combustiwe of the additives that are put into it. The bulk of a typical gasoline consists of hydrocarbons with between 4 and 12 carbon atoms per molecule. Depending on use, it can be classified:

- Automobile gasoline
- Aviation gasoline
- Technical (solvent)

Octane Rating

The octane rating is a measure of the resistance of petrol and other fuels to autoignition in spark-ignition internal combustion engines.
The octane number of a fuel is measured in a test engine, and is defined by comparison with the mixture of 2,2,4-trimethylpentane (iso-octane) and heptane which would have the same anti-knocking capacity as the fuel under test: the percentage, by volume, of 2,2,4-trimethylpentane in that mixture is the octane number of the fuel. For example, petrol with the same knocking characteristics as a mixture of 95 % iso-octane and 5 % heptane would have an octane rating of 95. Lead in the form of tetra-ethyl lead was once a common antiknock additive, but since the 1970s, its use in most of the industrialised world has been restricted, and its use is currently limited mostly to aviation gasoline. It is complicated to find out the octane rating by GC/FID method because the chromatographic profiles are very similar.

Mineral spirits

Mineral Spirits, also called Stoddard solvent, is a petroleum distillate commonly used as a paint thinner and mild solvent. In Europe, it is referred to as petroleum spirit or white spirit. Mineral spirits are especially effective in removing oils, greases, carbon, and other material from metal. Mineral spirits may also be used in conjunction with cutting oil as a thread cutting and reaming lubricant. A typical composition for mineral spirits is the following: aliphatic solvent hexane having a maximum aromatic hydrocarbon content of 0,1 % by volume, a kauri-butanol value of 29, an initial boiling point of 65 °C, a dry point of approximately 69 °C, and a specific mass of 0,7 g/cm^3.

Turpentine

Turpentine (also called spirit of turpentine, oil of turpentine, wood turpentine, gum turpentine) is a fluid obtained by the distillation of resin obtained from trees, mainly pine trees. It is composed of terpenes, mainly the monoterpenes alpha-pinene and beta-pinene ($C_{10}H_{16}$). Turpentine is representative of non petroleum product. The two primary uses of turpentine in industry are as a solvent and as a source of materials for organic synthesis. As a solvent, turpentine is used for thinning oil-based paints, for producing varnishes, and as a raw material for the chemical industry. Its industrial use as a solvent in industrialized nations has largely been replaced by the much cheaper turpentine substitutes distilled from crude oil also known as mineral turpentine (b.p. 150-180 °C).

Characterization of Some Petroleum Products

Kerosene

Kerosene or paraffin oil is a colorless, oily, highly flammable liquid with a strong odour, distilled from petroleum (10–25 % of total volume). It is a mixture of about 10 different types of fairly simple hydrocarbons, depending on its source. Fraction distillation resulting in a mixture of carbon chains that typically contain between 6 and 16 carbon atoms per molecule. It is less volatile than gasoline, boiling at 150–275 °C. It is burned in lamps, heaters, and furnaces and is used as a fuel or fuel component for diesel and tractor engines, jet engines, and rockets and as a solvent for greases and insecticides. Kerosene is sometimes used as an additive in diesel fuel to prevent gelling or waxing in cold temperatures.

Jet fuel

Jet fuel is a type of aviation fuel designed for use in aircraft powered by gas-turbine engines. It is clear to straw-colored in appearance. The most commonly used fuels for commercial aviation are Jet A and Jet A-1 which are produced to a standardized international specification. Jet fuel is a mixture of a large number of different hydrocarbons. The range of their sizes (molecular weights or carbon numbers) is restricted by the requirements for the product, for example, freezing point or smoke point. Kerosene-type jet fuel (including Jet A and Jet A-1) has a carbon number distribution between about 8 and 16 carbon numbers; wide-cut or naphtha-type jet fuel (including Jet B), between about 5 and 15 carbon numbers.

Fuel Oil

Fuel oil is a fraction obtained from petroleum distillation, either as a distillate or a residue. Broadly speaking, fuel oil is any liquid petroleum product that is burned in a furnace or boiler for the generation of heat or used in an engine for the generation of power, except oils having a flash point of approximately 40 °C and oils burned in cotton or wool-wick burners. In this sense, diesel is a type of fuel oil. Fuel oil is made of long hydrocarbon chains, particularly alkanes, cycloalkanes and aromatics. The term fuel oil is also used in a stricter sense to refer only to the heaviest commercial fuel that can be obtained from crude oil, heavier than gasoline and naphtha.

Fuel oil is classified into six classes, numbered 1 through 6, according to its boiling point, composition and purpose. The boiling point, ranging from 175-600 °C, and carbon chain length, 9 to 70 atoms, of the fuel increases with fuel oil number. Viscosity also increases with number, and the heaviest oil has to be heated in order to get into liquid state. Price usually decreases as the fuel number increases.

Diesel fuel

Diesel oil is a type of Fuel oil. It is produced from the fractional distillation of crude oil between 200 °C and 350 °C at atmospheric pressure, resulting in a mixture of carbon chains that typically contain between 8 and 21 carbon atoms per molecule with specific gravity range of 0.76–0.94. Diesel fuel quality is defined by the cetane number, which usually falls into the range 30–60. A high cetane number indicates the potential for easy starting and smooth operation of the engine. The cetane number is the analog of the automobile engine octane number, with cetane (n-hexadecane, $C_{16}H_{34}$) having the arbitrarily assigned number of 100. At the other end of the scale, heptamethylnonane, an isomer of cetane, has the assigned cetane number of 0.

Biodiesel

Fuel made from natural, renewable sources, such as new and used vegetable oils and animal fats, for use in a diesel engine. Biodiesel has physical properties very similar to petroleum-derived diesel fuel, but its emission properties are superior. Using biodiesel in a conventional diesel engine substantially reduces emissions of unburned hydrocarbons, carbon monoxide, sulfates, polycyclic aromatic hydrocarbons, nitrated polycyclic aromatic hydrocarbons, and particulate matter. Diesel blends containing up to 20 % biodiesel can be used in nearly all diesel-powered equipment, and higher-level blends and pure biodiesel can be used in many engines with little or no modification. Lower-level blends are compatible with most storage and distribution equipment, but special handling is required for higher-level blends.
Biodiesel is made from oils or fats, which are hydrocarbons. Fresh soybean oil is most commonly used, although biodiesel can be made from mustard seed oil or waste vegetable oil (such

as used oil from restaurant deep fryers). These hydrocarbons are filtered and mixed with an alcohol, such as methanol, and a catalyst (sodium hydroxide or potassium hydroxide), resulting in a chemical reaction whose major products are the biodiesel fuel and glycerol. Biodiesel refers to a vegetable oil or animal fat based diesel fuel consisting of long-chain alkyl (methyl, propyl or ethyl) esters. Products of catalyzed reaction between fats or fatty acids and methanol are fatty acid methyl esters (FAME).

Motor oil

Motor oils are derived from petroleum-based and non-petroleum-synthesized chemical compounds. Most motor oils are made from a heavier, thicker petroleum hydrocarbon base stock derived from crude oil, with additives to improve certain properties. The bulk of typical motor oil consists of hydrocarbons with between 18 and 34 carbon atoms per molecule. Motor oil is oil used for lubrication of various internal combustion engines. The main function is to lubricate moving parts. Motor oil also cleans, inhibits corrosion, improves sealing, and cools the engine by carrying heat away from moving parts. Motor oils are today mainly blended by using base oils composed of hydrocarbons (mineral, polyalphaolefins, polyinternal olefins), thus organic compounds consisting entirely of carbon and hydrogen. The base oils of some high-performance motor oils contain up to 20 % of esters.

The Society of Automotive Engineers (SAE) has established a numerical code system for grading motor oils according to their viscosity characteristics. SAE viscosity grade includes the following, from low to high viscosity: 0, 5, 10, 15, 20, 25, 30, 40, 50 or 60. The numbers 0, 5, 10, 15 and 25 are suffixed with the letter W, designating their “winter” (not “weight”) or cold-start viscosity, at lower temperature. The number 20 comes with or without a W, depending on whether it is being used to denote a cold or hot viscosity grade.

Hydraulic oil (Fluids)

Hydraulic fluids (liquids) are a large group based on mineral oils or water. It is used in machinery equipment ranging from brakes, hydraulic cylinders, power steering, and transmissions. Natural oils such as rapeseed (also called canola oil) are used as base stocks for fluids where biodegradability and renewable sources are considered important. Other base stocks are used for specialty applications, such as for fire resistance and extreme temperature applications. Some examples include: glycol, esters, organophosphate ester, polyalphaolefin, propylene glycol, and silicone oils. Hydraulic fluids can contain a wide range of chemical compounds including: oils, butanol, esters (e.g. phthalates and adipates), polyalkylene glycols (PAG), phosphate esters, silicones, alkylated aromatic hydrocarbons, polyalphaolefins (PAO), corrosion inhibitors, etc.

Chromatographic Method GC/FID

This method was developed by ALS for quantitative analysis of non-volatile hydrocarbons in range of C10-C40 extracted with non polar solvent – hexane. The extract is analyzed by gas chromatograph (GC) with flame ionization detector (FID).

Conditions of Chromatographic Separation

Injection method	COC (cool on column)
Inlet temperature	73 °C
Oven temperature	Programmed, final temp. 360 °C
Column type	Varian Select Mineral Oil (15m x 0.32 x 0.1µm)
Column mode	Constant flow
Detector temperature	350 °C
Detector gases	Hydrogen, air, nitrogen
Carrier gas	Hydrogen

Chromatographic Method GC/FID

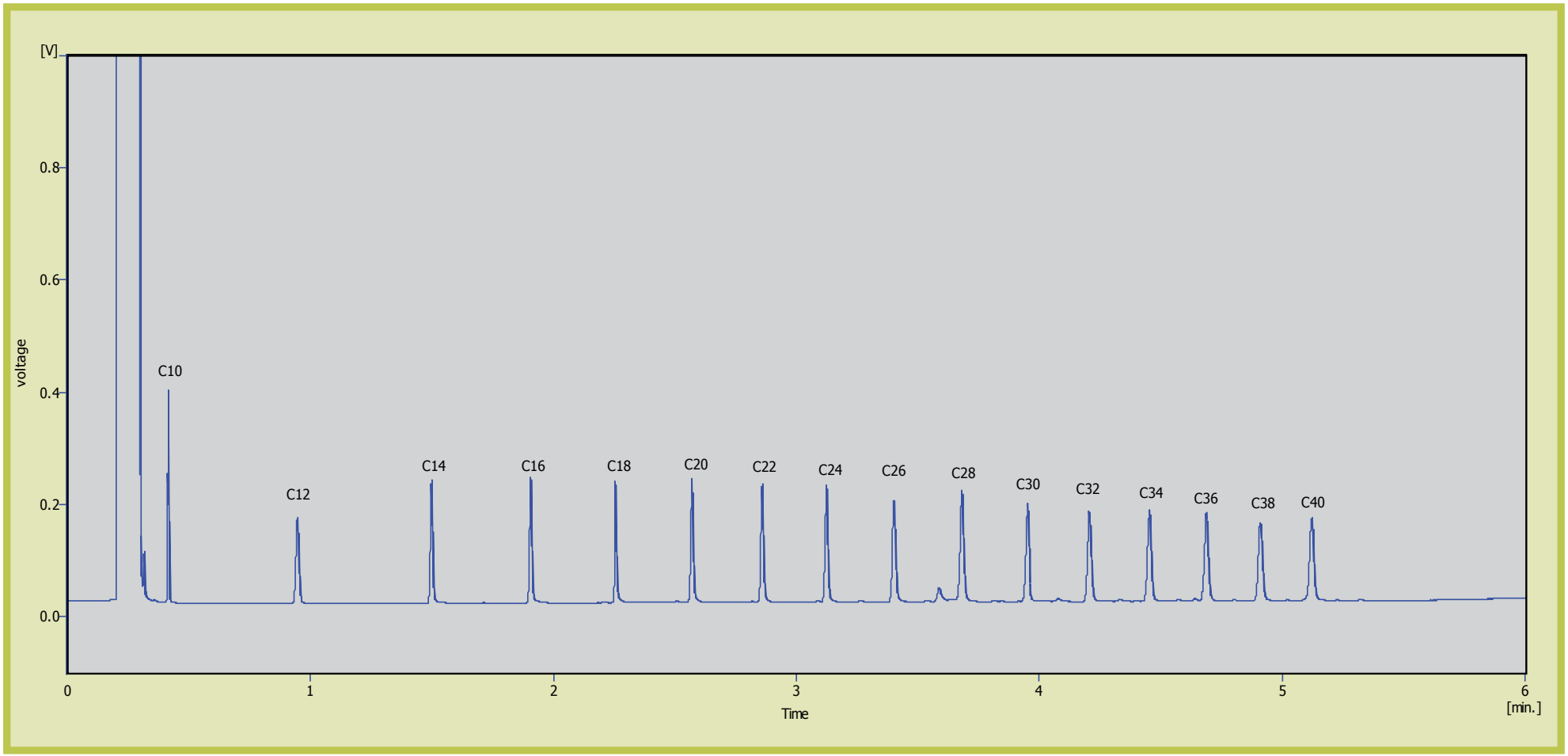


Fig.1 Chromatogram of Standard Alkanes Mix 12 (Mixture of even Hydrocarbons from C10 to C40)

Chromatographic Method GC/FID

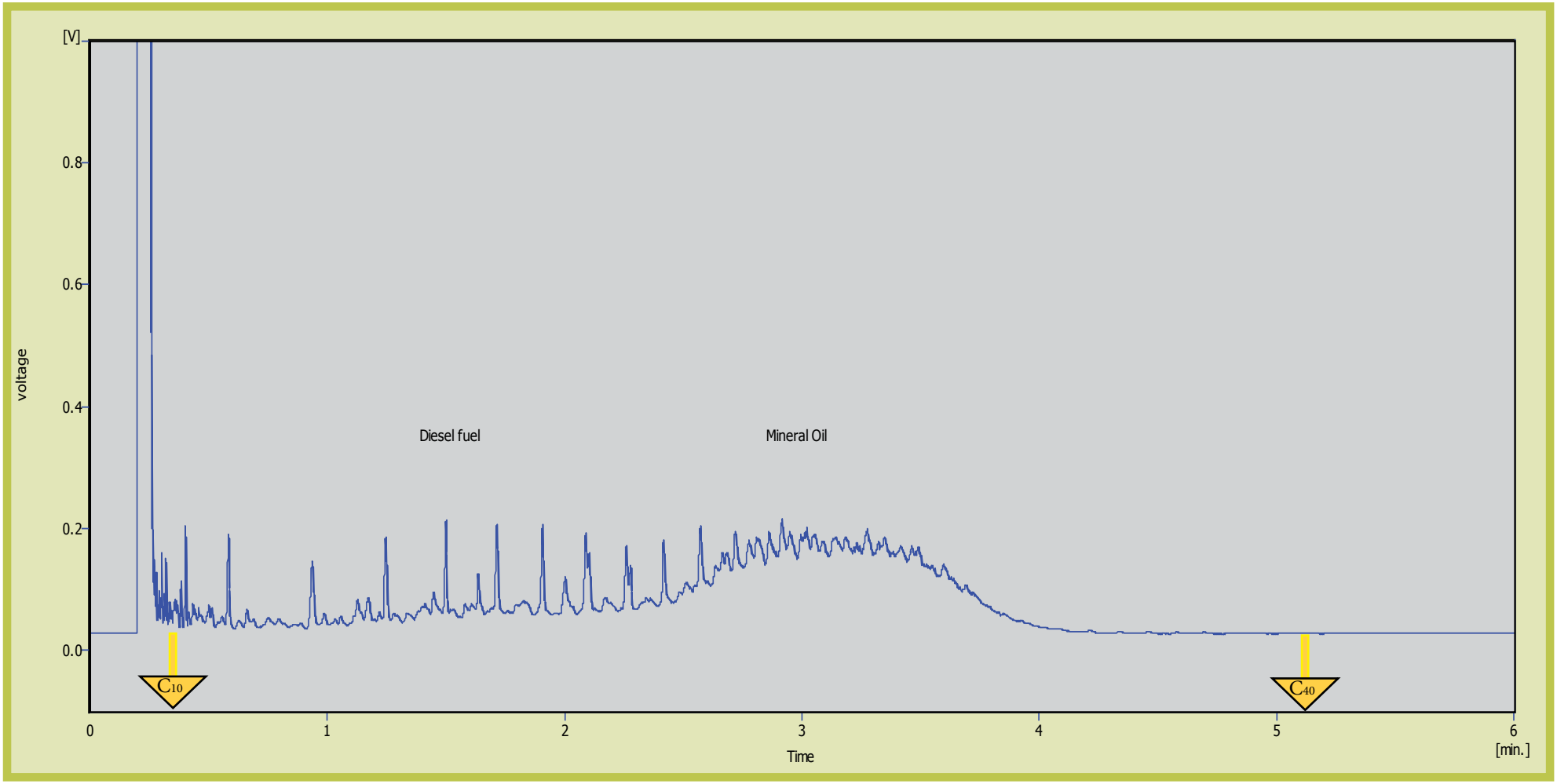
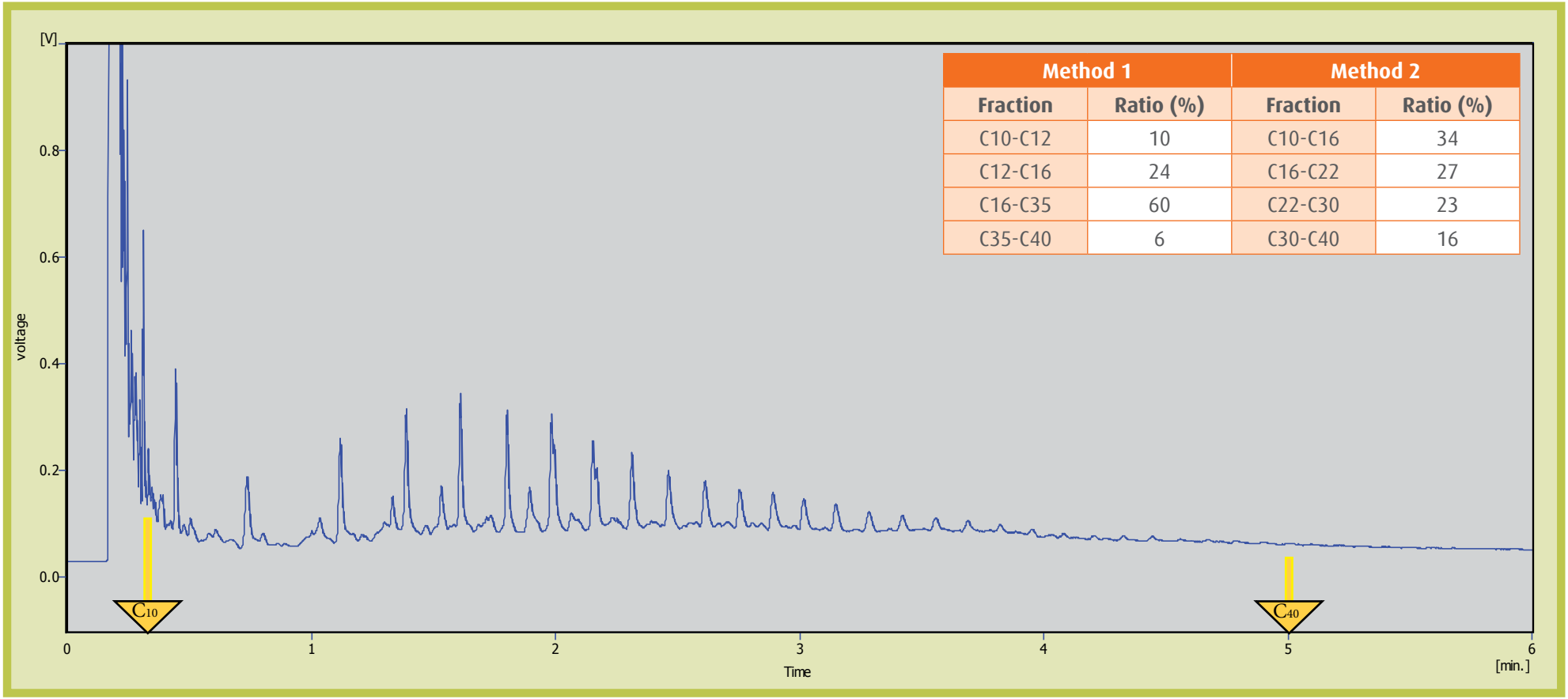


Fig.2 Chromatogram of Calibration Standard BAM-K010 (Diesel Fuel - Mineral Oil 1:1)

Petroleum

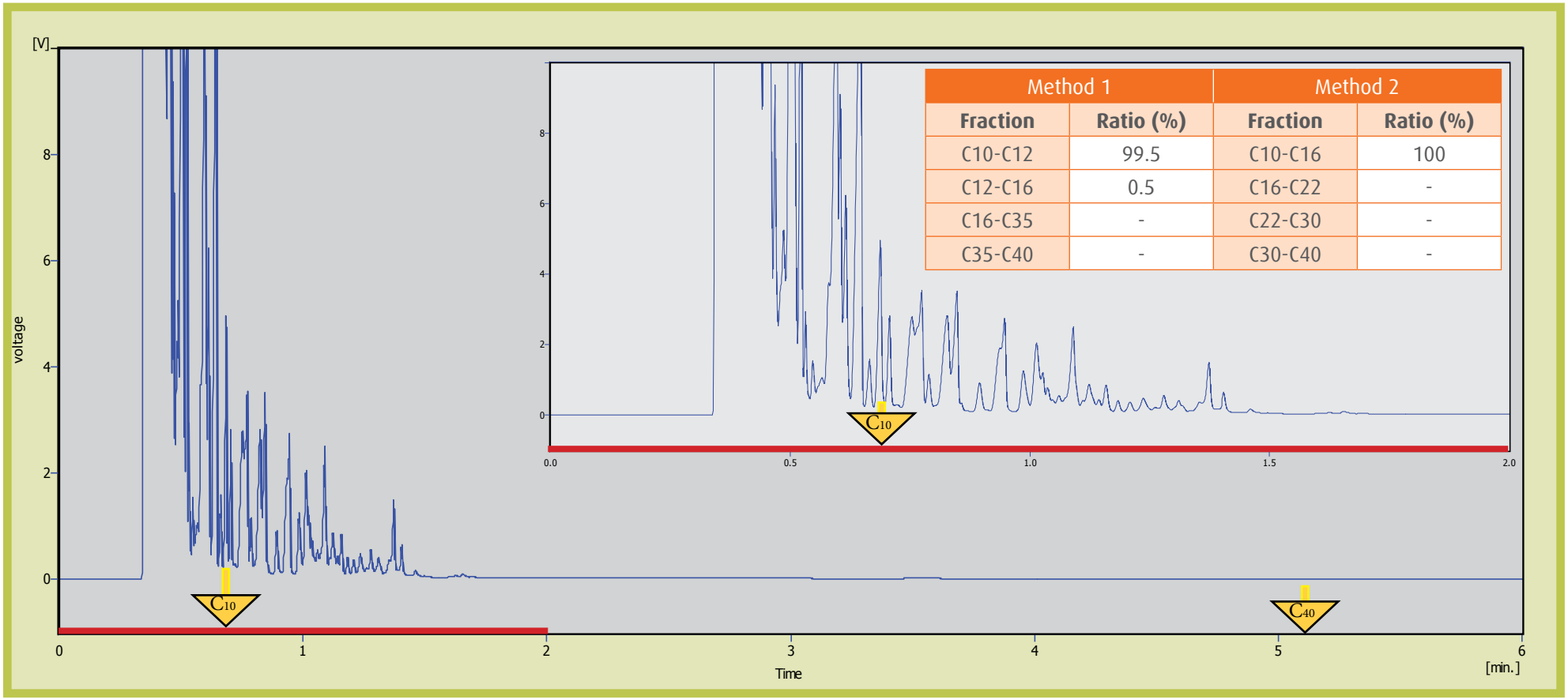
Petroleum or crude oil is a naturally occurring, toxic, flammable liquid consisting of a complex mixture of hydrocarbons of various molecular weights, and other organic compounds, that are found in geologic formations beneath the Earth's surface. The hydrocarbons in crude oil are mostly alkanes, cycloalkanes and various aromatic hydrocarbons while the other organic compounds contain nitrogen, oxygen and sulfur, and trace amounts of metals such as iron, nickel, copper and vanadium. The exact molecular composition varies widely from formation to formation.



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	10	C10-C16	34
C12-C16	24	C16-C22	27
C16-C35	60	C22-C30	23
C35-C40	6	C30-C40	16

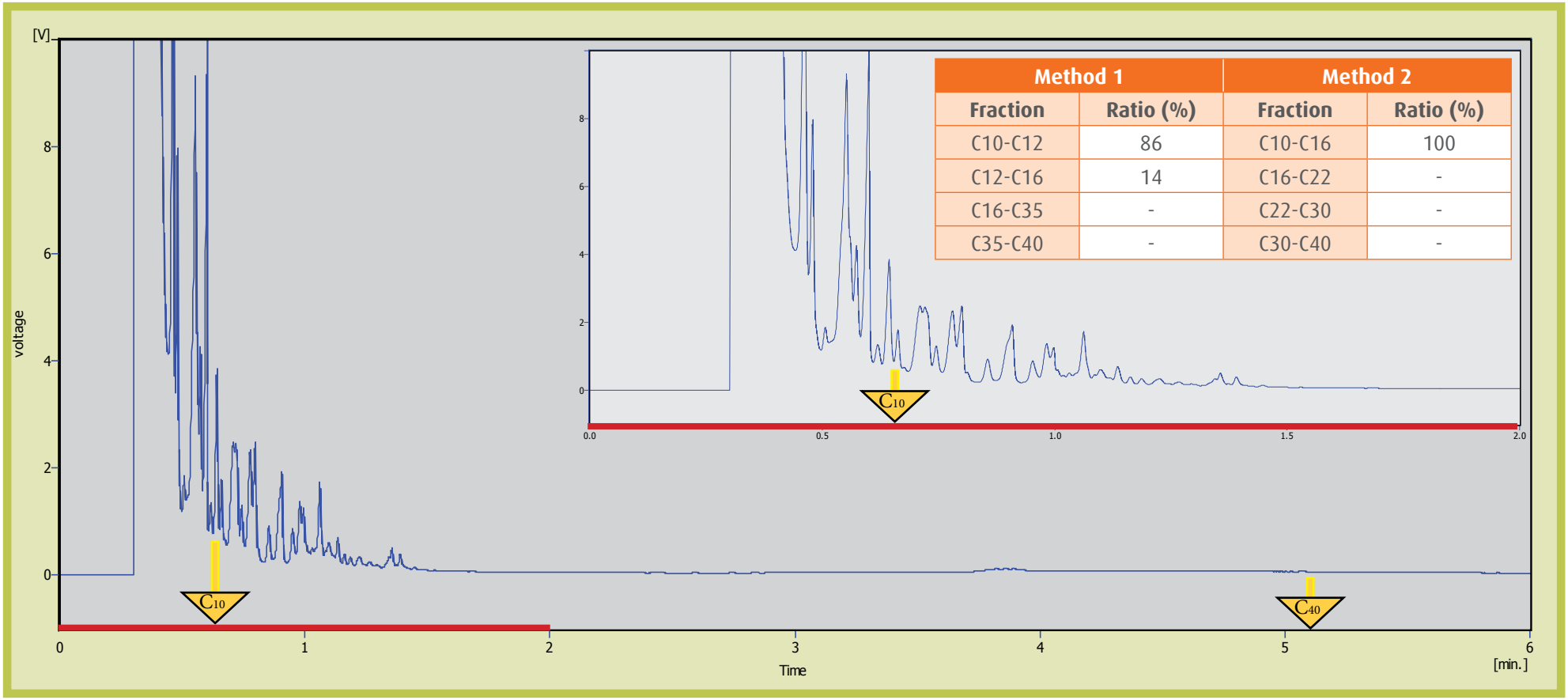
Fig.3 Crude Oil

Motor Fuels & Lubricating Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	99.5	C10-C16	100
C12-C16	0.5	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

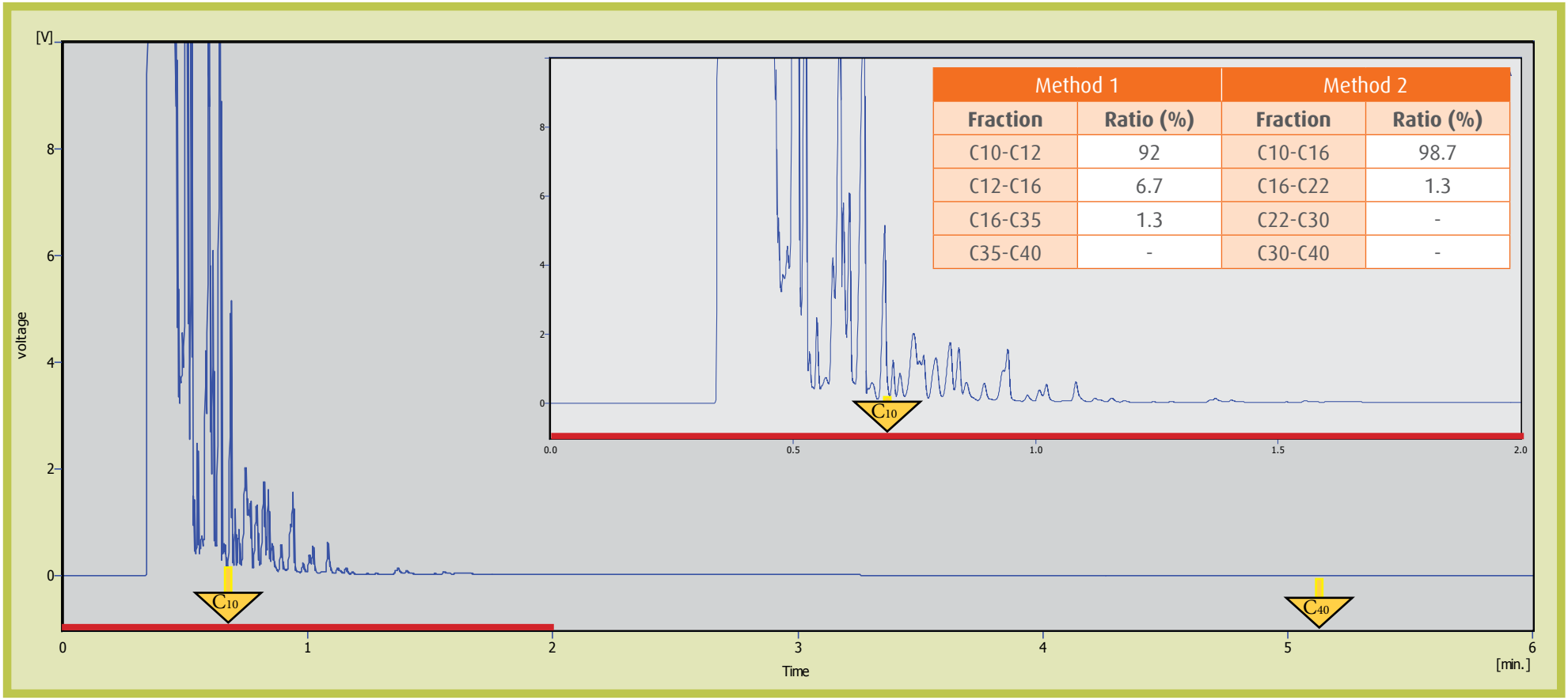
Fig.4 Natural 91



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	86	C10-C16	100
C12-C16	14	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

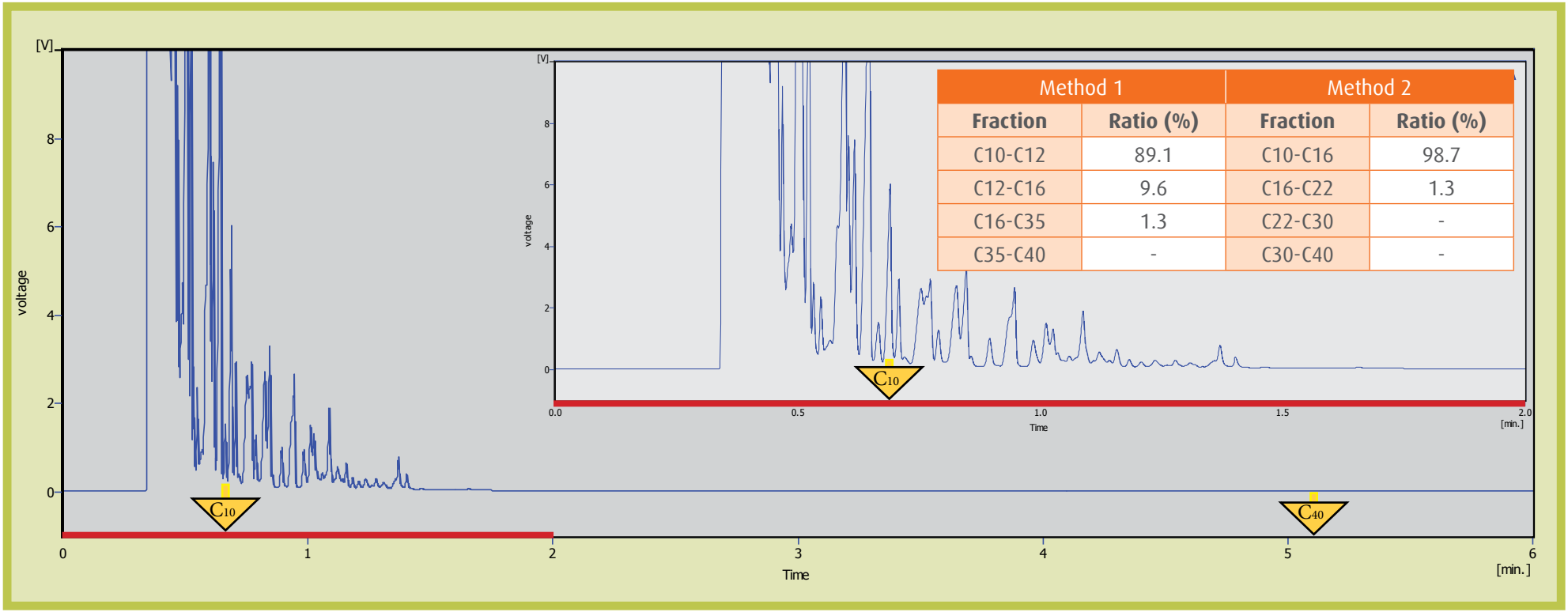
Fig.5 Natural 95

Motor Fuels & Lubricating Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	92	C10-C16	98.7
C12-C16	6.7	C16-C22	1.3
C16-C35	1.3	C22-C30	-
C35-C40	-	C30-C40	-

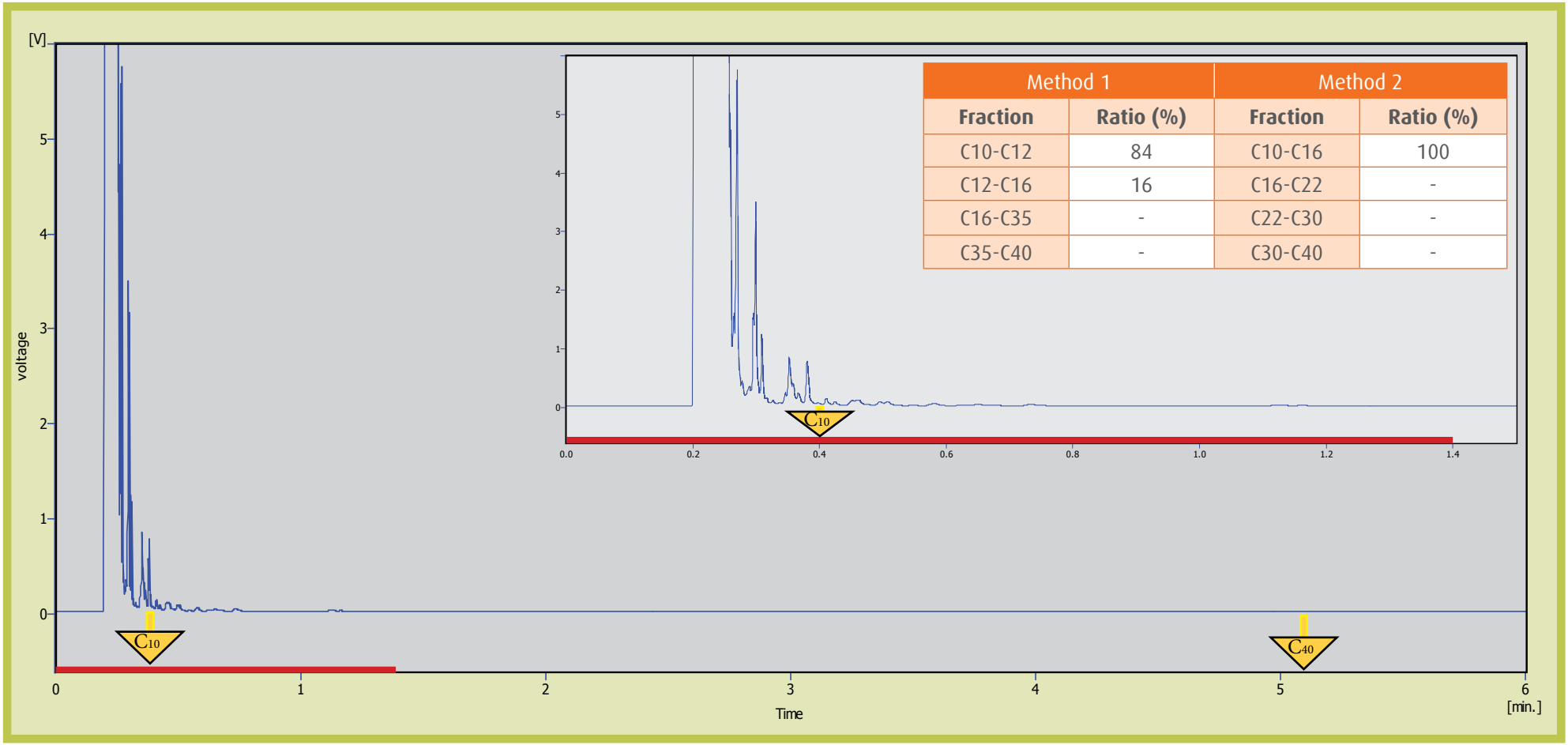
Fig.6 Natural 98



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	89.1	C10-C16	98.7
C12-C16	9.6	C16-C22	1.3
C16-C35	1.3	C22-C30	-
C35-C40	-	C30-C40	-

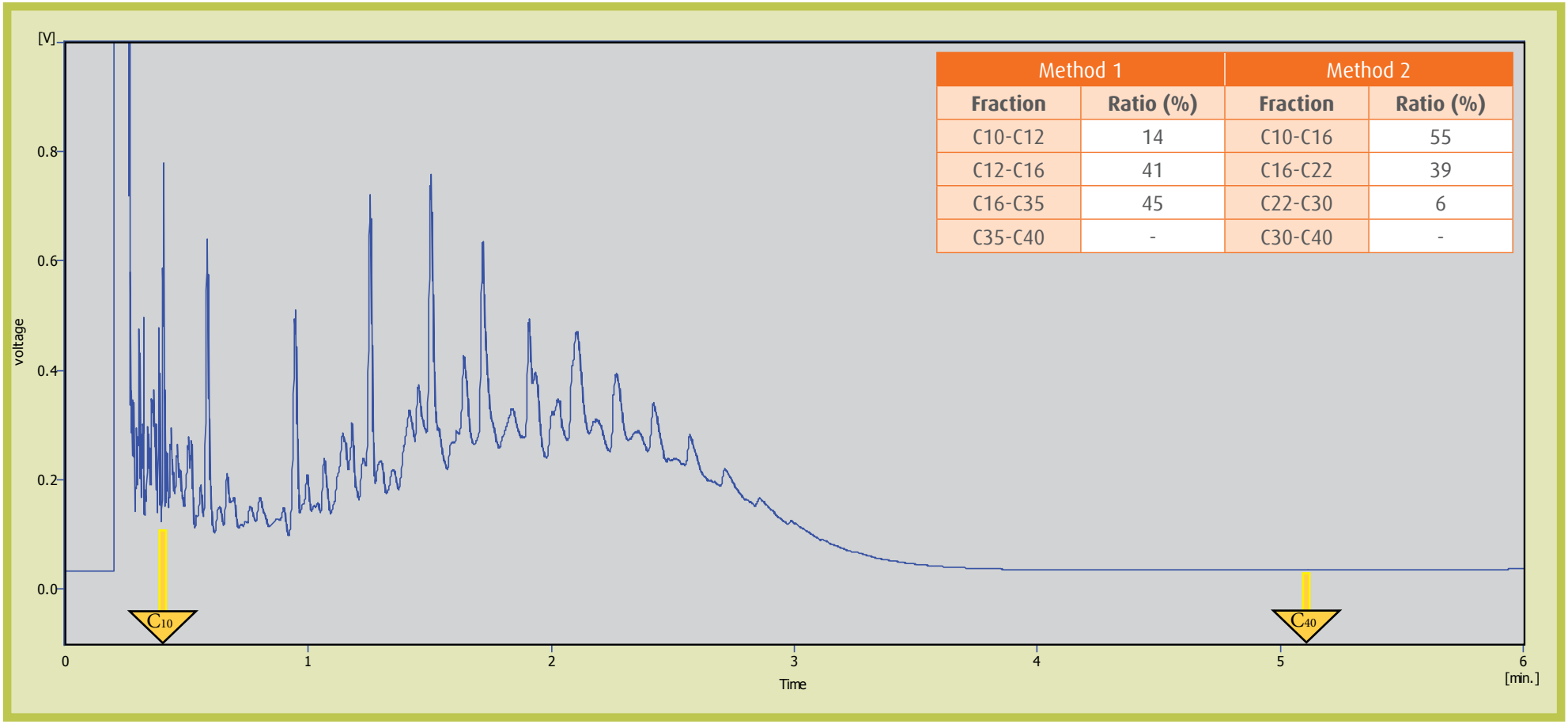
Fig.7 Special 91

Motor Fuels & Lubricating Oils



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	84	C10-C16	100
C12-C16	16	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

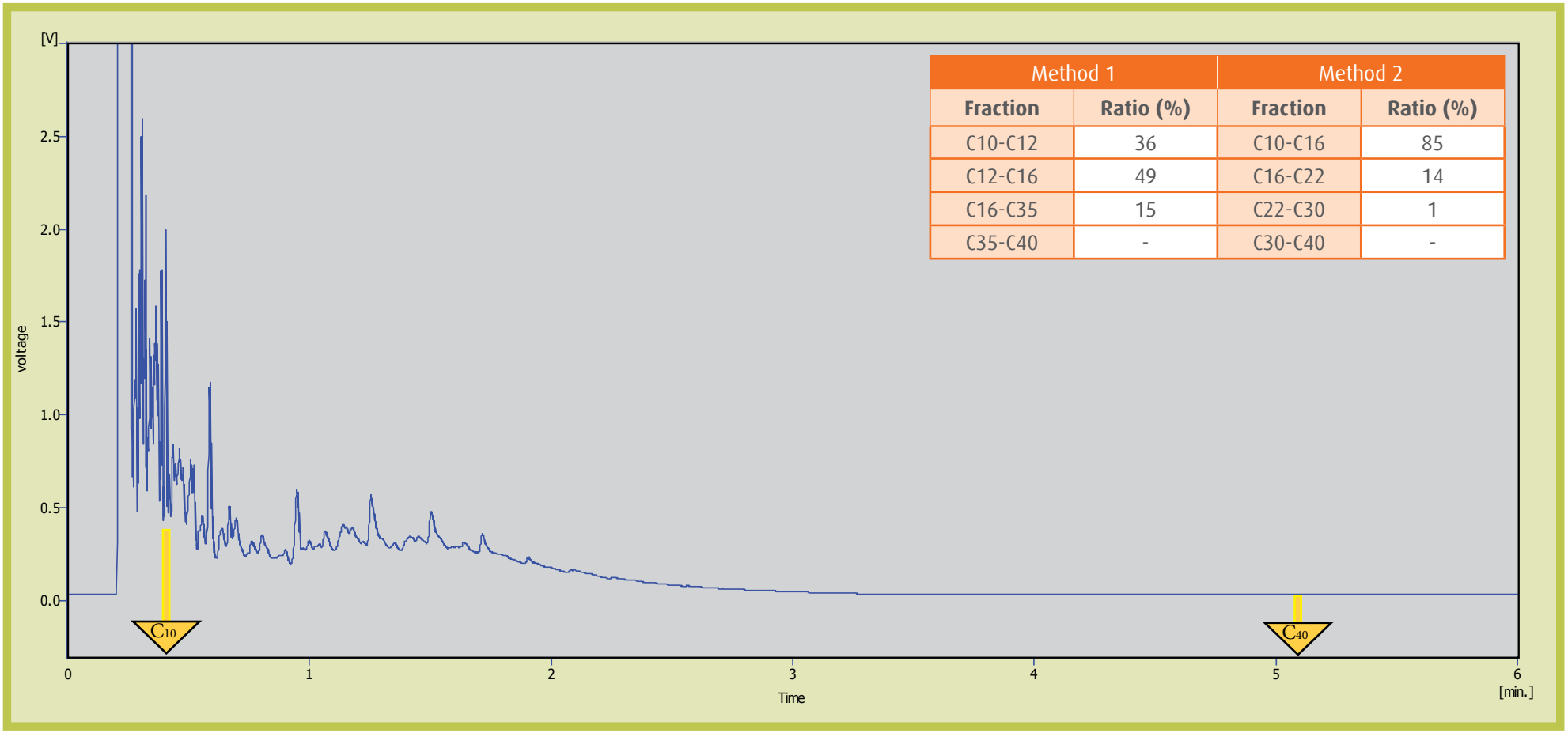
Fig.8 RFA Gasoline



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	14	C10-C16	55
C12-C16	41	C16-C22	39
C16-C35	45	C22-C30	6
C35-C40	-	C30-C40	-

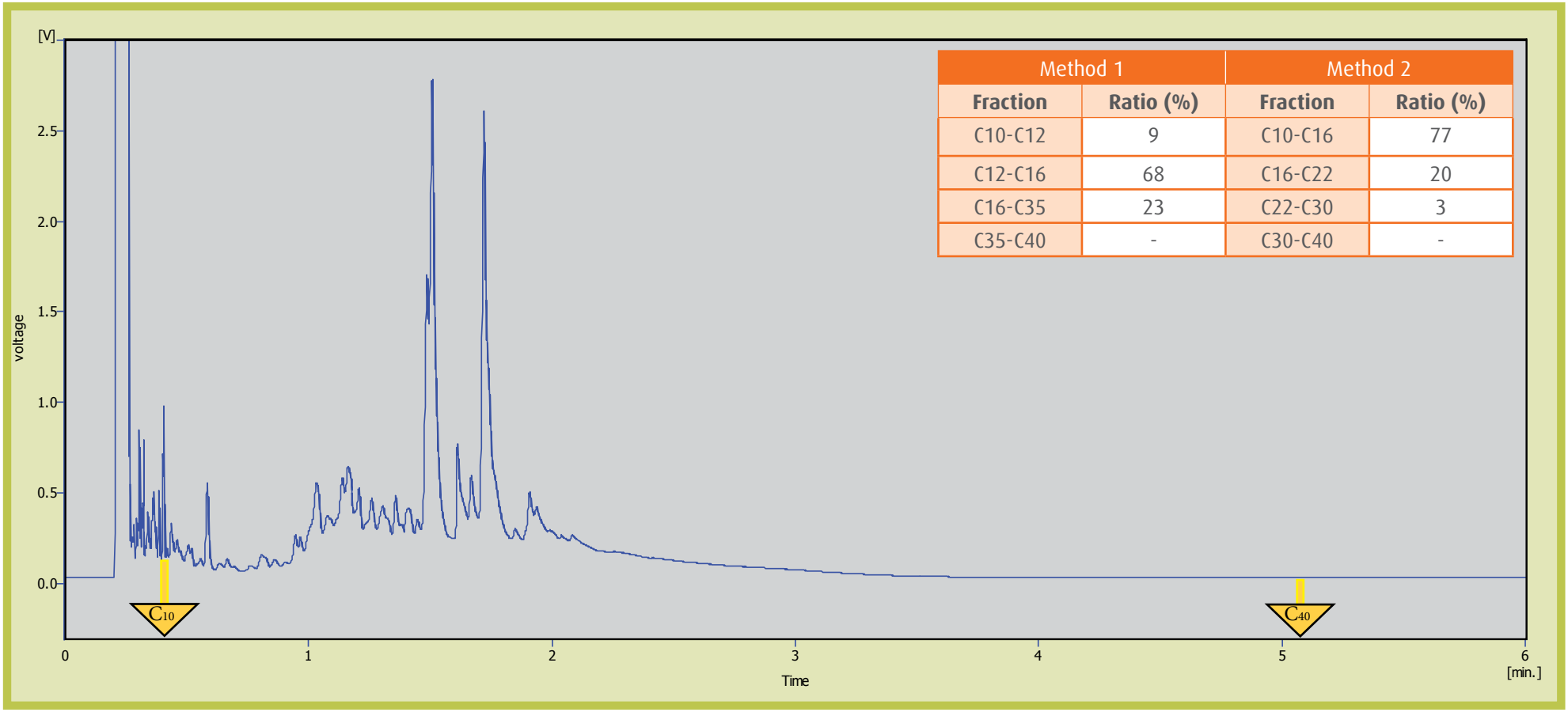
Fig.9 Diesel Fuel #2

Motor Fuels & Lubricating Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	36	C10-C16	85
C12-C16	49	C16-C22	14
C16-C35	15	C22-C30	1
C35-C40	-	C30-C40	-

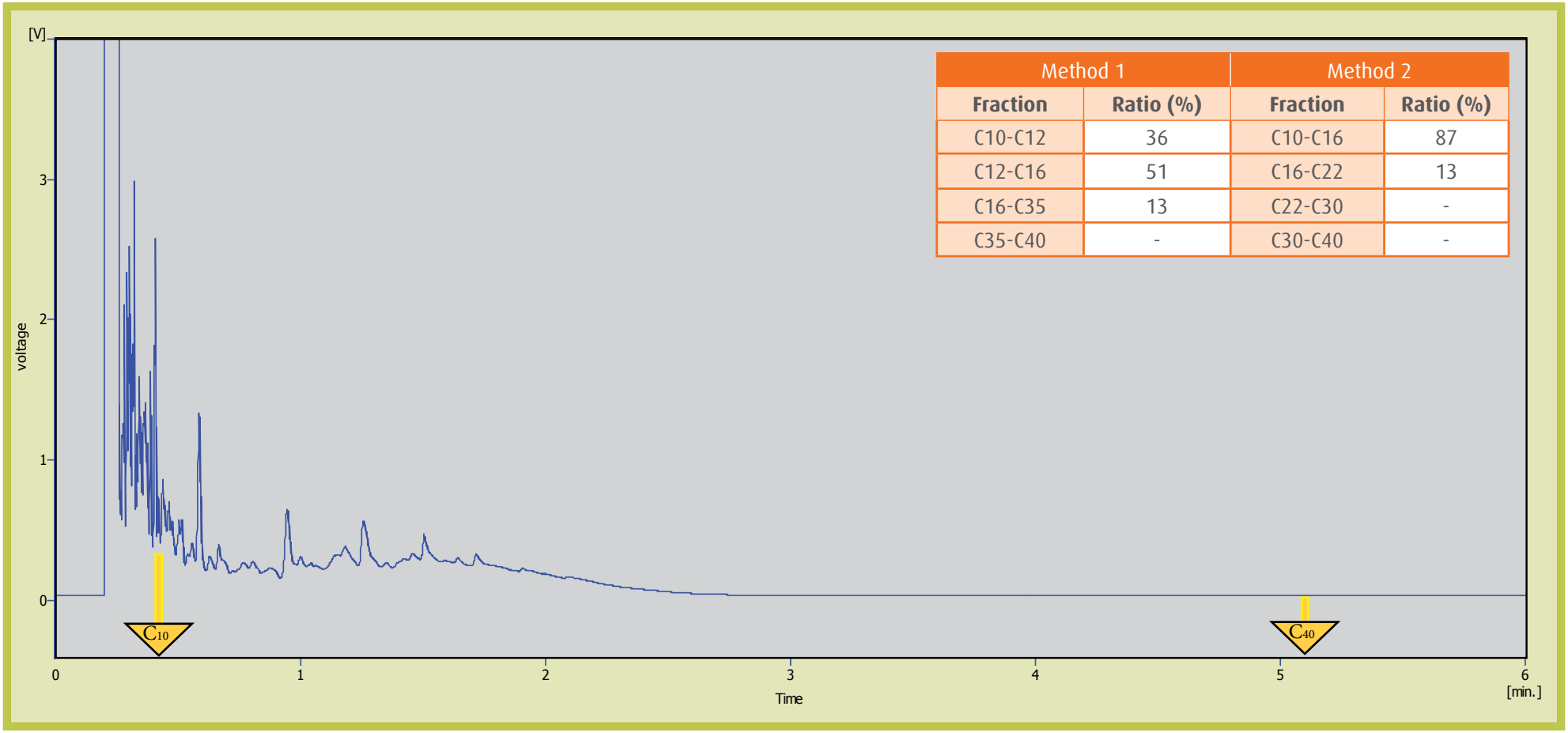
Fig.10 Diesel Fuel #1(Low Sulfur)



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	9	C10-C16	77
C12-C16	68	C16-C22	20
C16-C35	23	C22-C30	3
C35-C40	-	C30-C40	-

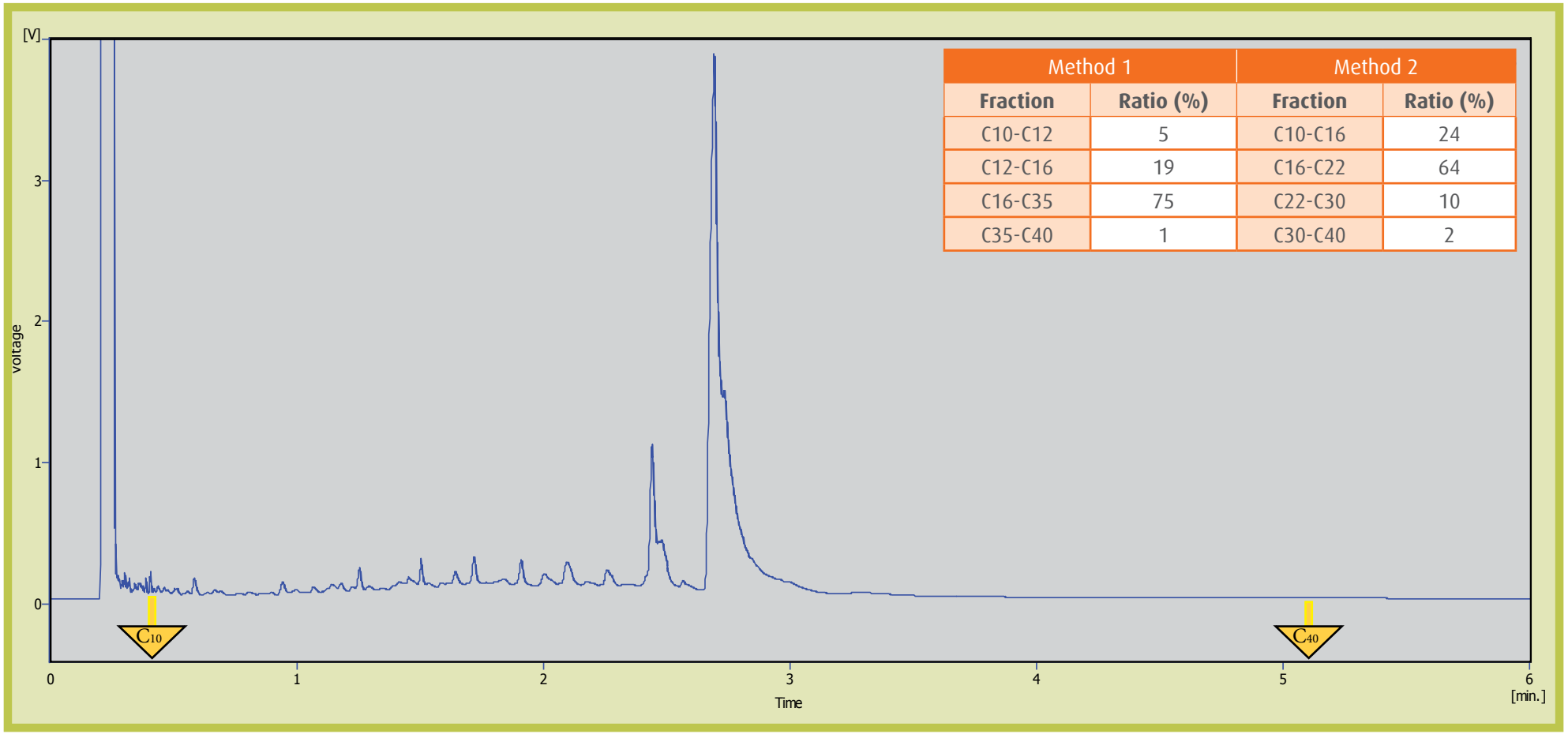
Fig.11 Diesel Fuel #2 (Extra Low Sulfur)

Motor Fuels & Lubricating Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	36	C10-C16	87
C12-C16	51	C16-C22	13
C16-C35	13	C22-C30	-
C35-C40	-	C30-C40	-

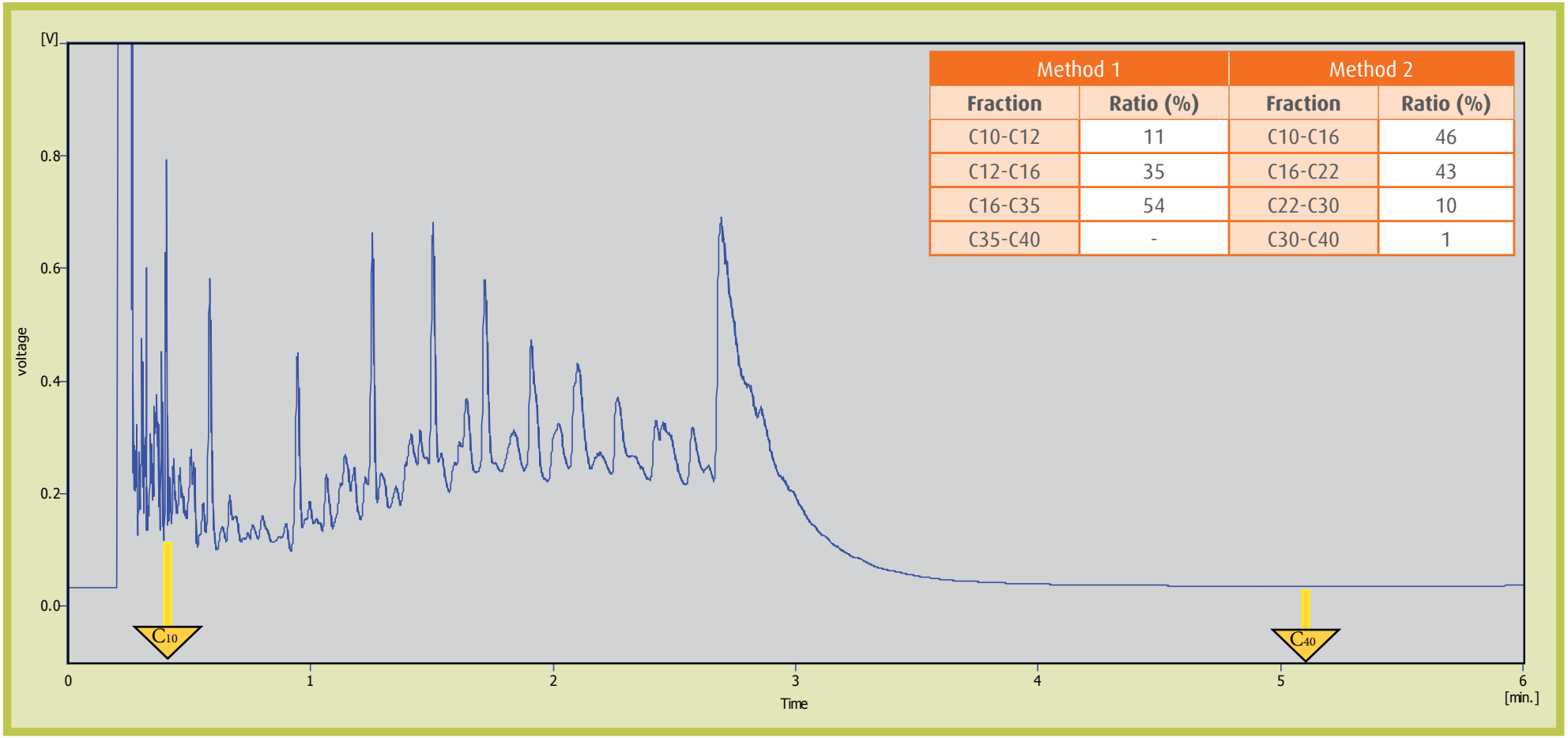
Fig. 12 Artic Diesel Fuel



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	5	C10-C16	24
C12-C16	19	C16-C22	64
C16-C35	75	C22-C30	10
C35-C40	1	C30-C40	2

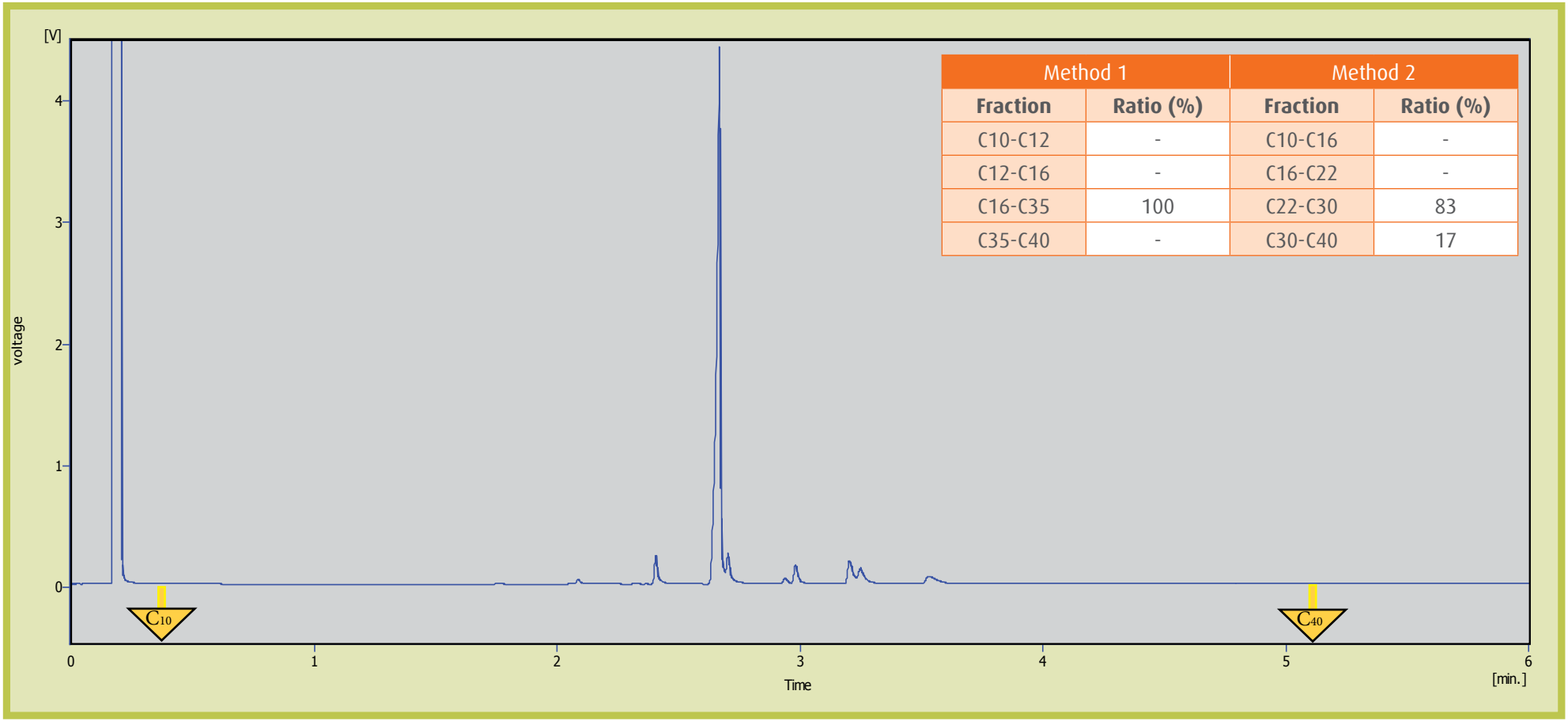
Fig. 13 Biodiesel 100 (Consumer Grade)

Motor Fuels & Lubricating Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	11	C10-C16	46
C12-C16	35	C16-C22	43
C16-C35	54	C22-C30	10
C35-C40	-	C30-C40	1

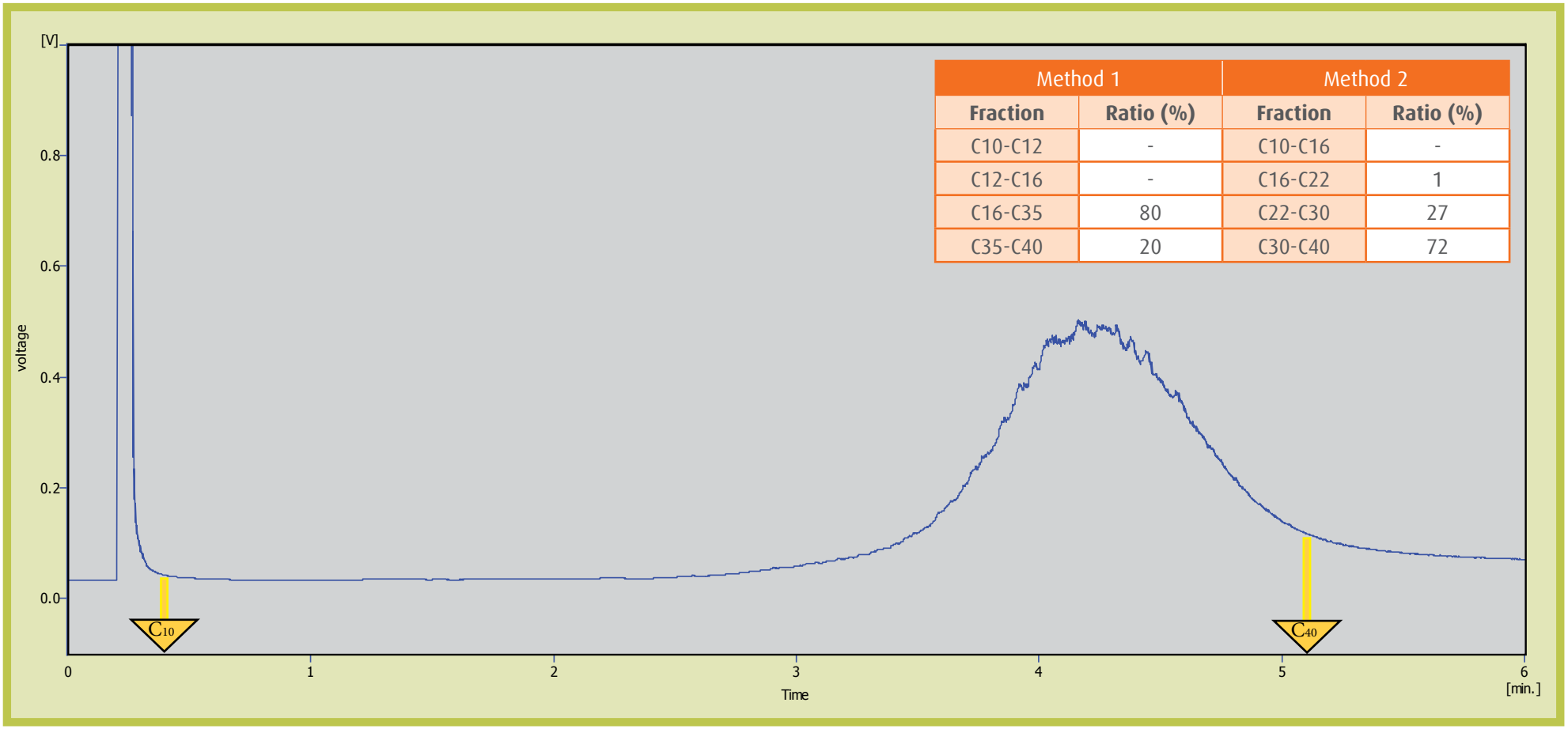
Fig.14 Biodiesel 20



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	-	C10-C16	-
C12-C16	-	C16-C22	-
C16-C35	100	C22-C30	83
C35-C40	-	C30-C40	17

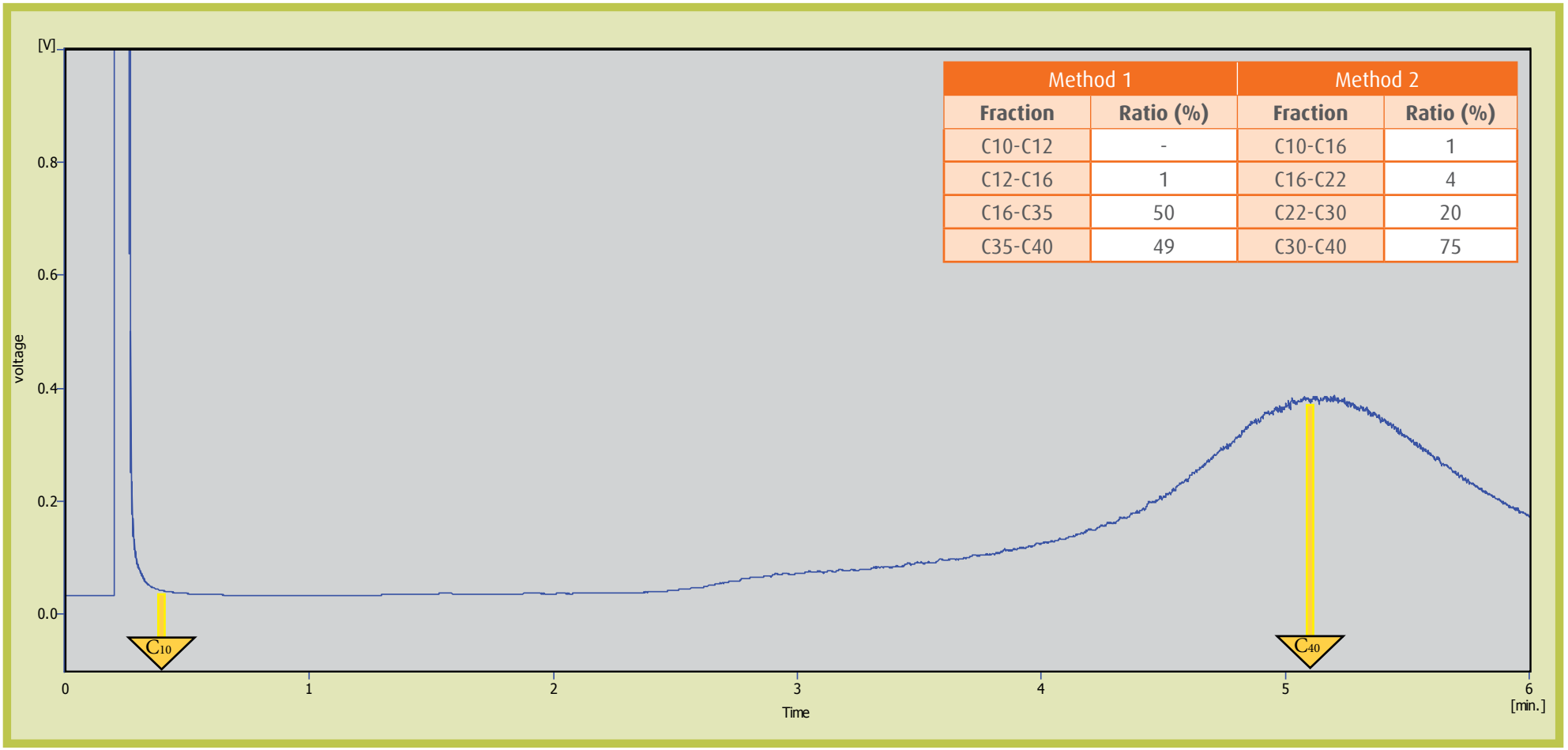
Fig.15 FAME Rapeseed Oil

Motor Fuels & Lubricating Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	-	C10-C16	-
C12-C16	-	C16-C22	1
C16-C35	80	C22-C30	27
C35-C40	20	C30-C40	72

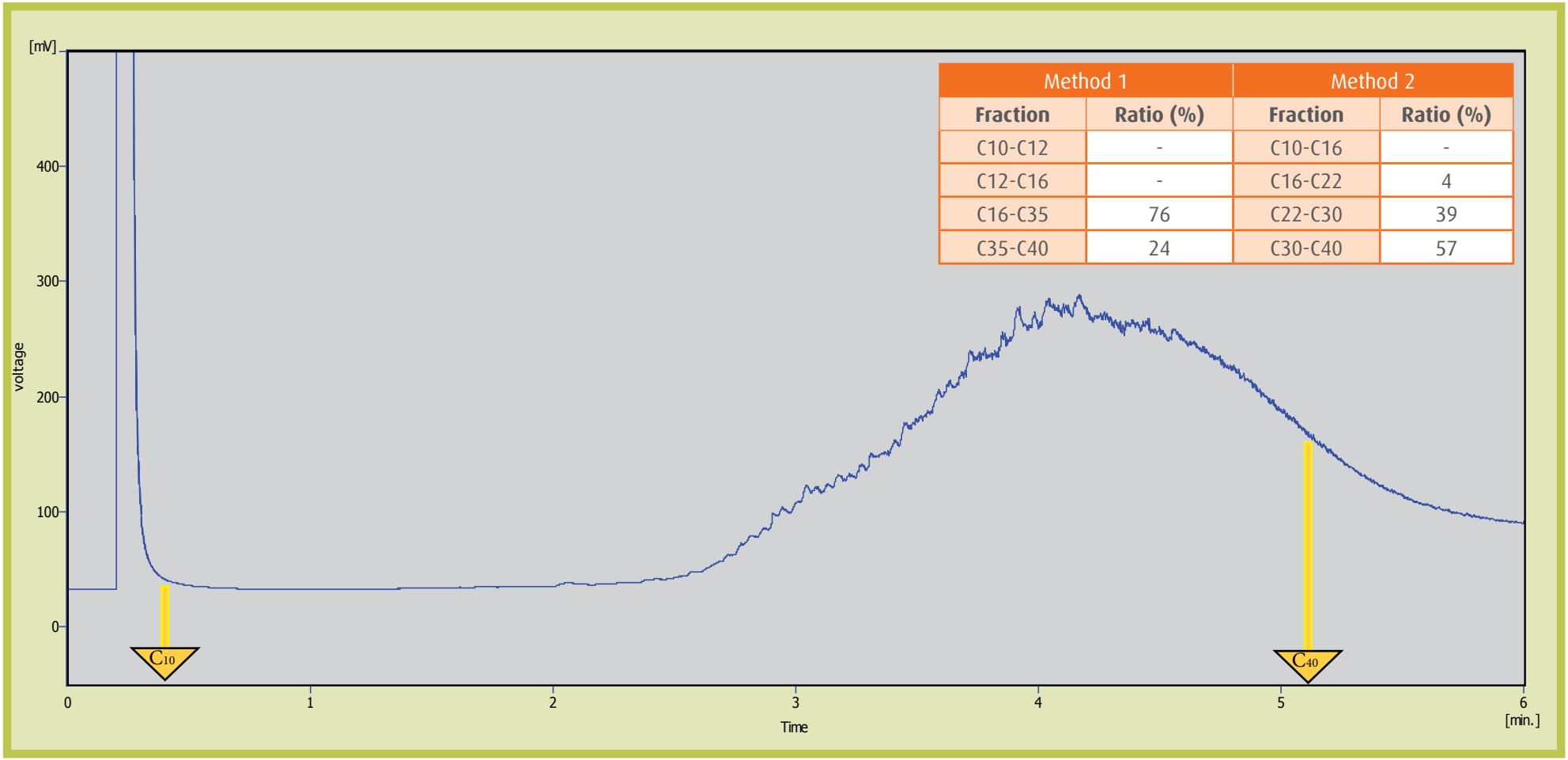
Fig.16 SAE 30W Motor Oil



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	-	C10-C16	1
C12-C16	1	C16-C22	4
C16-C35	50	C22-C30	20
C35-C40	49	C30-C40	75

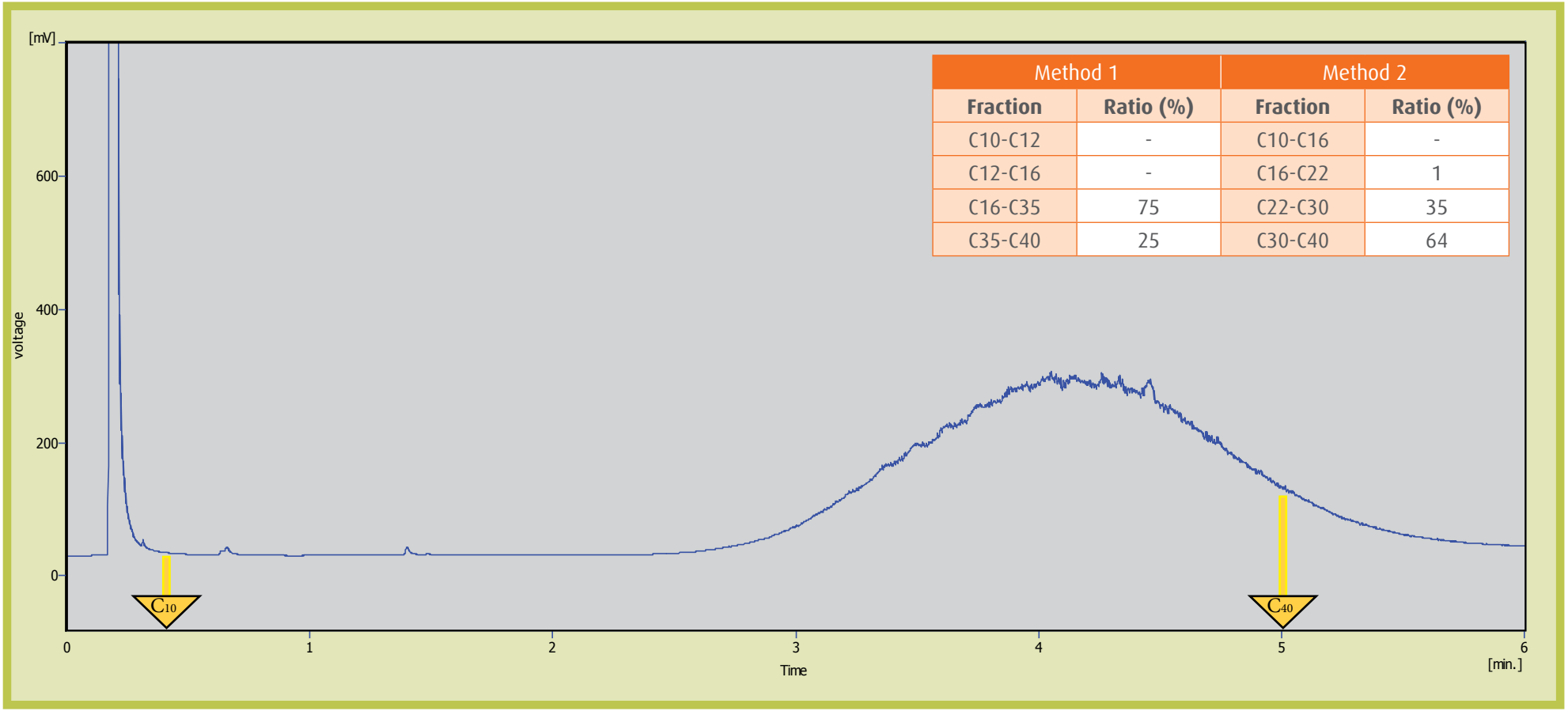
Fig.17 SAE 40W Motor Oil

Motor Fuels & Lubricating Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	-	C10-C16	-
C12-C16	-	C16-C22	4
C16-C35	76	C22-C30	39
C35-C40	24	C30-C40	57

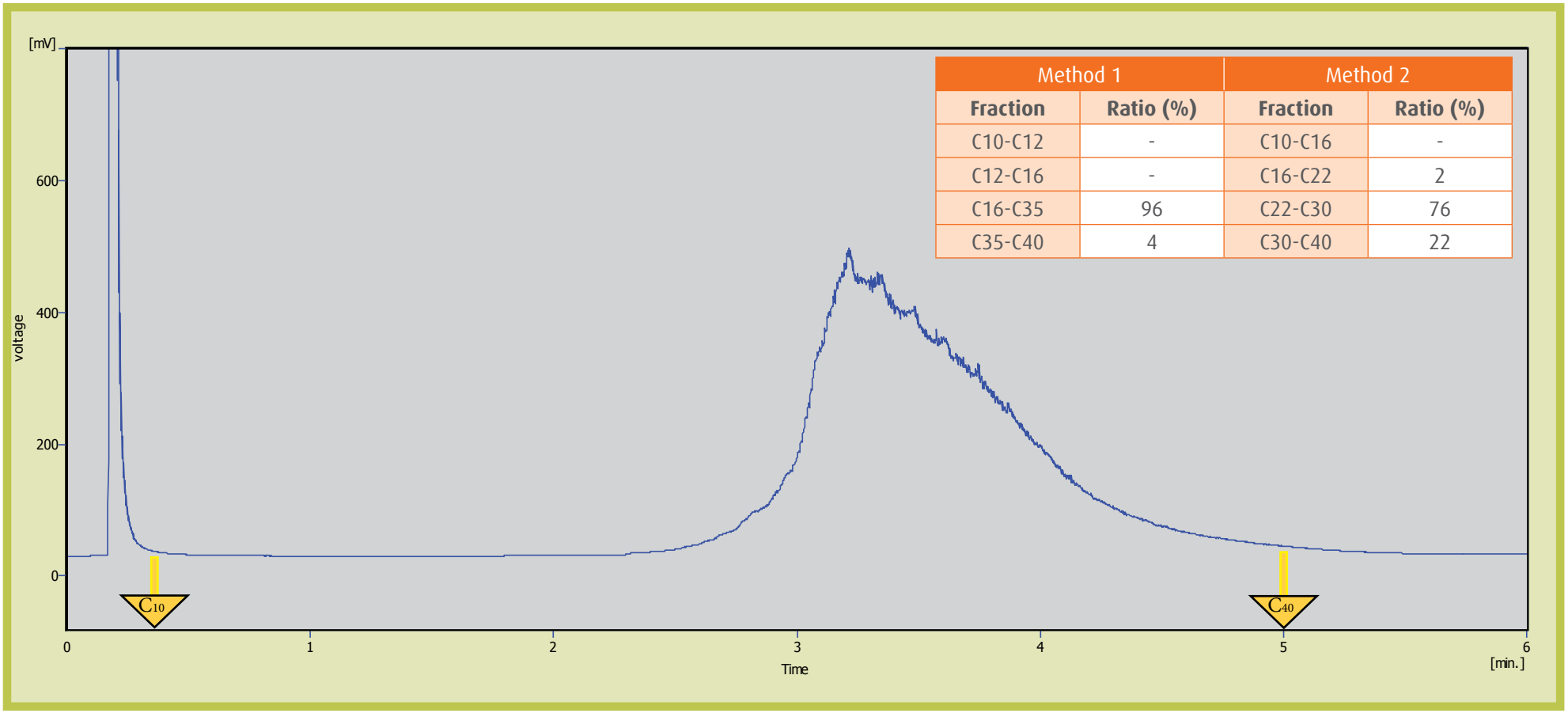
Fig.18 SAE 50W Motor Oil



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	-	C10-C16	-
C12-C16	-	C16-C22	1
C16-C35	75	C22-C30	35
C35-C40	25	C30-C40	64

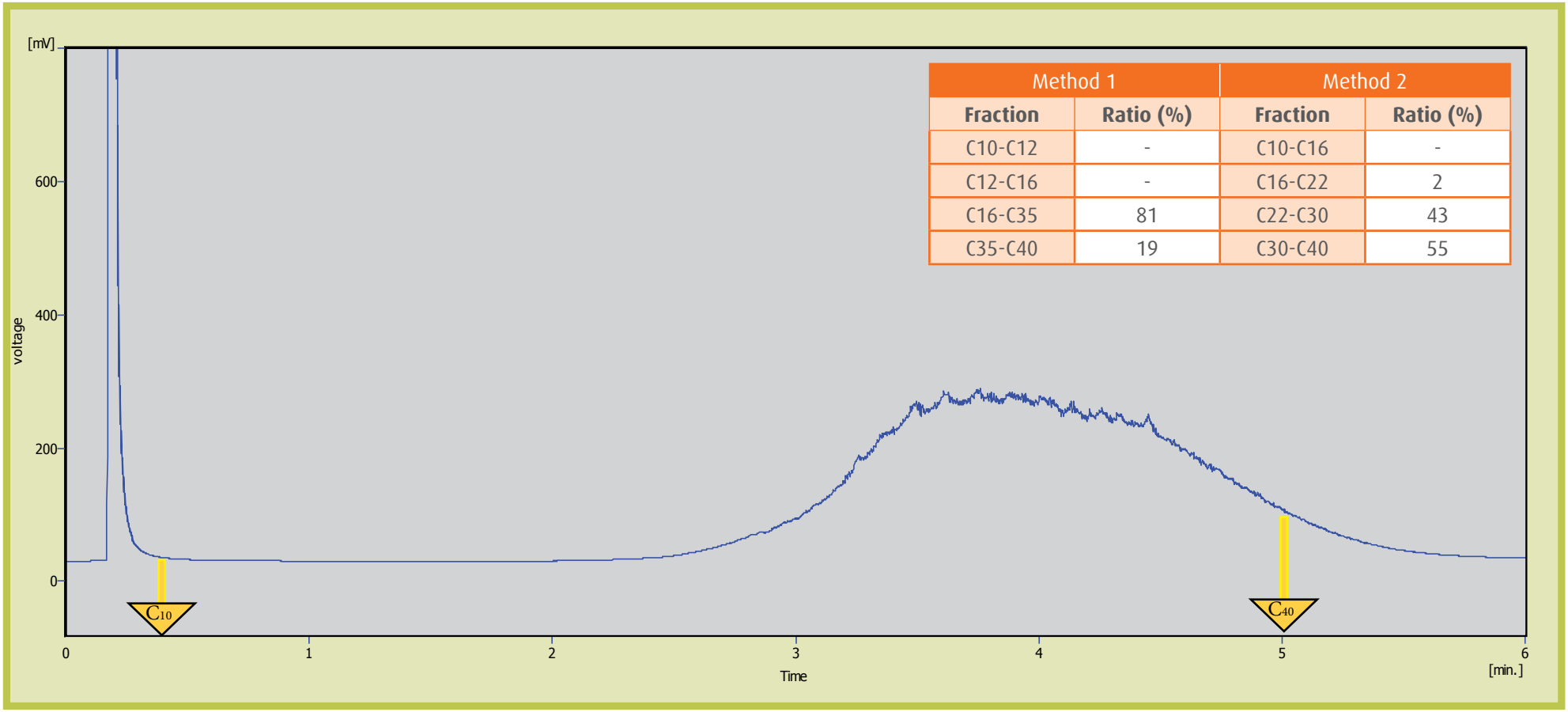
Fig.19 Mogul Trans SAE 80W

Motor Fuels & Lubricating Oils



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	-	C10-C16	-
C12-C16	-	C16-C22	2
C16-C35	96	C22-C30	76
C35-C40	4	C30-C40	22

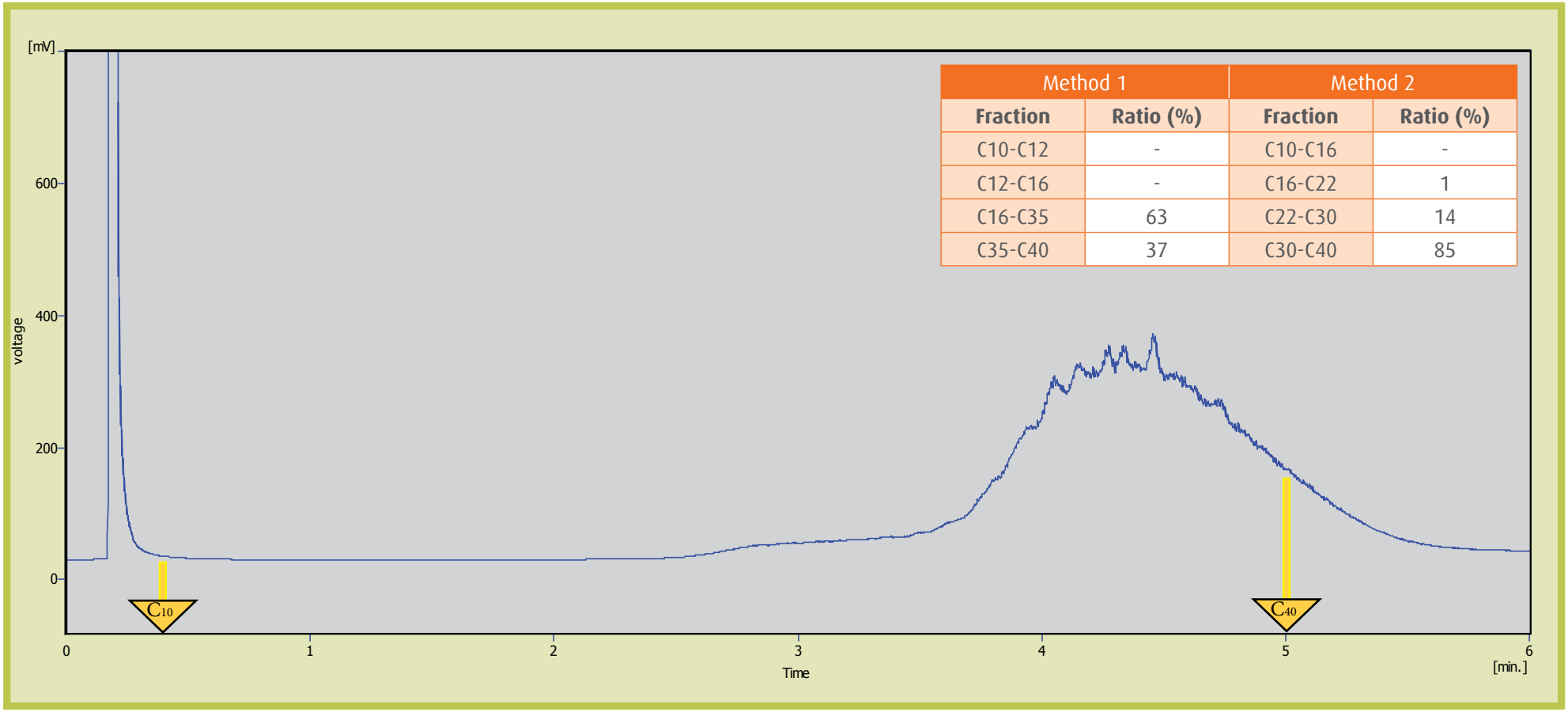
Fig.20 Mogul Racing 5W-40



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	-	C10-C16	-
C12-C16	-	C16-C22	2
C16-C35	81	C22-C30	43
C35-C40	19	C30-C40	55

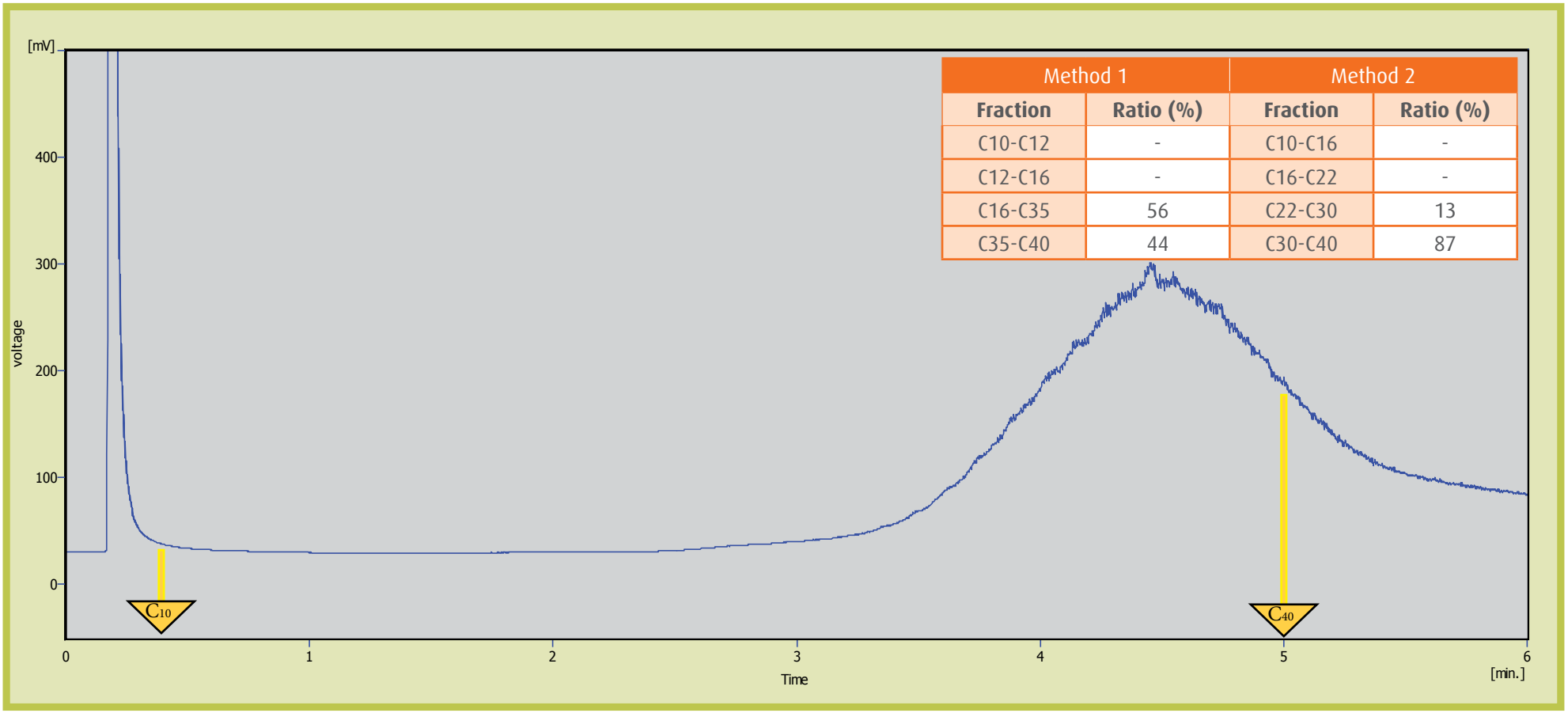
Fig.21 Mogul 15W-40

Motor Fuels & Lubricating Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	-	C10-C16	-
C12-C16	-	C16-C22	1
C16-C35	63	C22-C30	14
C35-C40	37	C30-C40	85

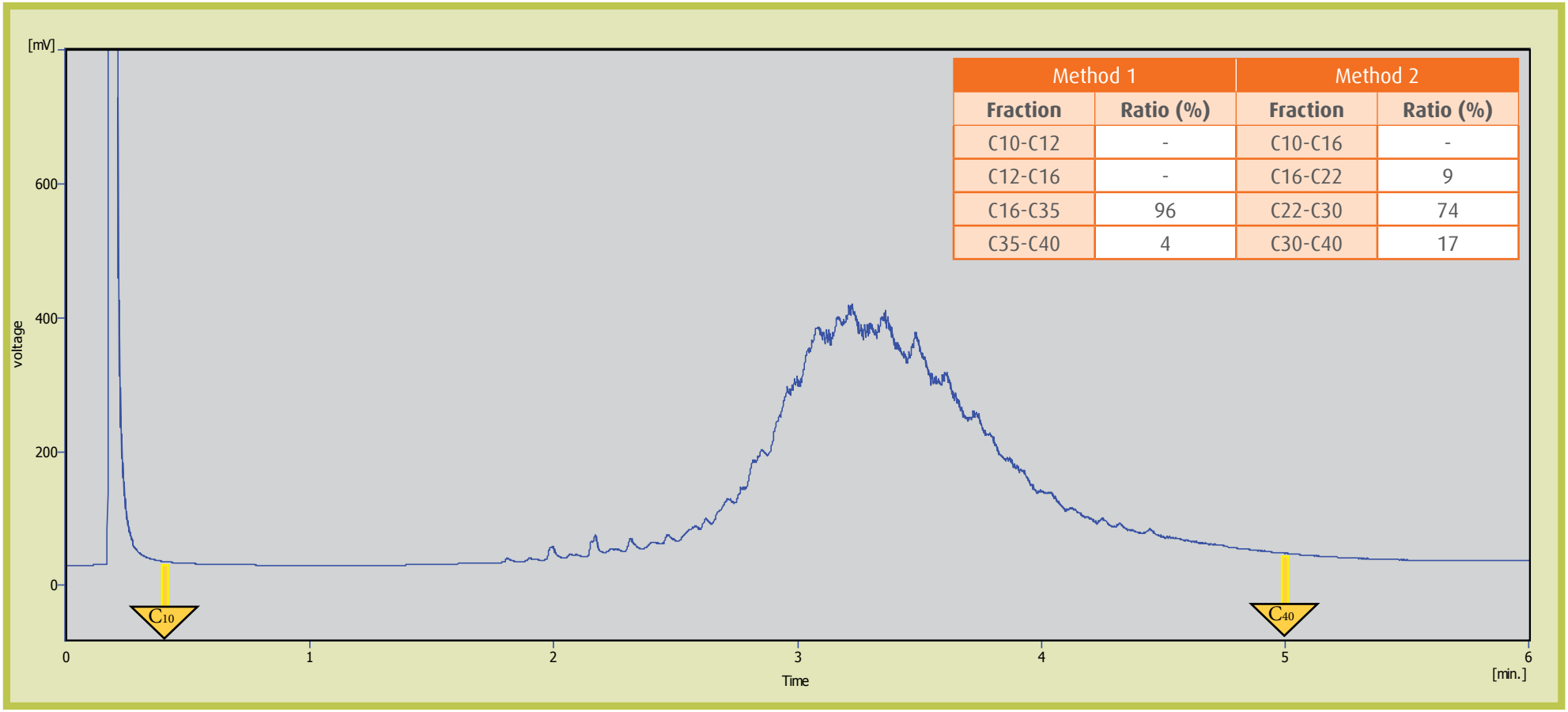
Fig.22 Mogul SAE 30 M6A



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	-	C10-C16	-
C12-C16	-	C16-C22	-
C16-C35	56	C22-C30	13
C35-C40	44	C30-C40	87

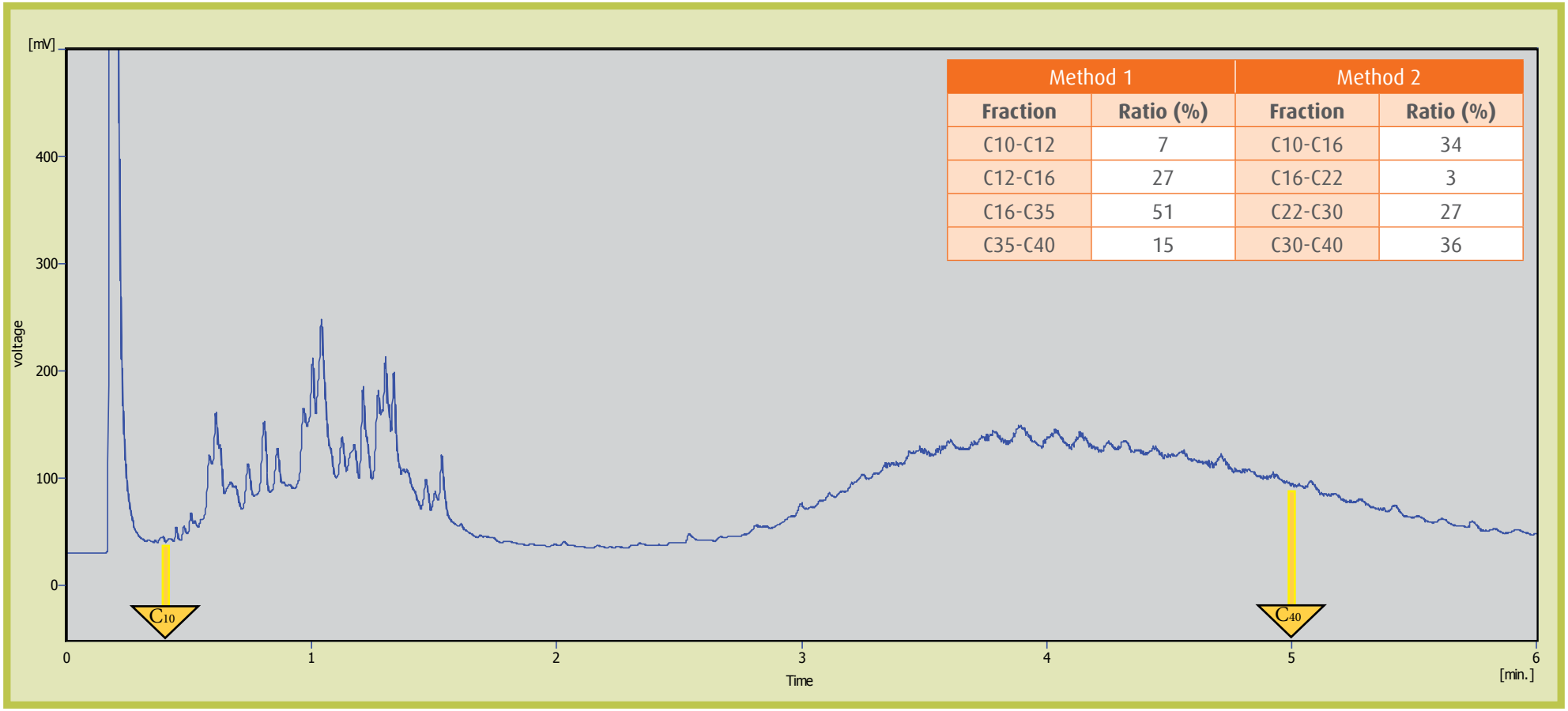
Fig.23 Mogul Oil Alfa Profi

Motor Fuels & Lubricating Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	-	C10-C16	-
C12-C16	-	C16-C22	9
C16-C35	96	C22-C30	74
C35-C40	4	C30-C40	17

Fig.24 Madit Emol SAE 10W-30

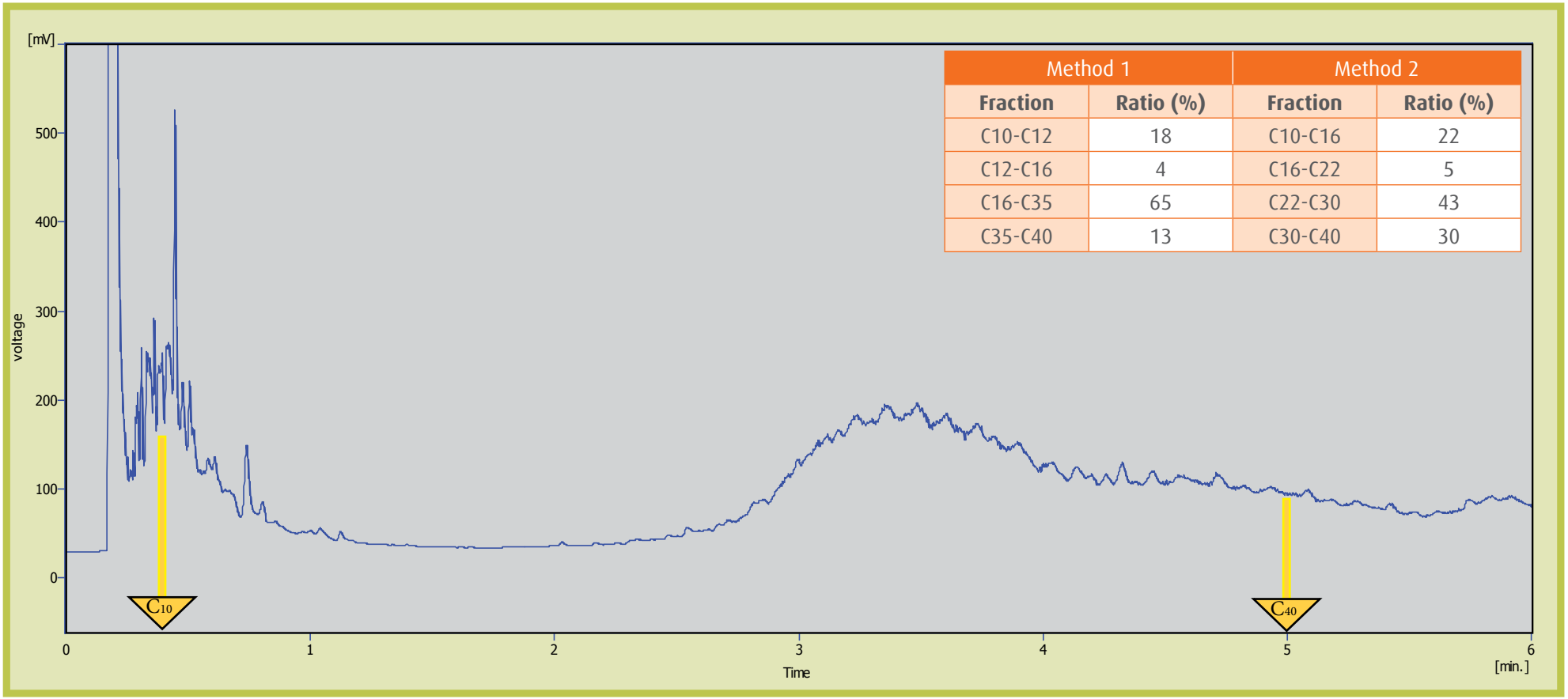


Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	7	C10-C16	34
C12-C16	27	C16-C22	3
C16-C35	51	C22-C30	27
C35-C40	15	C30-C40	36

Fig.25 Prosint Oleo Mac - Oil for Two-Stroke Engines

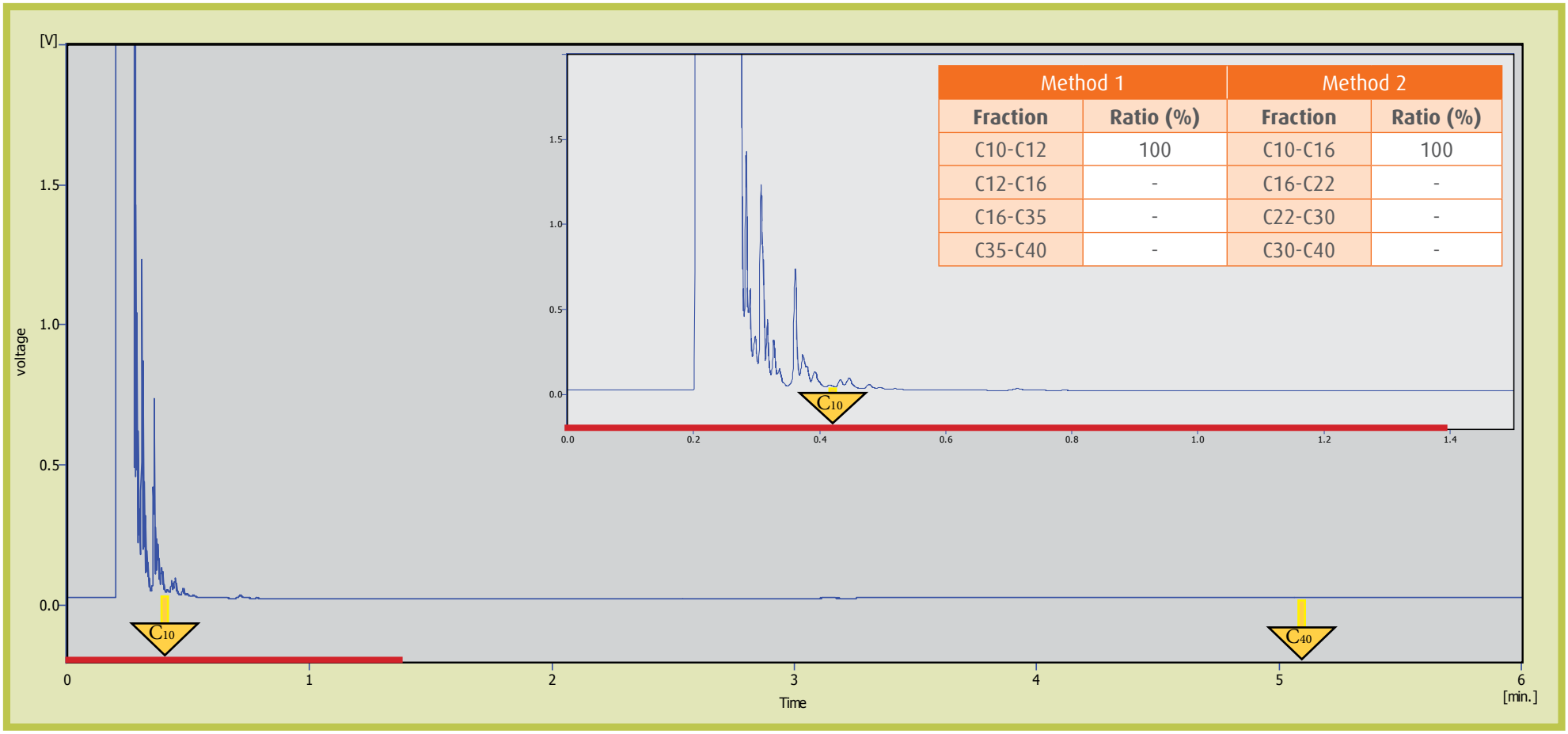
Motor Fuels & Lubricating Oils

Two-stroke oil (also referred to as two-cycle oil, 2-cycle oil, 2T oil or 2-stroke oil) is an engine oil intended for use in two-stroke engines. Since these lightweight engines do not have a closed crankcase like 4 cycle engines, as they use the crankcase as part of the induction tract, oil must be mixed with the petrol fuel, for distribution throughout the engine for the purpose of lubrication. The two-stroke oil is ultimately burned along with the fuel resulting in exhaust emissions with blue smoke and/or a distinctive odor. The oil base stock is either petroleum, vegetable, semi-synthetic or synthetic oil and is mixed with petrol/gasoline at a fuel:oil ratio ranging from 16:1 to as low as 100:1.



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	18	C10-C16	22
C12-C16	4	C16-C22	5
C16-C35	65	C22-C30	43
C35-C40	13	C30-C40	30

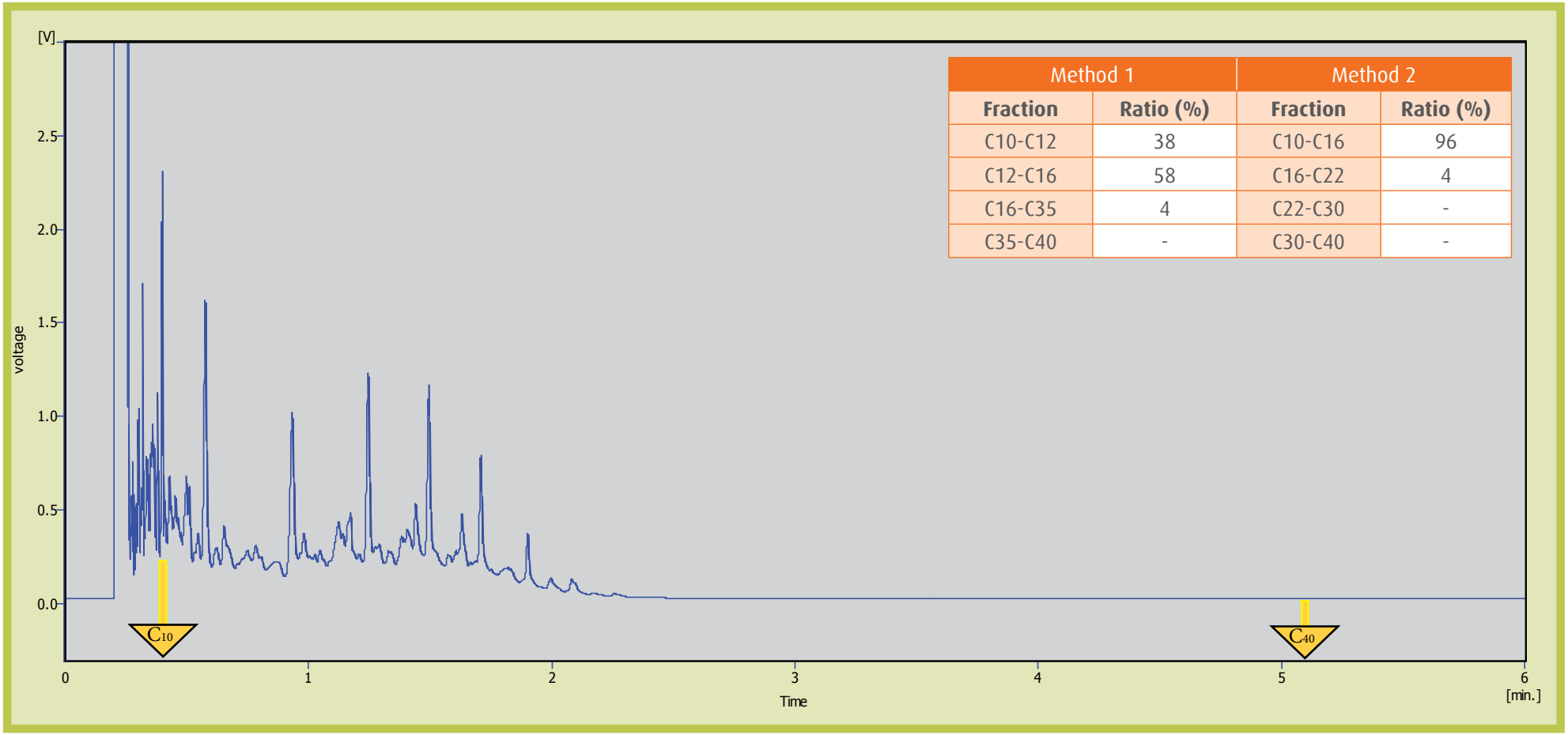
Fig.26 Oil for Two-Stroke Engines



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	100	C10-C16	100
C12-C16	-	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

Fig.27 Aviation Fuel

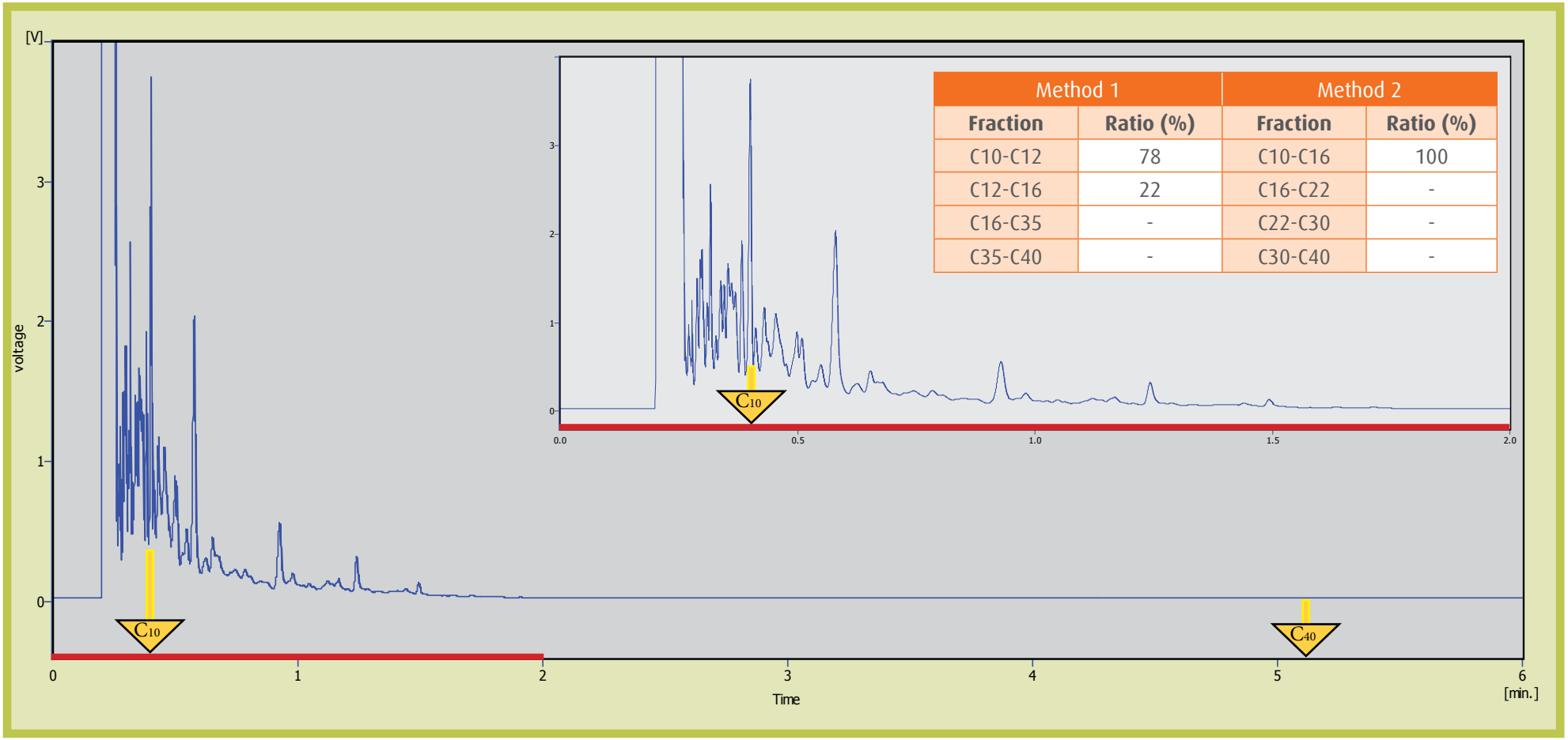
Aviation Fuels & Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	38	C10-C16	96
C12-C16	58	C16-C22	4
C16-C35	4	C22-C30	-
C35-C40	-	C30-C40	-

Fig.28 Turbine (Jet) Fuel

JP-4 or JP4 (for „Jet Propellant“) was a jet fuel, specified in 1951 by the U.S. government (MIL-DTL-5624). It was a 50-50 kerosene-gasoline blend. It has lower flash point than JP-1, but was preferred because of its greater availability. It was the primary U.S. Air Force jet fuel between 1951 and 1995. Its NATO code is F-40. It is also known as avtag. JP-4 is a mixture of aliphatic and aromatic hydrocarbons. It is a flammable transparent liquid with clear or straw color, and a kerosene-like smell. It evaporates easily and floats on water. Although it has a low flash point −18 °C, if a lit match is dropped into JP-4, ignition does not occur. JP-4 freezes at −60 °C, and its maximum burning temperature is 3,688 °C. Commercial aviation uses a similar mixture under the name Jet-B. JP-4 in addition contains corrosion inhibitors and icing inhibitors.

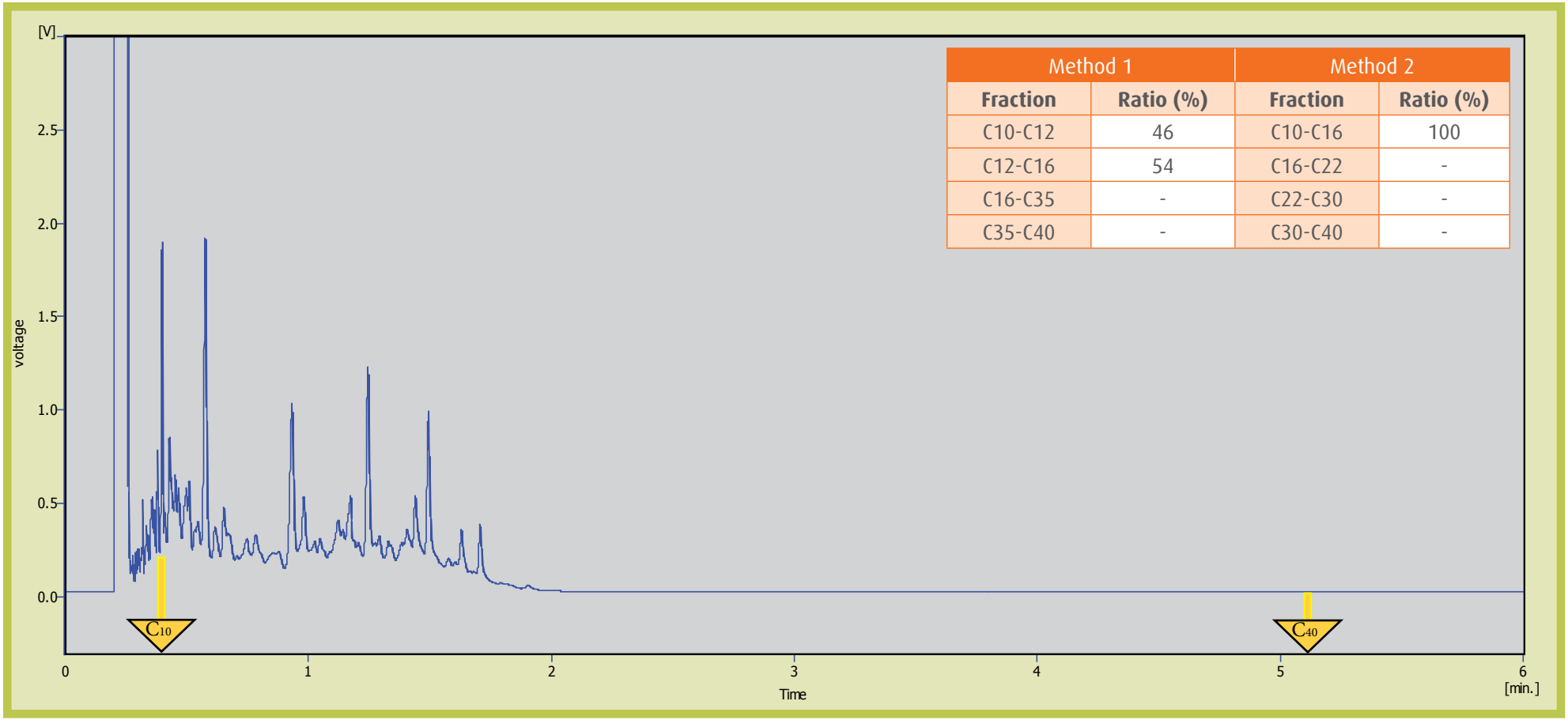


Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	78	C10-C16	100
C12-C16	22	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

Fig.29 JP-4 (Jet Fuel)

Aviation Fuels & Oils

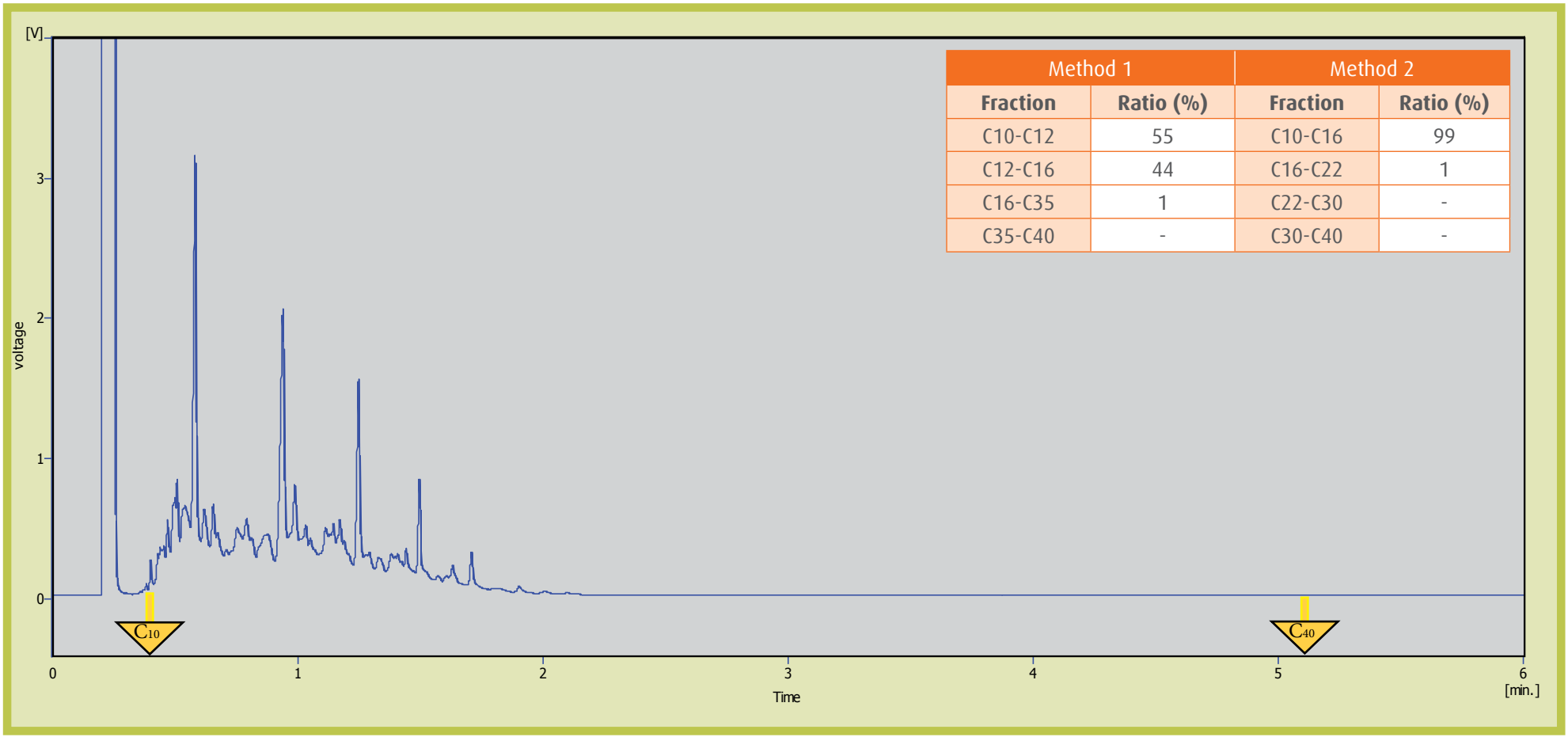
JP-5 or JP5 (for „Jet Propellant“) is a jet fuel that weighs 0,81kg per 1L and has a high flash point (min. 60 °C). It was developed in 1952 for use in aircraft stationed aboard aircraft carriers, where the risk from fire is particularly great. JP-5 remains the primary jet fuel for most navies. Its NATO code is F-44. It is also called AVCAT fuel for Aviation carrier turbine fuel. The JP-4 and JP-5 fuels, covered by the MIL-DTL-5624 U Specification, are intended for use in aircraft turbine engines. These fuels require military-unique additives that are necessary in military weapon systems. This requirement is unique to military aircraft, engine designs, and missions. JP-5 is a complex mixture of hydrocarbons, containing alkanes, naphthenes, and aromatic hydrocarbons.



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	46	C10-C16	100
C12-C16	54	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

Fig.30 JP-5 Fuel

JP-7 is a jet fuel developed by the U.S. Air Force for use in supersonic aircraft because of its high flashpoint and thermal stability. JP-7 is a mixture composed primarily of hydrocarbons, including alkanes, cycloalkanes, alkylbenzenes, indanes/tetralins, and naphthalenes, with addition of fluorocarbons to increase its lubricant properties, an oxidizing agent to make it burn better, and a cesium containing compound known as A-50, which aided in disguising the radar signature of the exhaust plume. JP-7 is unusual in that it is not a distillate fuel but is created from special blending stocks in order to have very low (<3%) concentration of highly volatile components like benzene or toluene, and almost no sulfur, oxygen, and nitrogen impurities. It has low vapor pressure and high thermal oxidation stability.

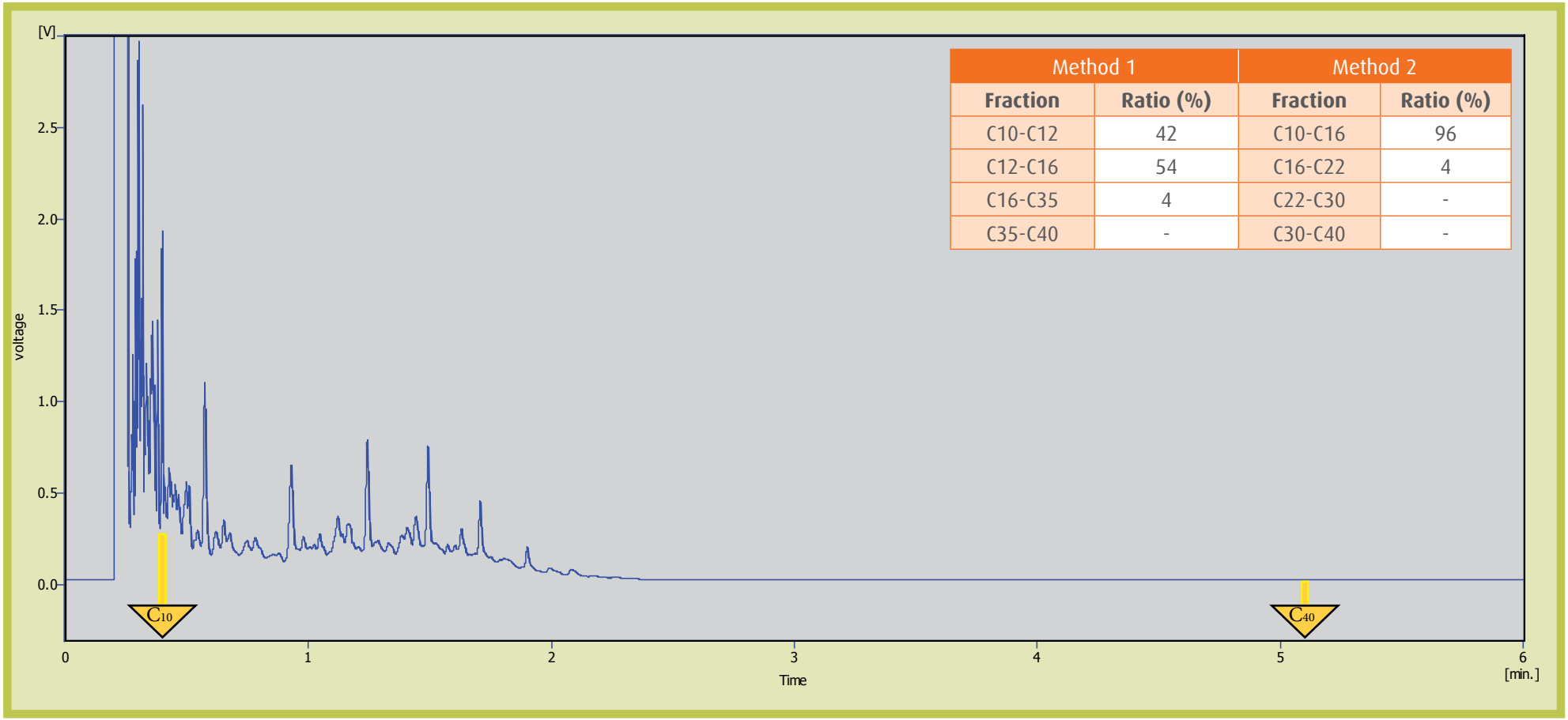


Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	55	C10-C16	99
C12-C16	44	C16-C22	1
C16-C35	1	C22-C30	-
C35-C40	-	C30-C40	-

Fig.31 JP-7 Gasoline

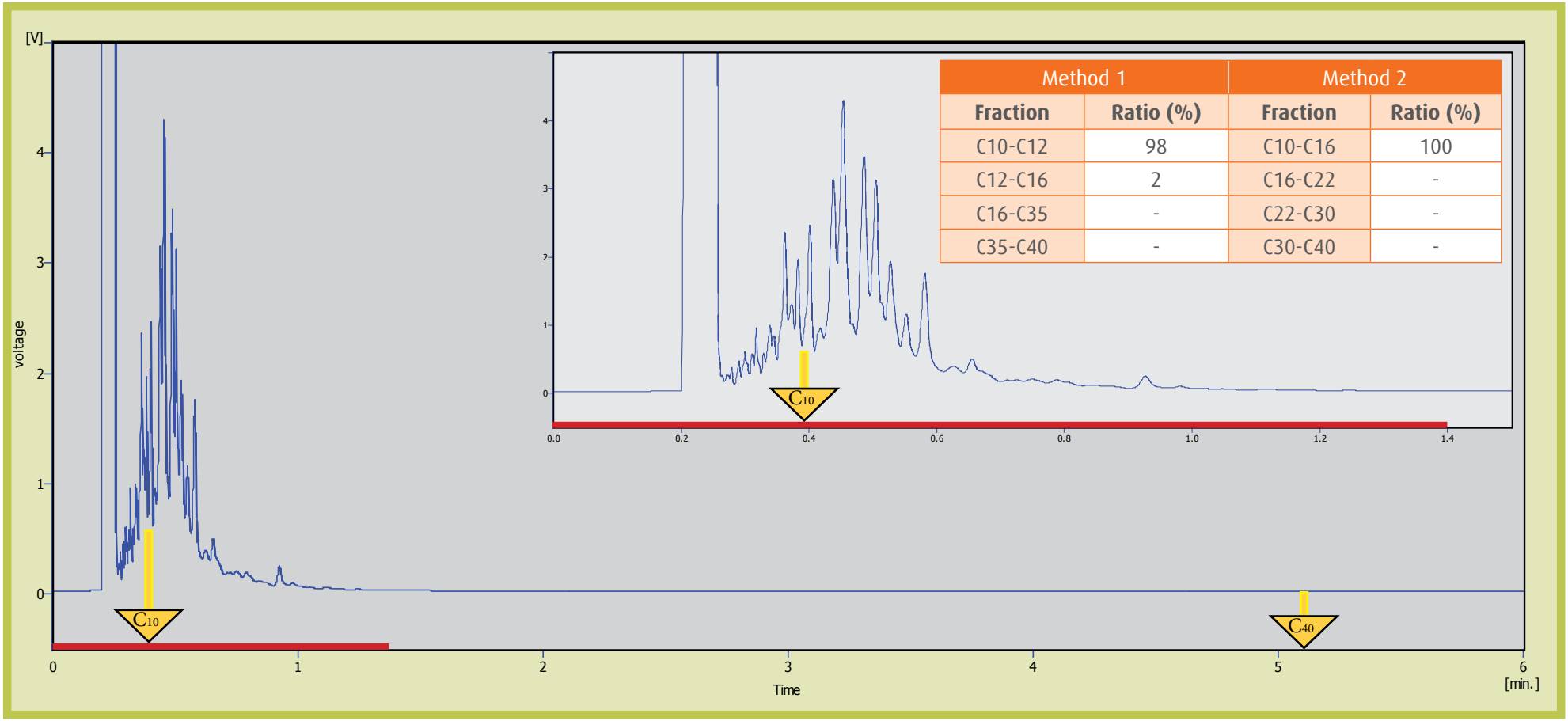
Aviation Fuels & Oils

JP-8 is a jet fuel, specified in 1990 by the U.S. government. It is kerosene-based. It is a replacement for the JP-4 fuel; the U.S. Air Force replaced JP-4 with JP-8 completely by the fall of 1996, to use a less flammable, less hazardous fuel for better safety and combat survivability. The U.S. Navy uses a similar formula, JP-5. It was first introduced at NATO bases in 1978. Its NATO code is F-34. JP-8 has a flash point of 38 °C, compared to -18 °C for JP-4. JP-5 has an even higher flash point of > 60 °C (140 °F), but also a higher cost. Outside of powering aircraft, JP-8 (or JP-5) is used as a fuel for heaters, stoves, tanks, by the U.S. military as a replacement for diesel fuel in the engines of nearly all tactical ground vehicles and electrical generators, and as a coolant in engines and some other aircraft components. The use of a single fuel greatly simplifies logistics.



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	42	C10-C16	96
C12-C16	54	C16-C22	4
C16-C35	4	C22-C30	-
C35-C40	-	C30-C40	-

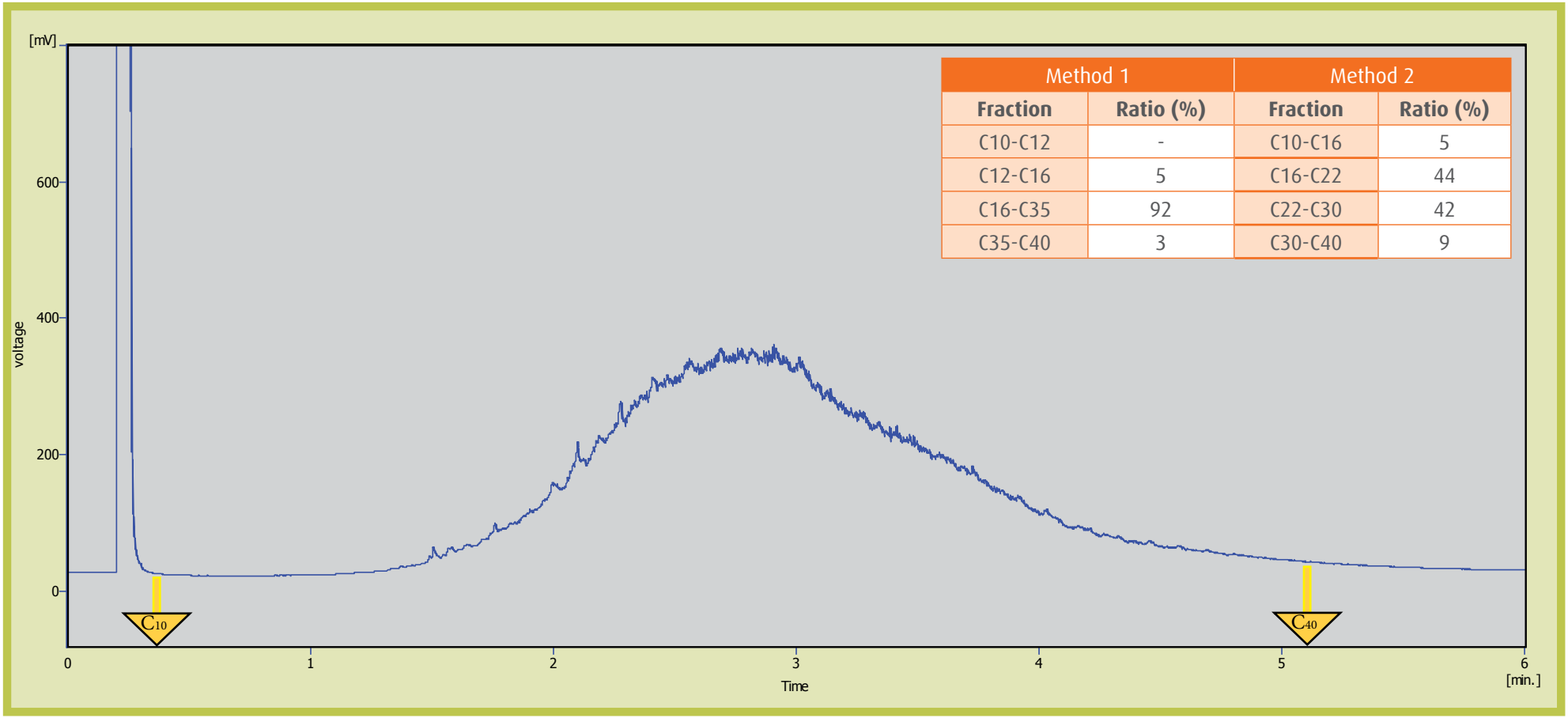
Fig.32 JP-8 Gasoline



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	98	C10-C16	100
C12-C16	2	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

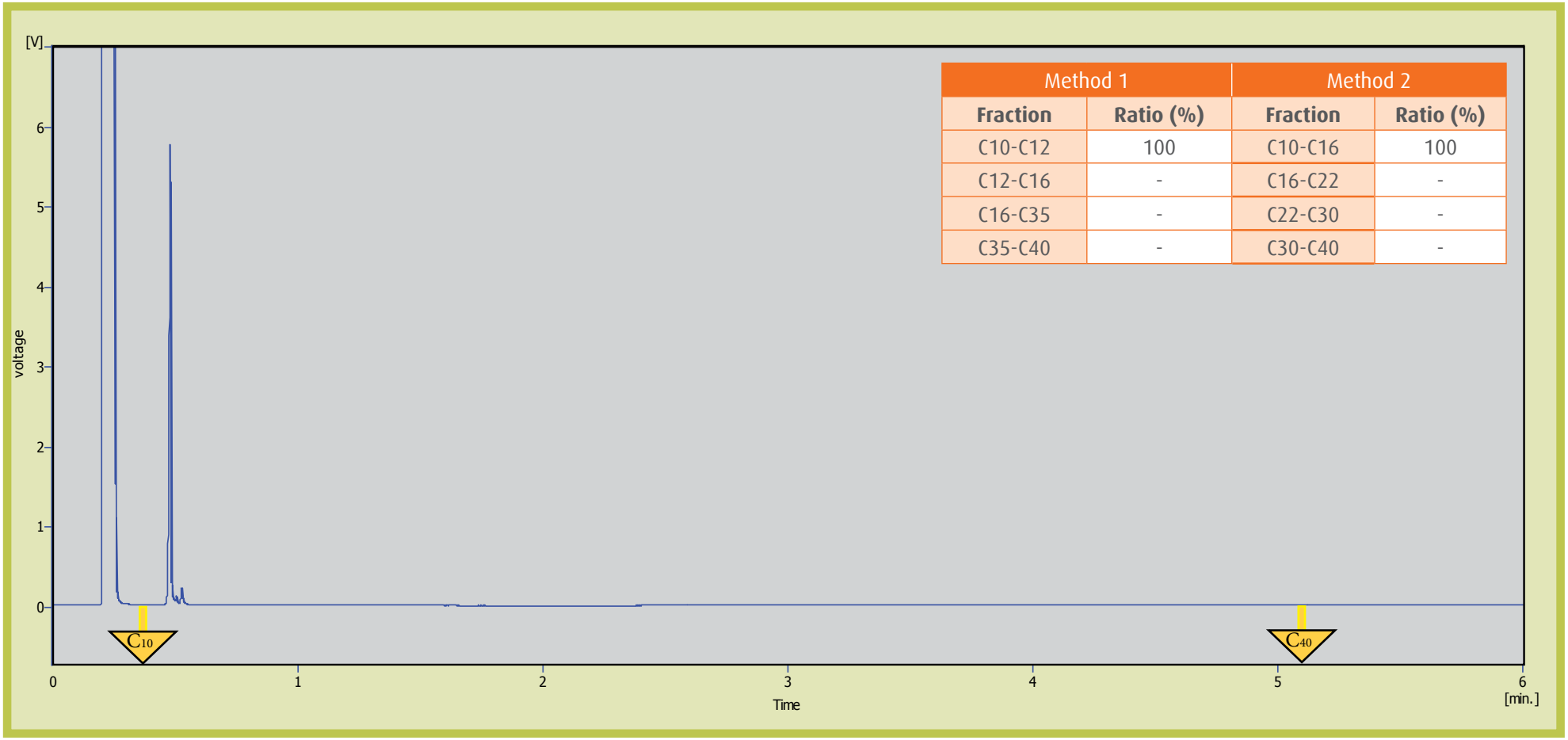
Fig.33 JP-TS Aviation Fuel

Aviation Fuels & Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	-	C10-C16	5
C12-C16	5	C16-C22	44
C16-C35	92	C22-C30	42
C35-C40	3	C30-C40	9

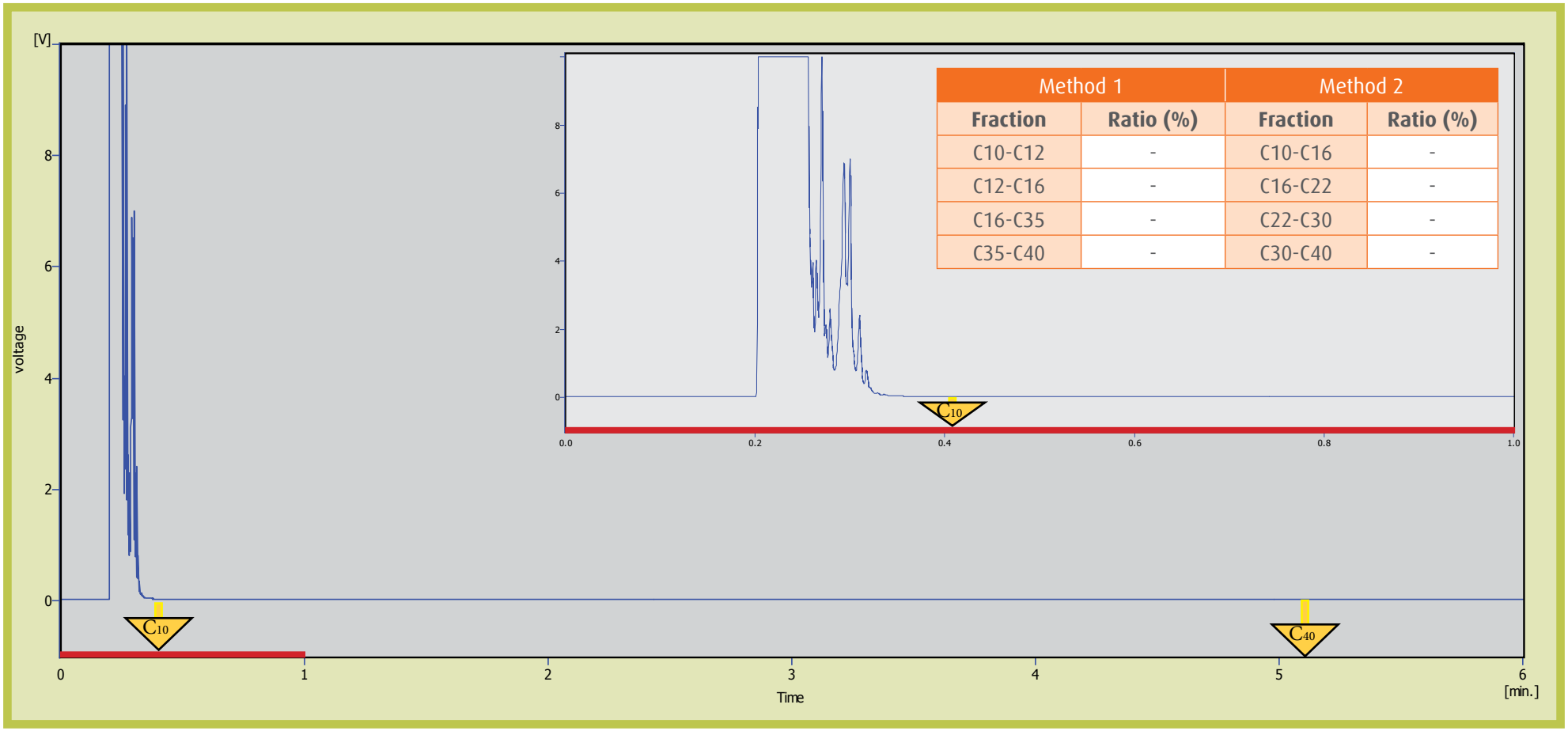
Fig.34 Hydraulic Fluid



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	100	C10-C16	100
C12-C16	-	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

Fig.35 JP-10 Aviation Fuel

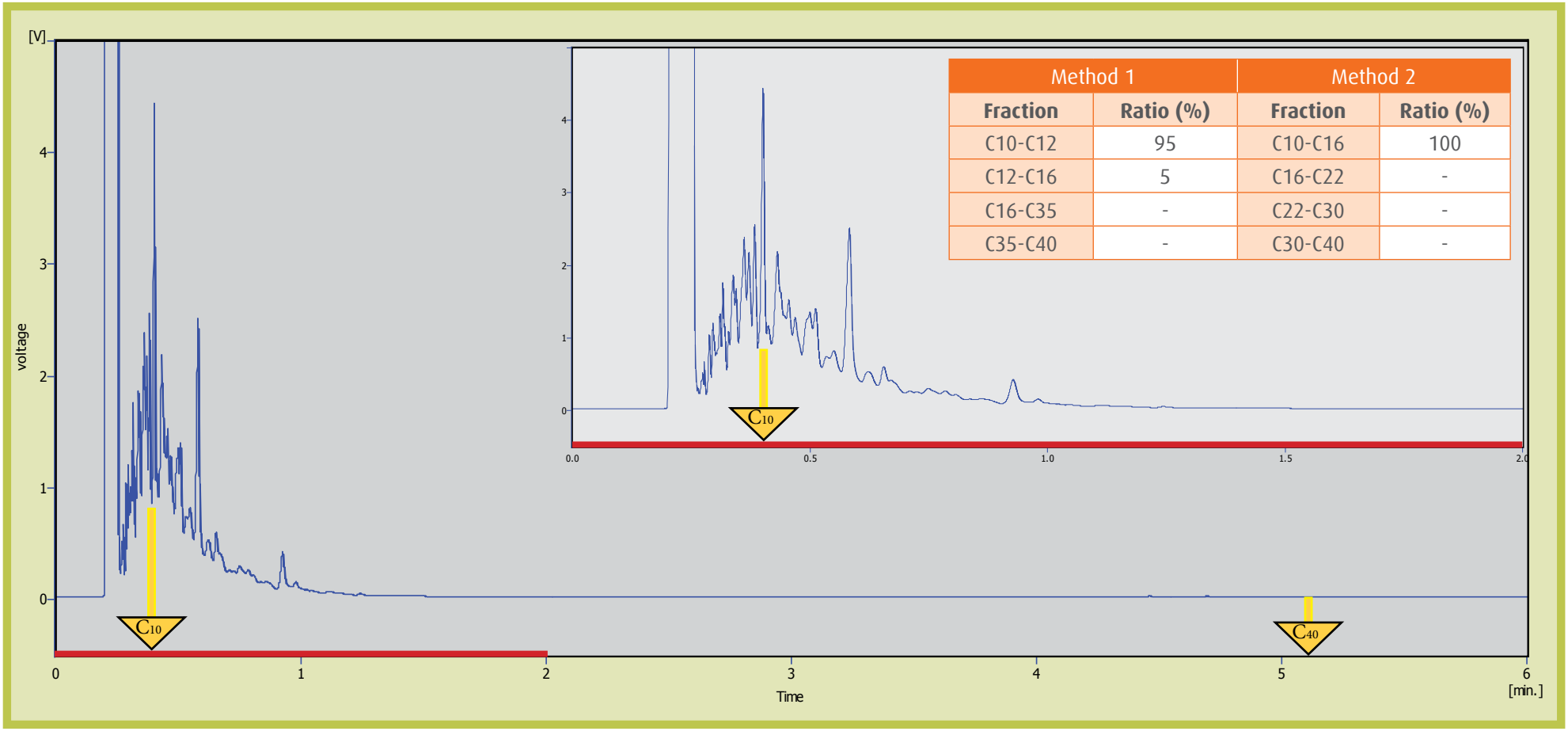
Household & Industrial Solvents



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	-	C10-C16	-
C12-C16	-	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

Fig.36 Lacquer Thinner

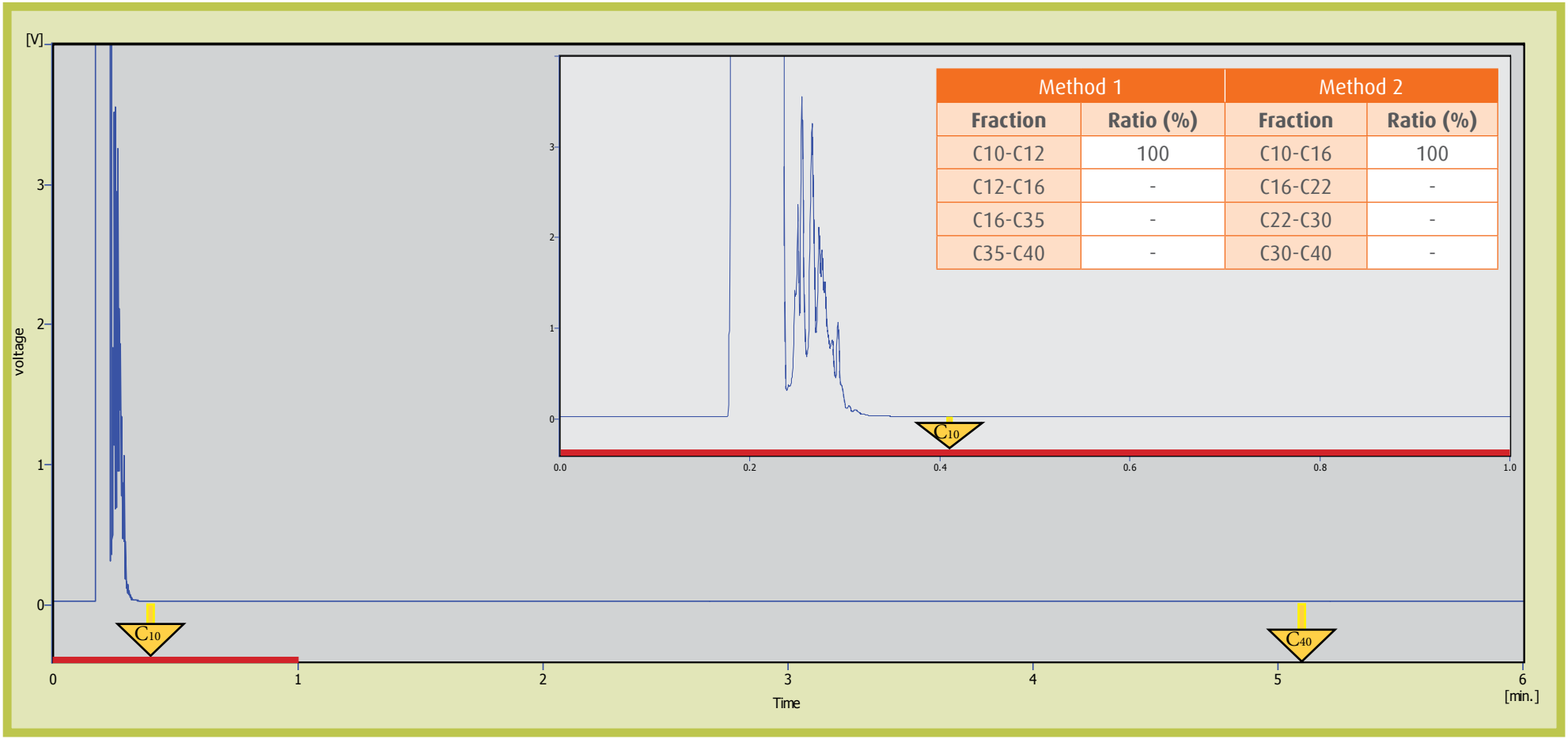
Household & Industrial Solvents



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	95	C10-C16	100
C12-C16	5	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

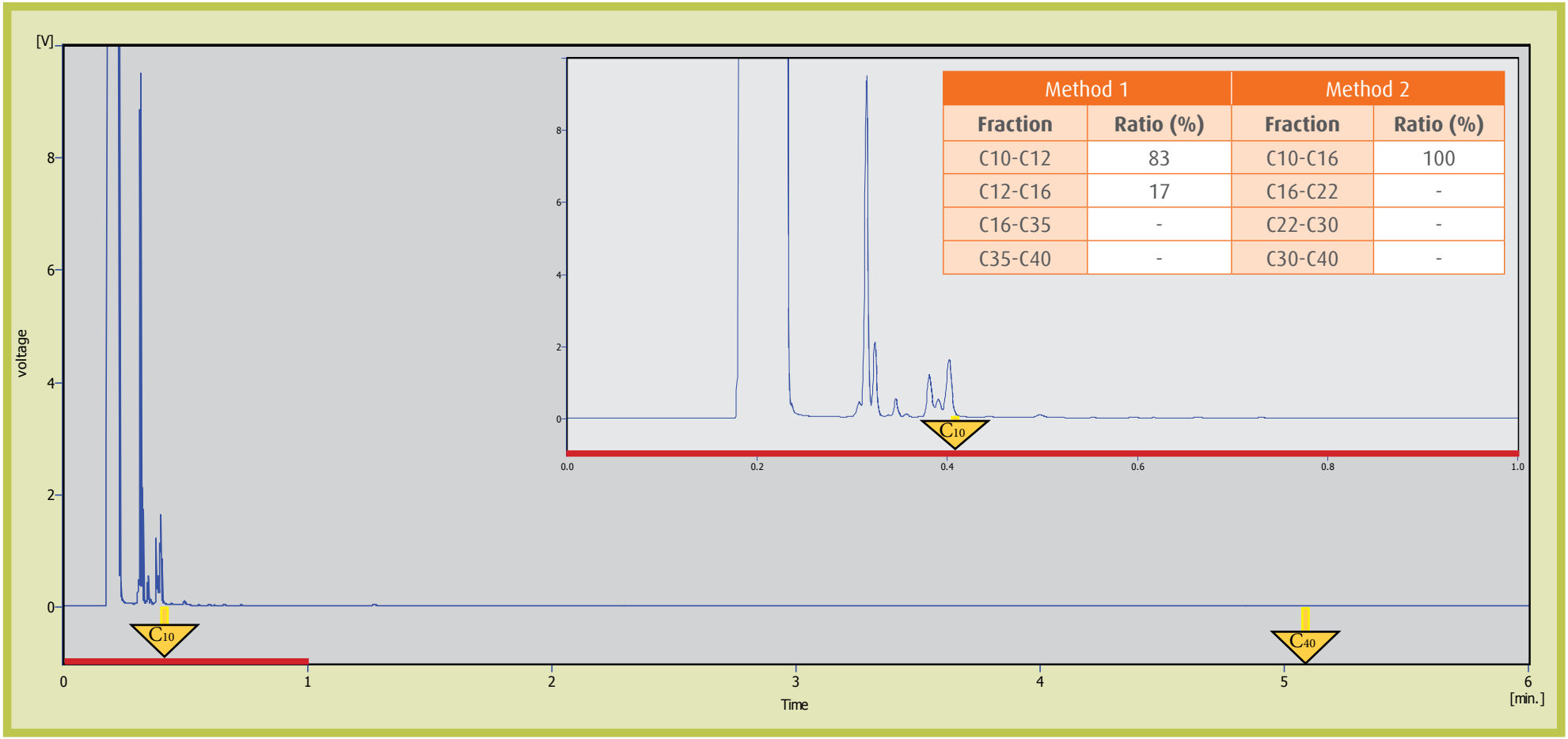
Fig.37 Mineral Spirits

Household & Industrial Solvents



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	100	C10-C16	100
C12-C16	-	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

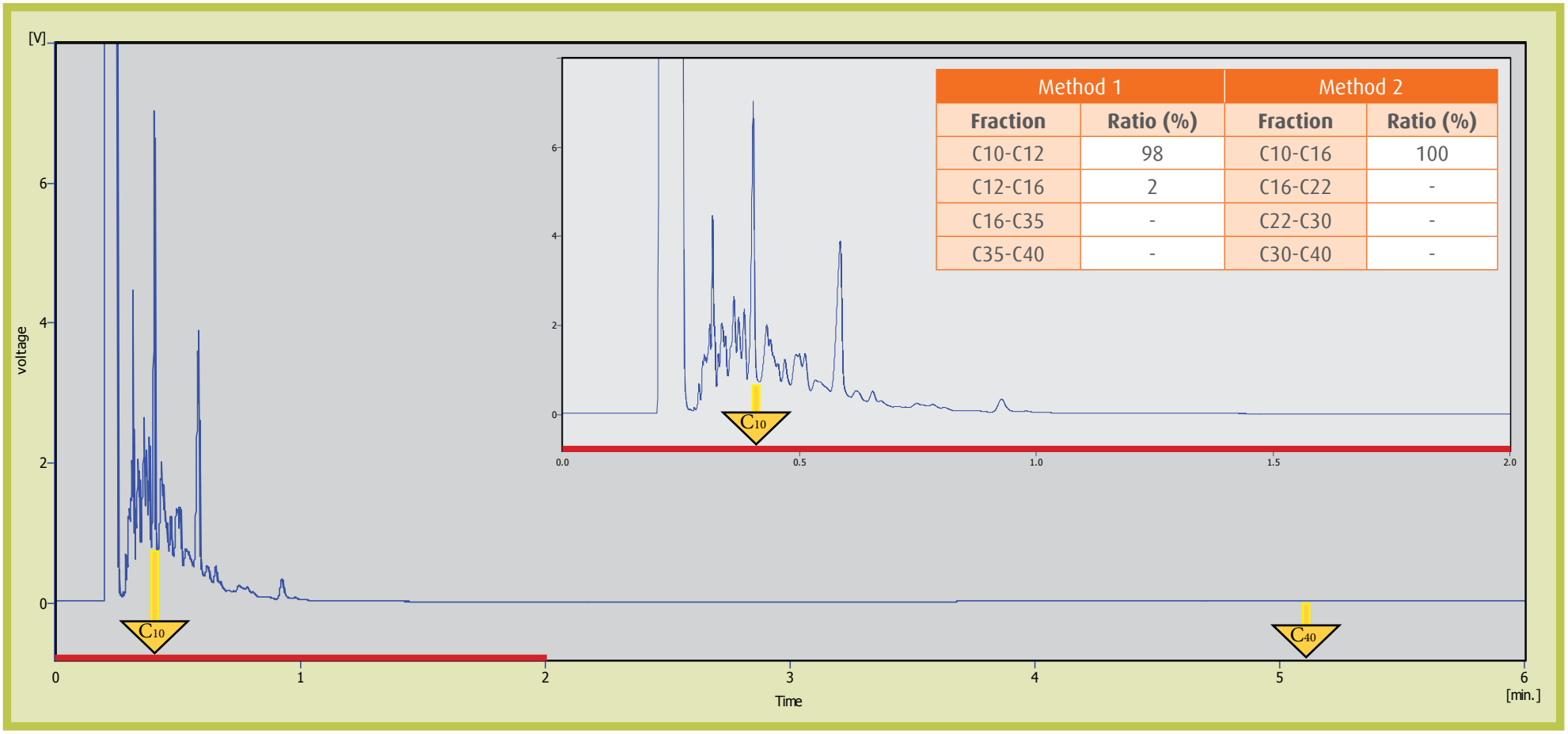
Fig.38 Naphta



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	83	C10-C16	100
C12-C16	17	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

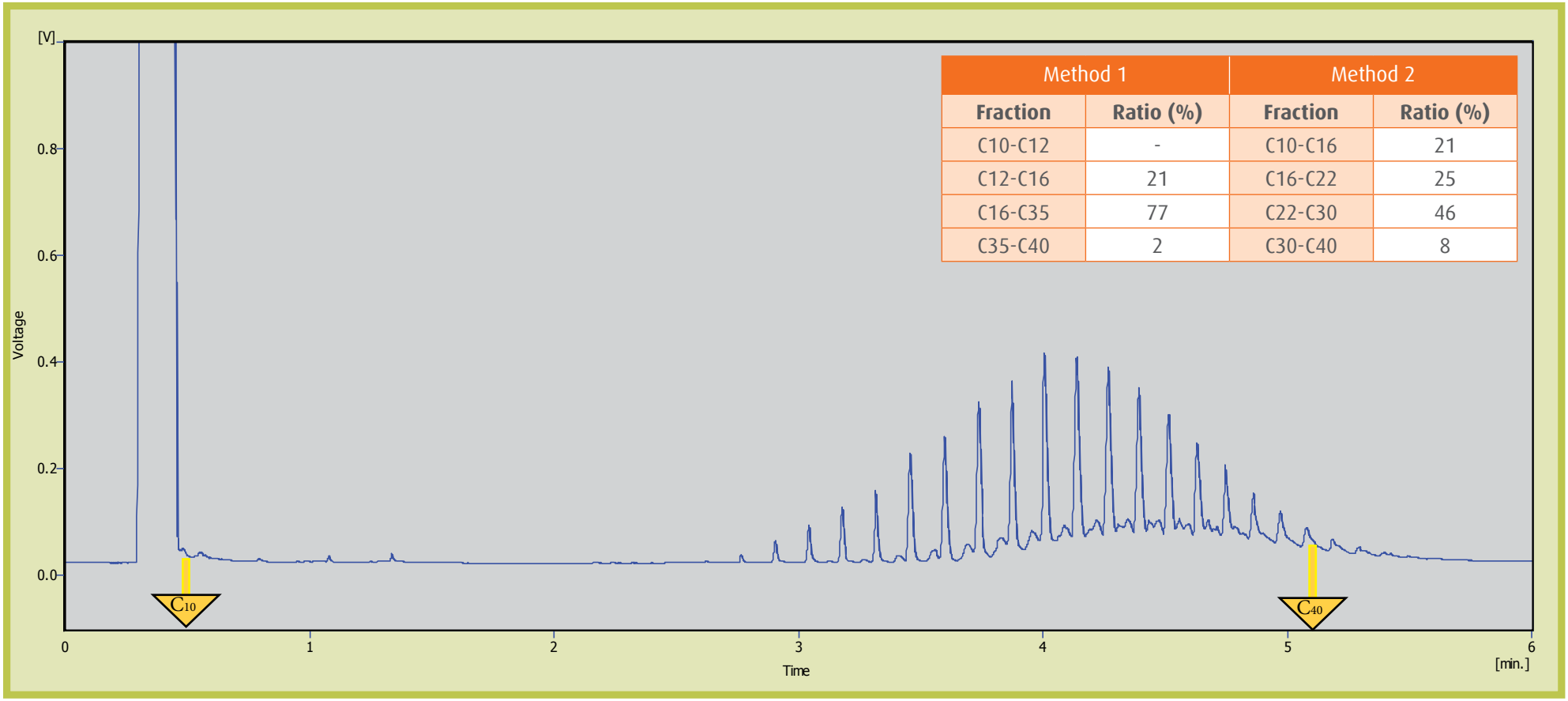
Fig.39 Turpentine

Household & Industrial Solvents



Method 1		Method 2	
Fraction	Ratio (%)	Fraction	Ratio (%)
C10-C12	98	C10-C16	100
C12-C16	2	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

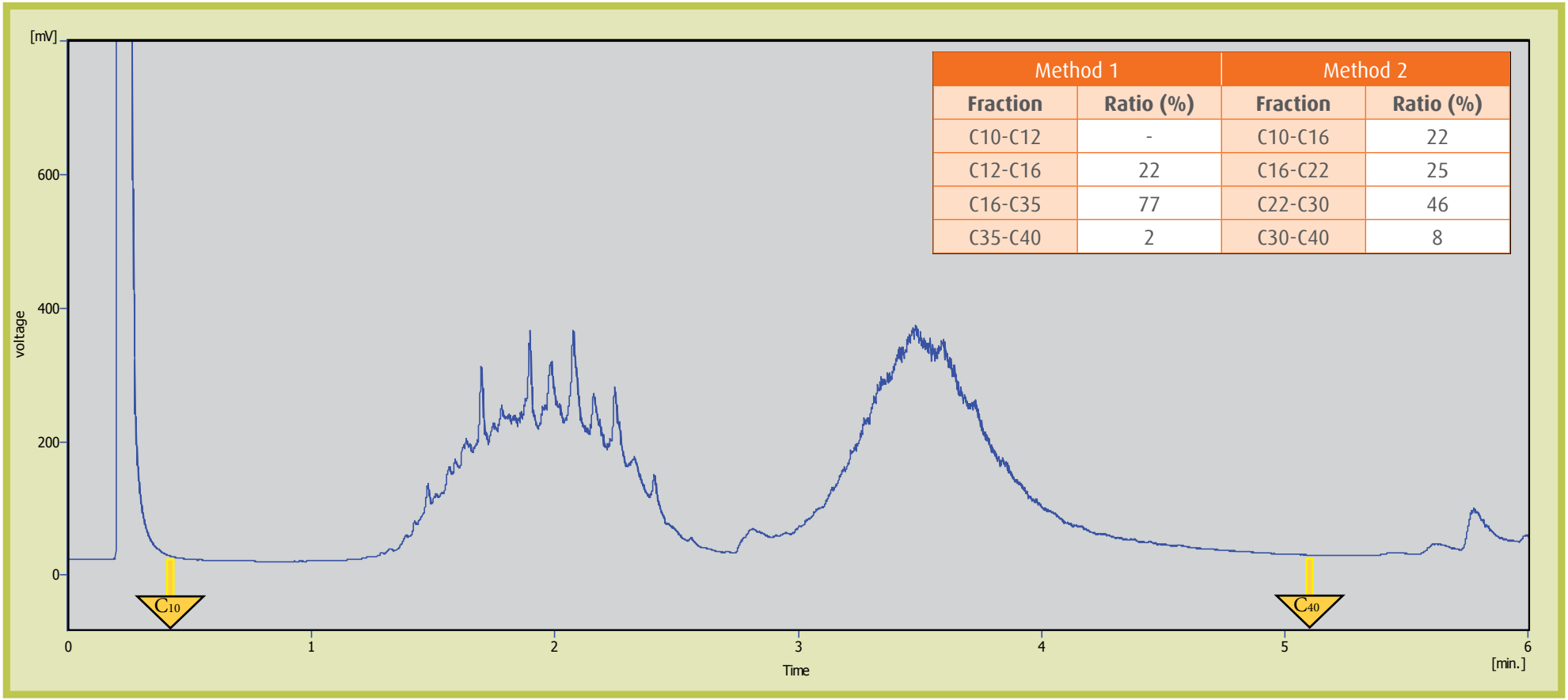
Fig.40 Stoddard Solvent



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	-	C10-C16	21
C12-C16	21	C16-C22	25
C16-C35	77	C22-C30	46
C35-C40	2	C30-C40	8

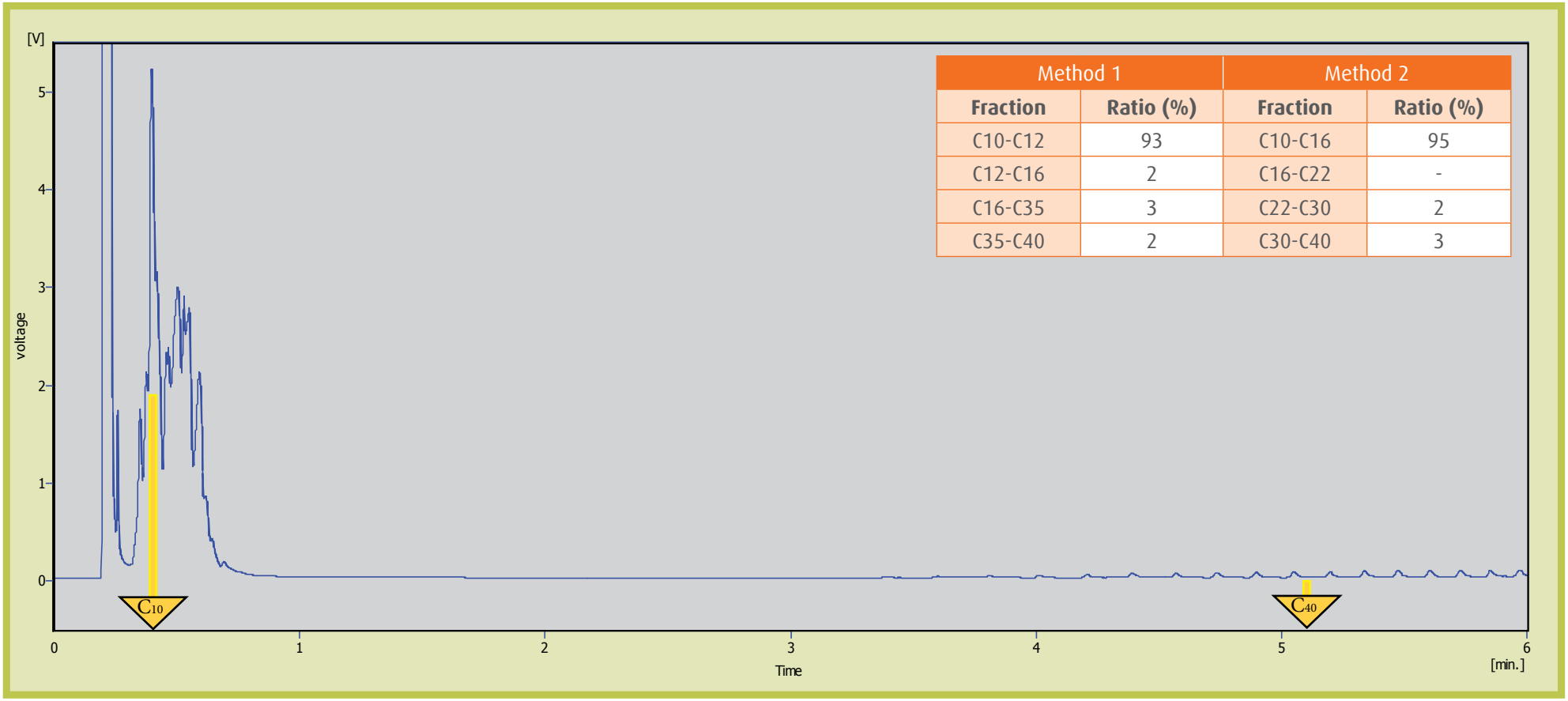
Fig.41 Parrafin Wax

Household & Industrial Solvents



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	-	C10-C16	22
C12-C16	22	C16-C22	25
C16-C35	77	C22-C30	46
C35-C40	2	C30-C40	8

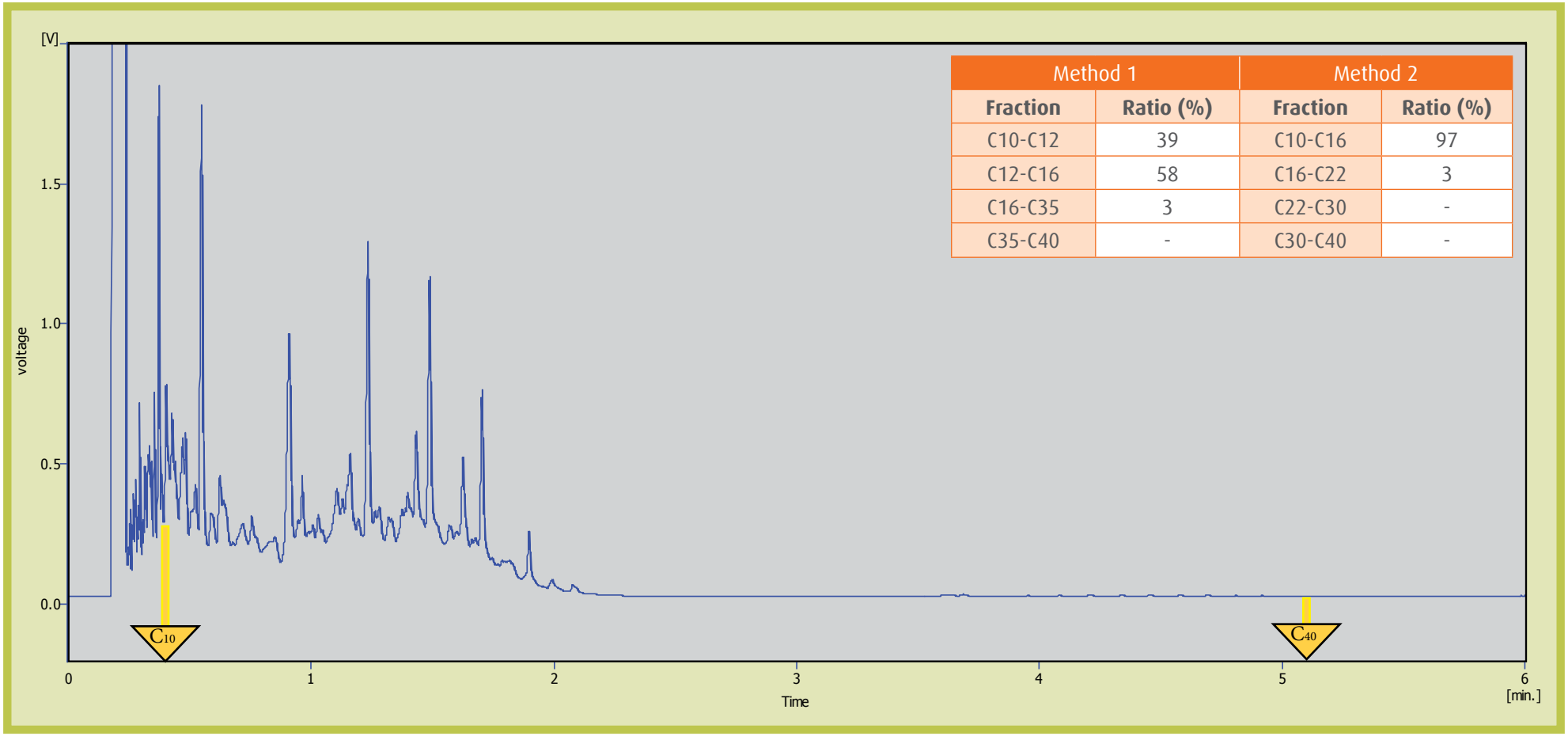
Fig.42 Sheron Konkor 101 - Lubrication Oil



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	93	C10-C16	95
C12-C16	2	C16-C22	-
C16-C35	3	C22-C30	2
C35-C40	2	C30-C40	3

Fig.43 Sonax Lax Reiniger - Car Polish

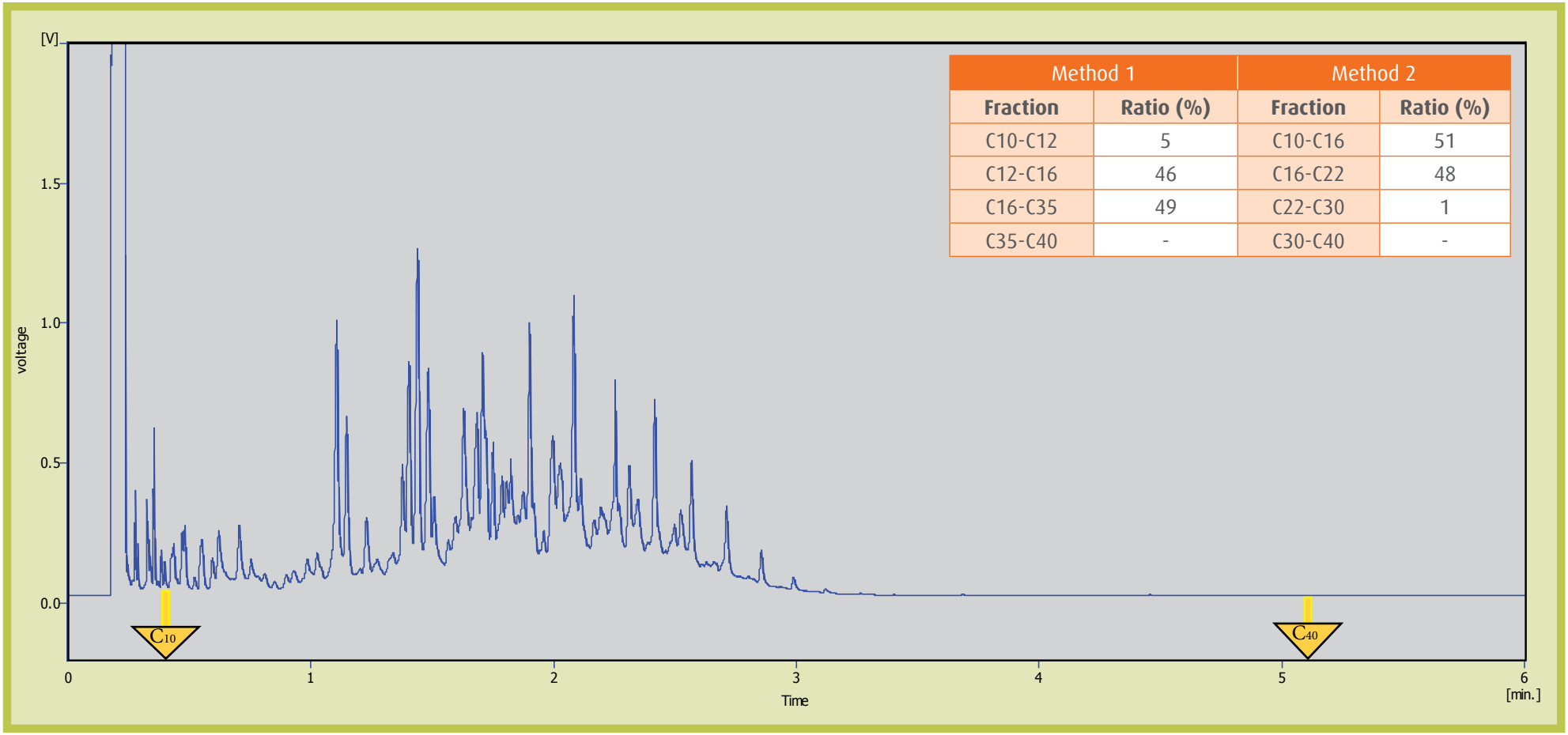
Heating Fuel Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	39	C10-C16	97
C12-C16	58	C16-C22	3
C16-C35	3	C22-C30	-
C35-C40	-	C30-C40	-

Fig.44 Fuel Oil #1

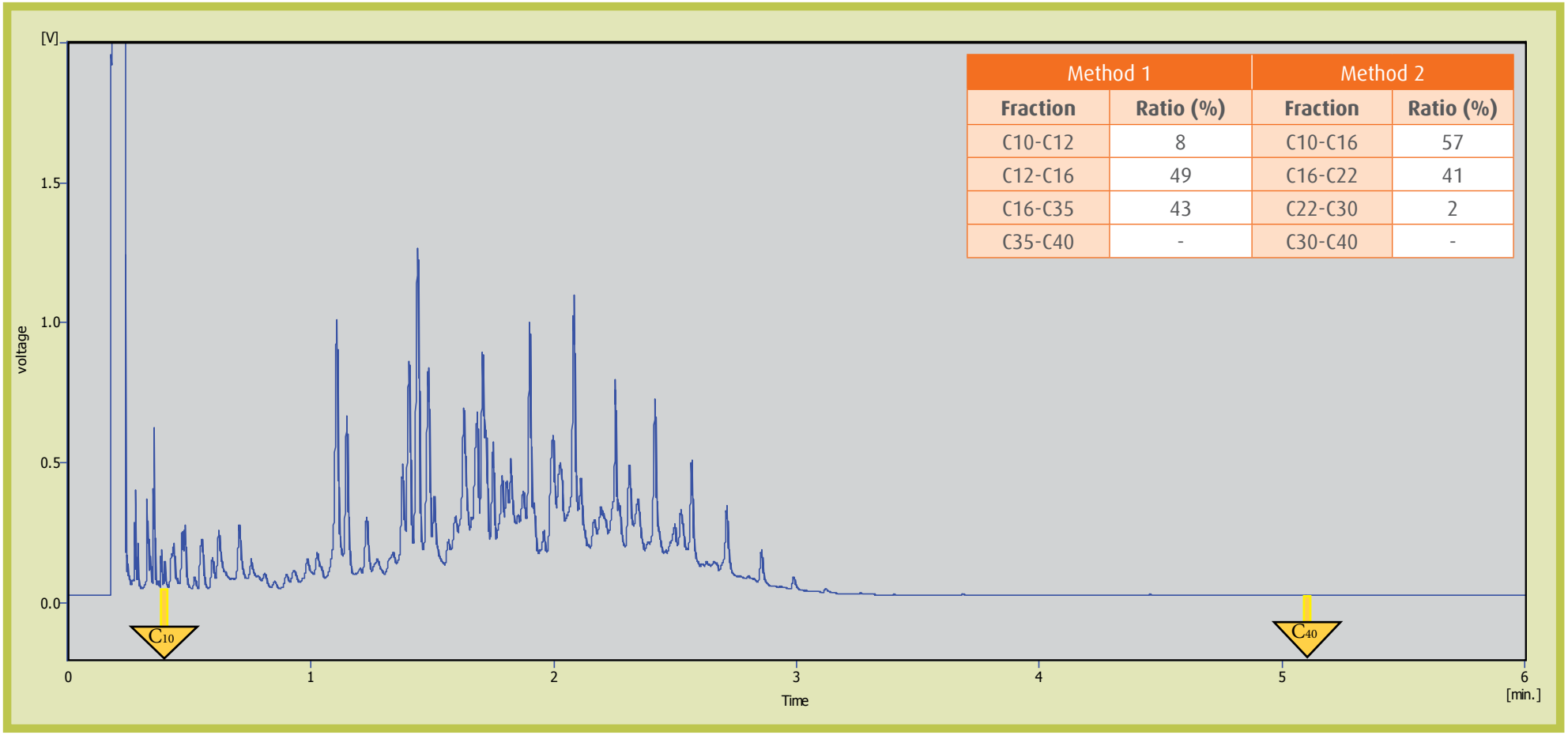
Heating Fuel Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	5	C10-C16	51
C12-C16	46	C16-C22	48
C16-C35	49	C22-C30	1
C35-C40	-	C30-C40	-

Fig.45 Fuel Oil #2

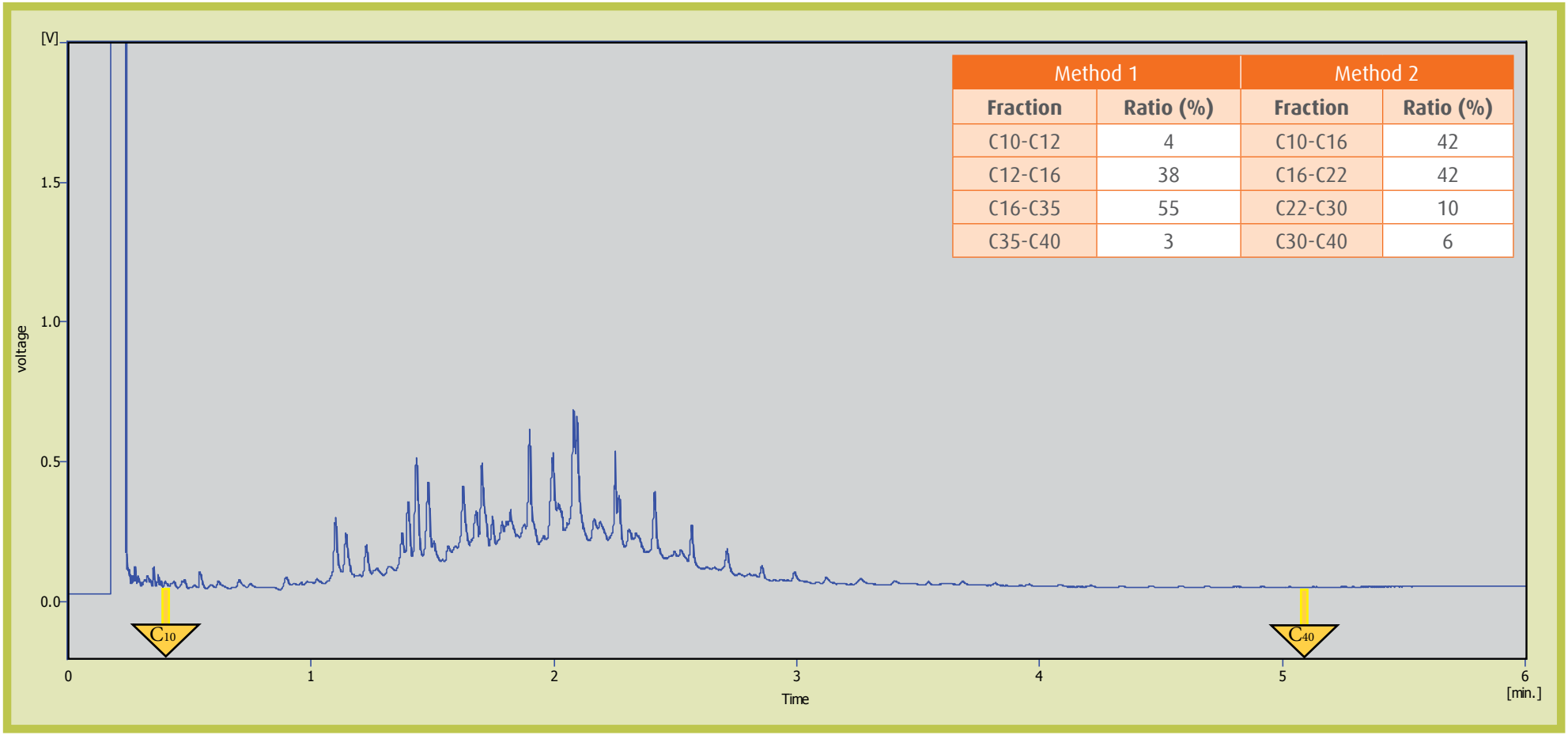
Heating Fuel Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	8	C10-C16	57
C12-C16	49	C16-C22	41
C16-C35	43	C22-C30	2
C35-C40	-	C30-C40	-

Fig.46 Fuel Oil #3

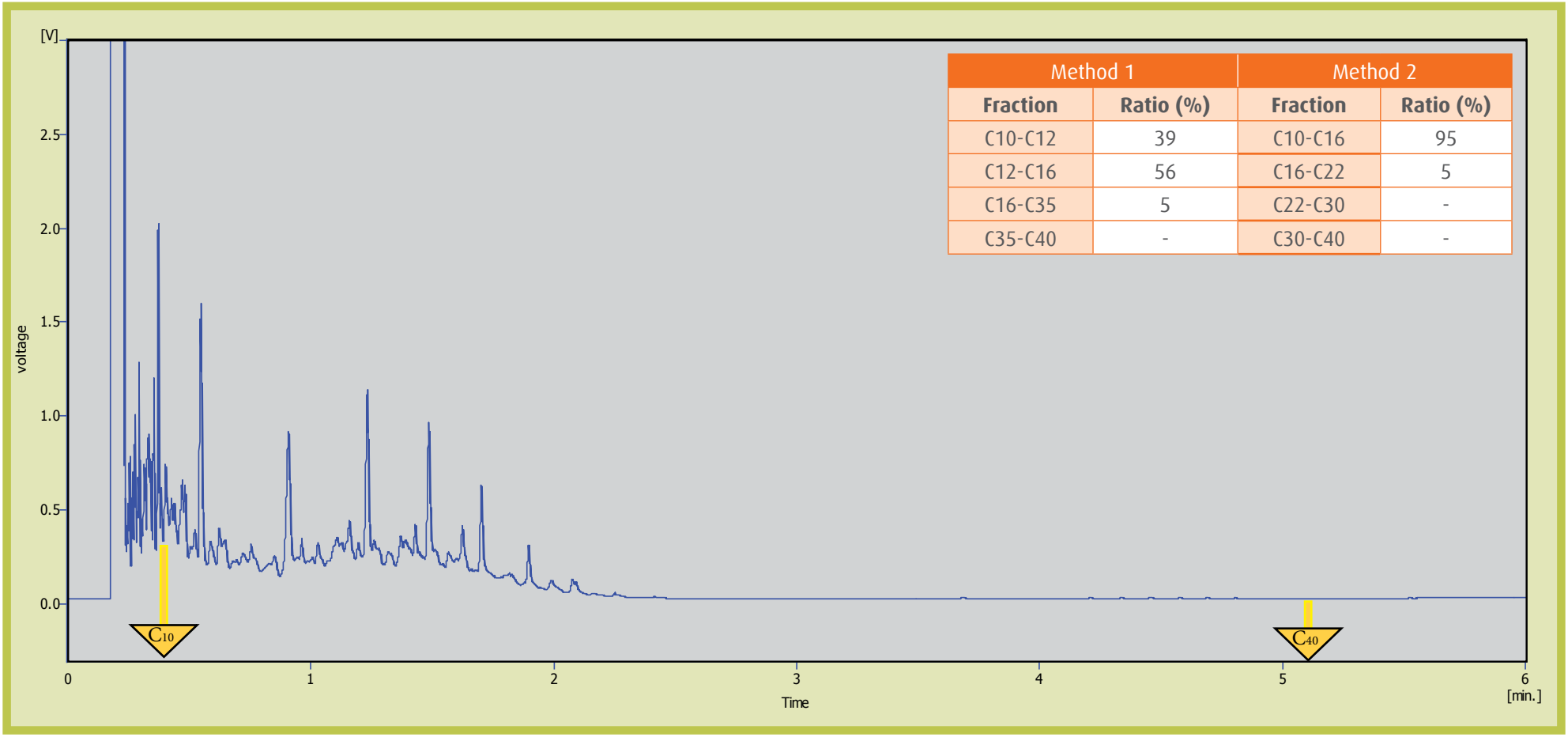
Heating Fuel Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	4	C10-C16	42
C12-C16	38	C16-C22	42
C16-C35	55	C22-C30	10
C35-C40	3	C30-C40	6

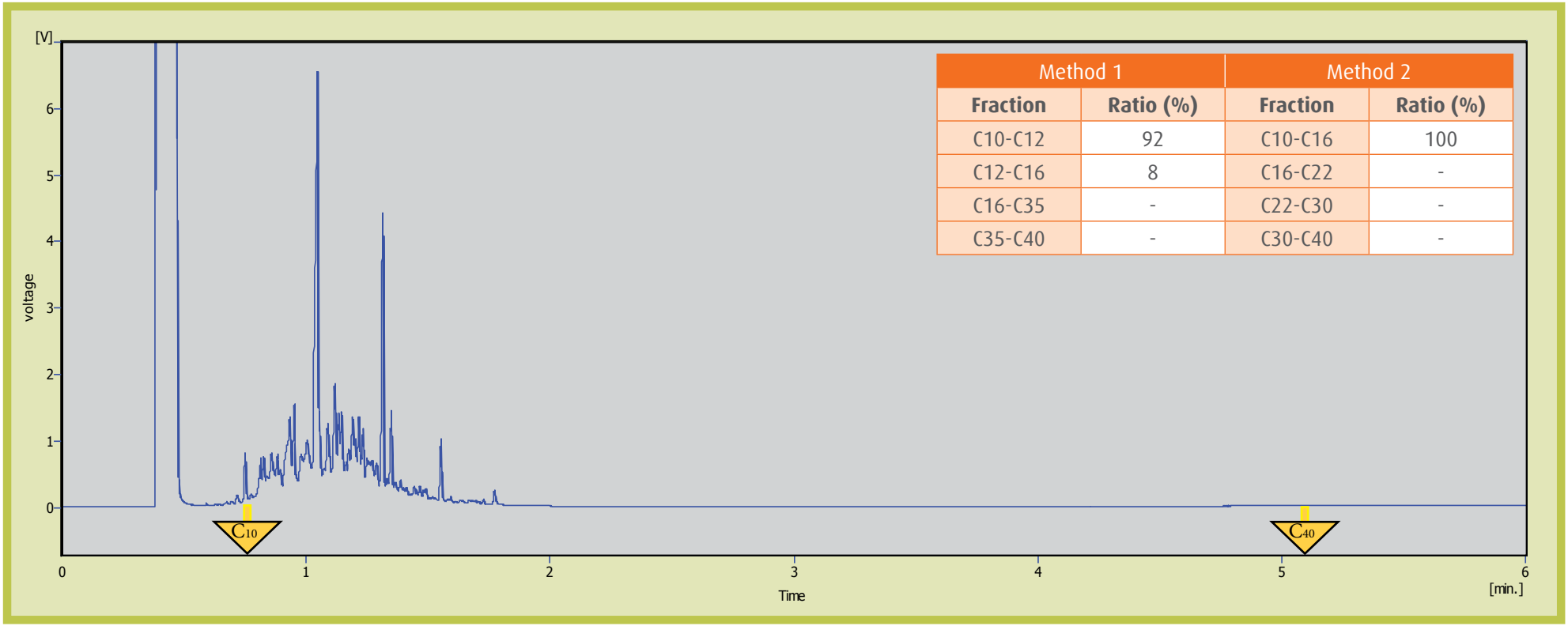
Fig.47 Fuel Oil #4

Heating Fuel Oils



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	39	C10-C16	95
C12-C16	56	C16-C22	5
C16-C35	5	C22-C30	-
C35-C40	-	C30-C40	-

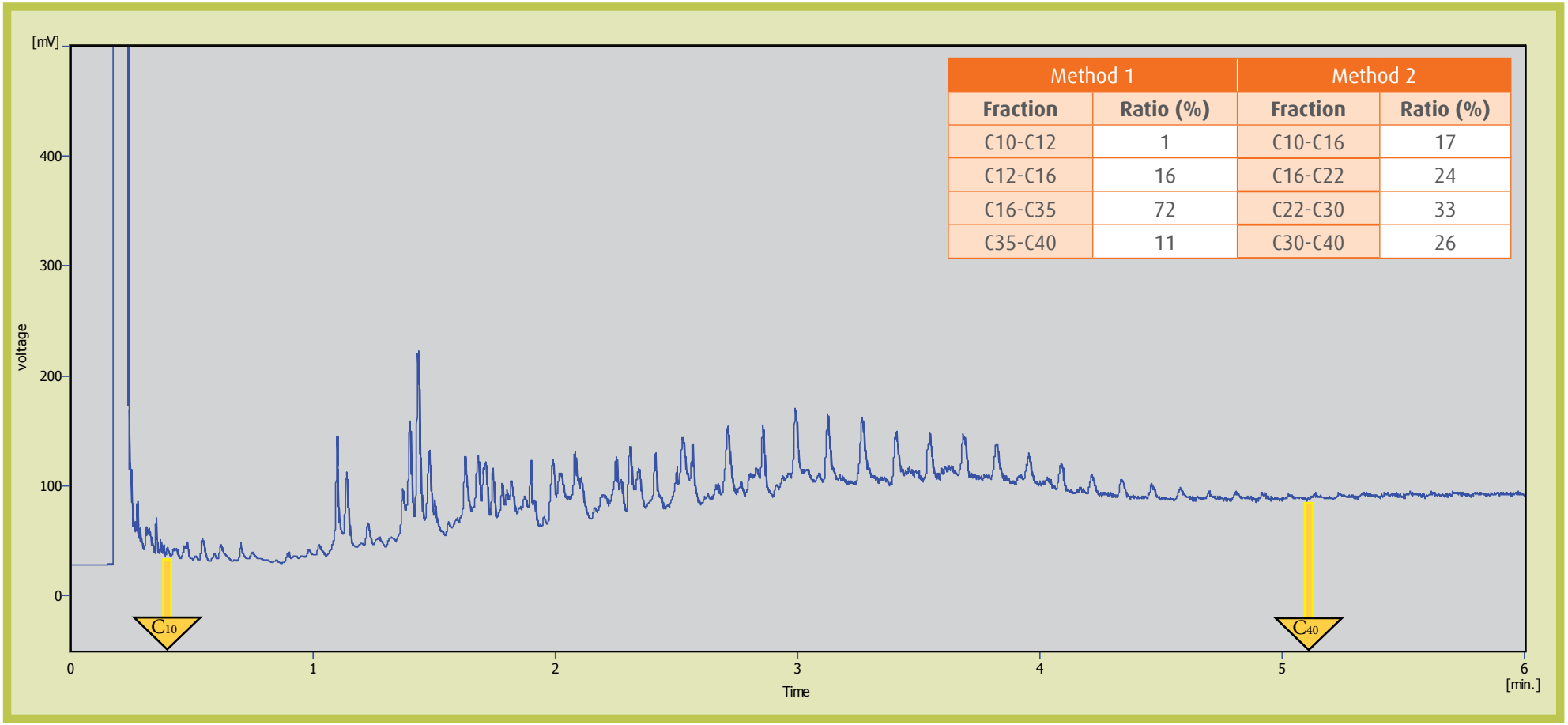
Fig.48 Kerosene I



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	92	C10-C16	100
C12-C16	8	C16-C22	-
C16-C35	-	C22-C30	-
C35-C40	-	C30-C40	-

Fig.49 Kerosene II

Heating Fuel Oils

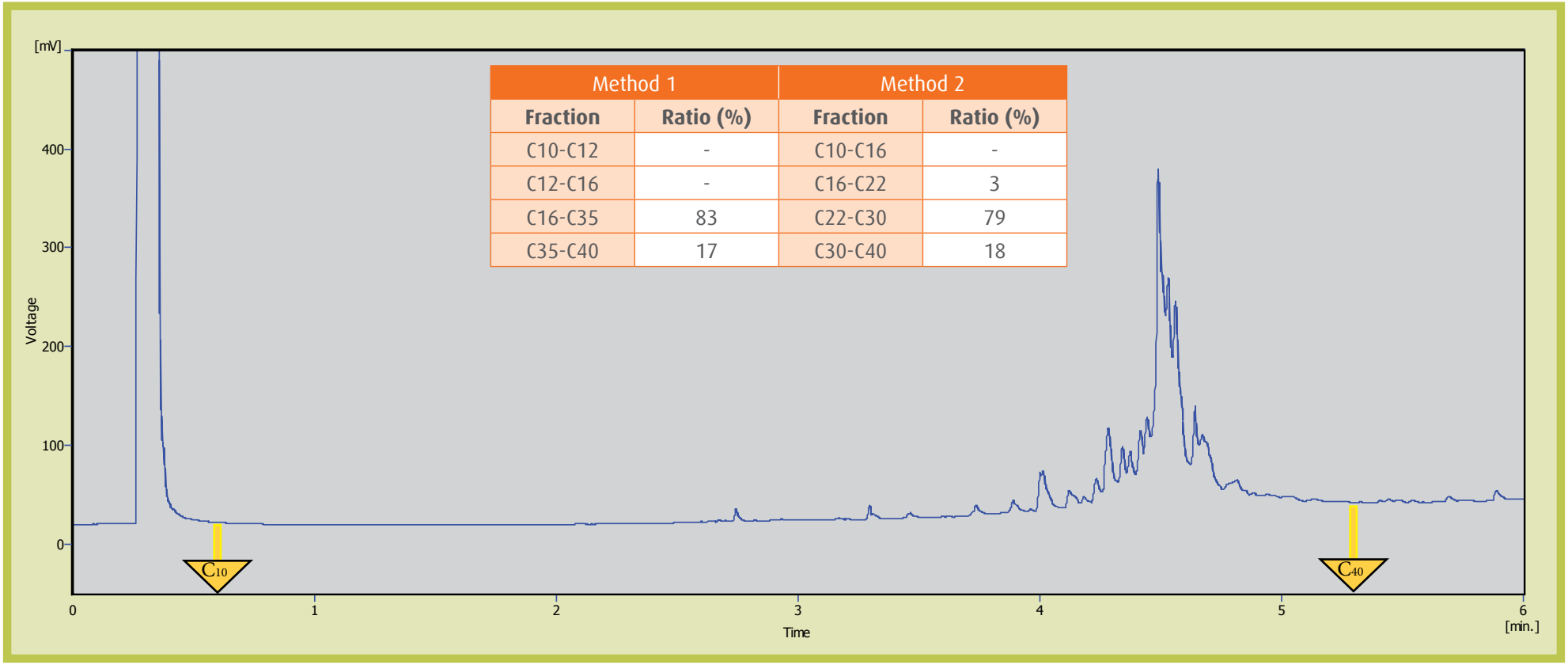


Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	1	C10-C16	17
C12-C16	16	C16-C22	24
C16-C35	72	C22-C30	33
C35-C40	11	C30-C40	26

Fig.50 Fuel Oil #6

Other Natural Matter

Compost is plant matter that has been decomposed and recycled as a fertilizer and soil amendment. Compost is a key ingredient in organic farming. At its most essential, the process of composting requires simply piling up waste outdoors and waiting a year or more. Modern, methodical composting is a multi-step, closely monitored process with measured inputs of water, air and carbon- and nitrogen-rich materials. The decomposition process is aided by shredding the plant matter, adding water and ensuring proper aeration by regularly turning the mixture. Worms and fungi further break up the material. Aerobic bacteria manage the chemical process by converting the inputs into heat, carbon dioxide and ammonium. The ammonium is further refined by bacteria into plant-nourishing nitrites and nitrates.

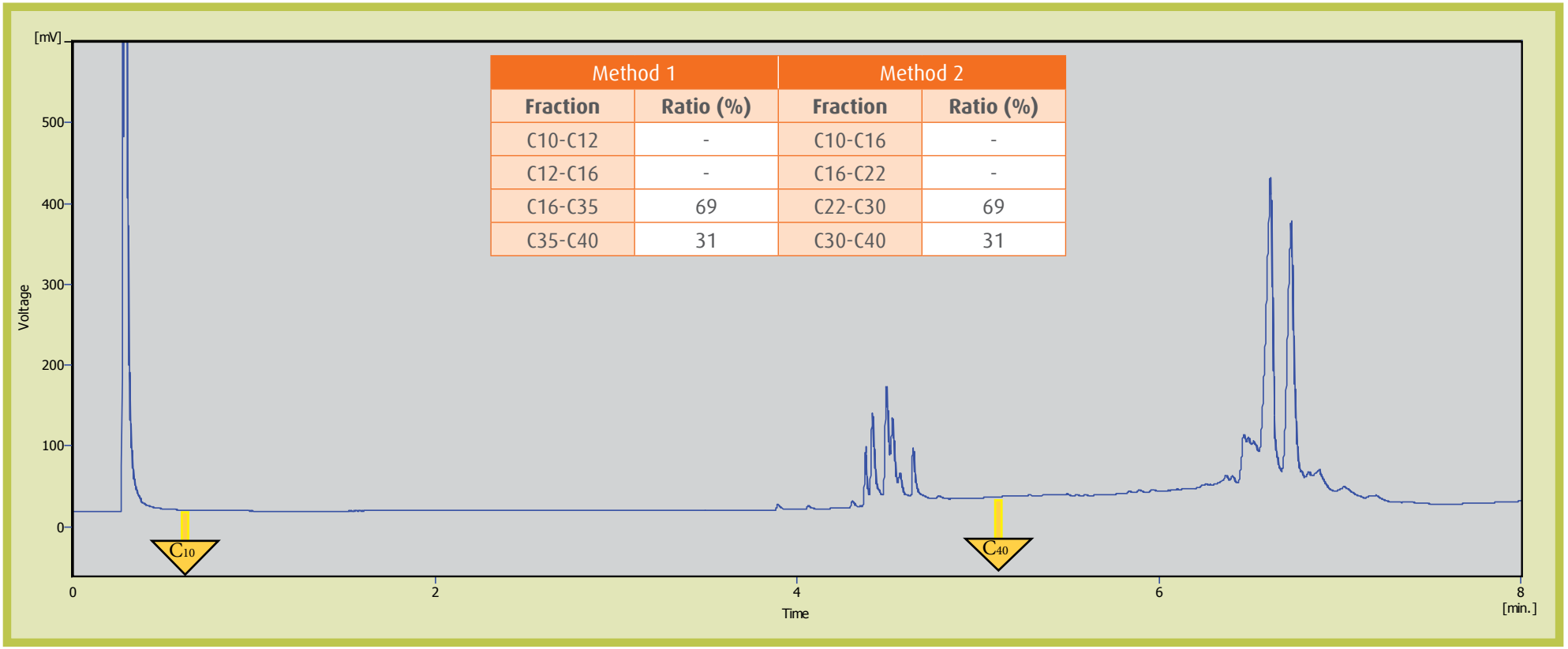


Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	-	C10-C16	-
C12-C16	-	C16-C22	3
C16-C35	83	C22-C30	79
C35-C40	17	C30-C40	18

Fig. 51 Compost

Other Natural Matter

Wood consists mainly from cellulose (40-50 %), lignin (20-30 %) and hemi cellulose (20-30 %). Minor compounds in wood are other organic compounds (1-3 %, tropical woods up to 15 %): terpenes, fats, waxes, pectins, tannins (leaf trees only), sterols, resin, and inorganic compounds (0,1-0,5 %, tropical trees up to 5 %) – which being ash when wood burns. Water is also contained in wood. Water content depends on season or degree of dryness. Terpenes, fats, waxes and resins may produce positive response on FID detector after extraction with non polar solvent.

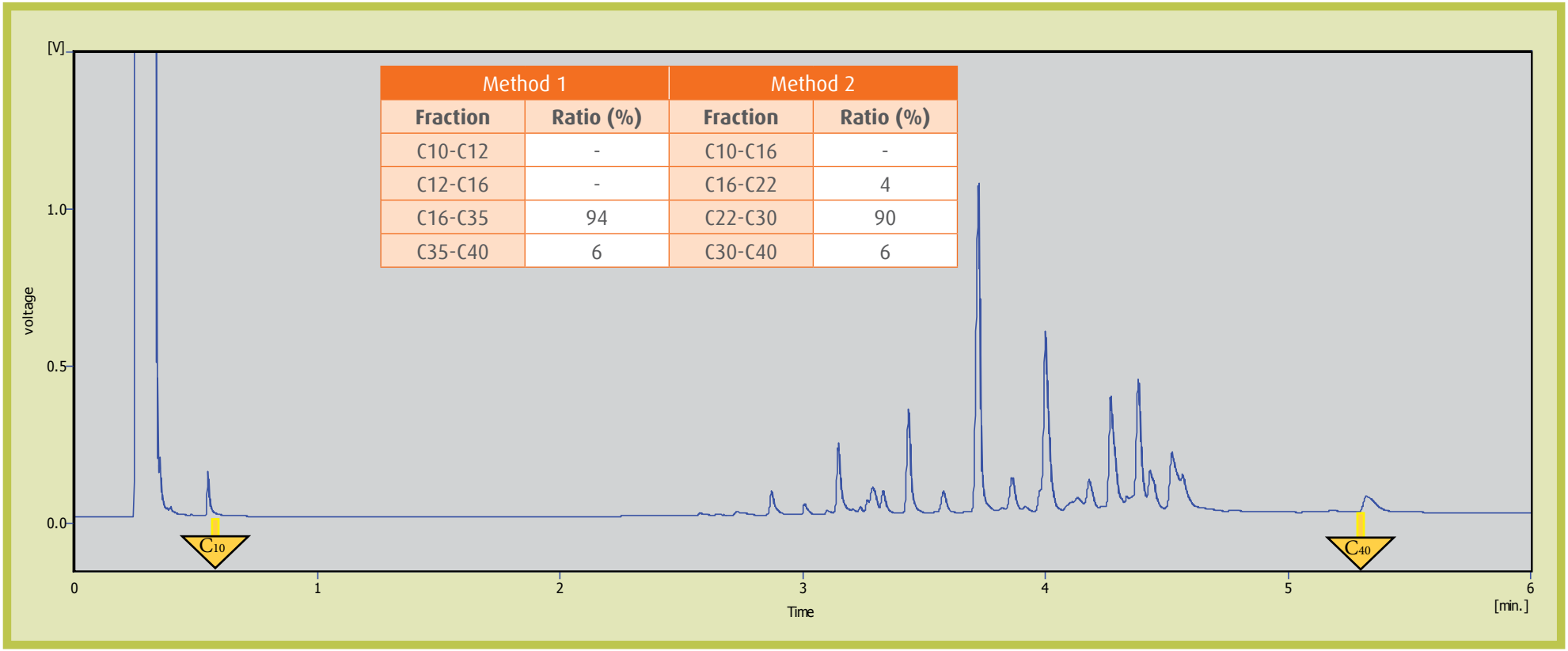


Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	-	C10-C16	-
C12-C16	-	C16-C22	-
C16-C35	69	C22-C30	69
C35-C40	31	C30-C40	31

Fig.52 Acacia Wood Sawdust

Other Natural Matter

Peat, or turf, is an accumulation of partially decayed vegetation matter or histosol. Peat forms in wetland bogs, moors, muskegs, pocosins, mires, and peat swamp forests. Peat is harvested as an important source of fuel in certain parts of the world. Peat forms when plant material, usually in marshy areas, is inhibited from decaying fully by acidic and anaerobic conditions. It is composed mainly of marshland vegetation: trees, grasses, fungi, as well as other types of organic remains, such as insects, and animal remains. Under certain conditions, the decomposition of the latter (in the absence of oxygen) is inhibited, and archaeologists often take advantage of this. Sometimes natural organic matter (NOM) complicates crude oil quantification by partitioning into extraction solvents. The compounds in NOM which partition into non-polar solvents are called “soil bitumens”, or natural fats, waxes and resins.



Method 1		Method 2	
Fraction	**Ratio (%)**	**Fraction**	**Ratio (%)**
C10-C12	-	C10-C16	-
C12-C16	-	C16-C22	4
C16-C35	94	C22-C30	90
C35-C40	6	C30-C40	6

Fig.53 Peat

Summary

	Name	CAS #	Producer
Petroleum	Crude oil	N/A	N/A
Motor Fuels & Lubricating Oils	Natural 91	N/A	PAP Oil
	Natural 95	N/A	Benzina
	Natural 98	N/A	PAP Oil
	Special 91	N/A	PAP Oil
	RFA Gasoline	8006-61-9	AccuStandard
	Diesel Fuel #2	68334-30-5	AccuStandard
	Diesel Fuel (Low Sulfur) #1	68334-30-5	AccuStandard
	Diesel Fuel (Extra Low Sulfur) #2	68476-34-6	AccuStandard
	Arctic Diesel Fuel	68334-30-5	AccuStandard
	Biodiesel 100 (consumer grade)	67784-80-9	AccuStandard
	Biodiesel 20	N/A	AccuStandard
	FAME Rapeseed Oil	N/A	Sigma-Aldrich
	SAE 30W Motor Oil	N/A	AccuStandard
	SAE 40W Motor Oil	N/A	AccuStandard
	SAE 50W Motor Oil	N/A	AccuStandard
	Mogul Trans SAE 80W	N/A	Paramo
	Mogul Racing 5W-40	N/A	Paramo
	Mogul Felicia 15w-40	N/A	Paramo
	Mogul SAE 30 M6A	N/A	Paramo
	Mogul Alfa Profi	N/A	Paramo
	Madit Emol SAE 10W-30	N/A	Slovnaft
	Prosint Oleo Mac - Oil for Two-Stroke Engines	N/A	Oleo Mac
	Oil for Two-Stroke Engines	N/A	Husqvarna

	Name	CAS #	Producer
Aviation Fuels & Oils	Aviation Fuel	N/A	AccuStandard
	Turbine (Jet) Fuel	N/A	AccuStandard
	JP-4 (Jet Fuel)	50815-00-4	AccuStandard
	JP-5 Fuel	N/A	AccuStandard
	JP-7 Gasoline	8006-61-9	AccuStandard
	JP-8 Gasoline	8006-61-9	AccuStandard
	JP-TS Aviation Fuel	64742-47-8	AccuStandard
	Hydraulic Fluid	64742-54-7	AccuStandard
	JP-10 Aviation Fuel	N/A	AccuStandard
Household & Industrial Solvents	Lacquer Thinner	N/A	AccuStandard
	Mineral Spirits	8030-30-6	AccuStandard
	Naphta	64742-89-8	AccuStandard
	Turpentine	8006-64-2	AccuStandard
	Stoddard Solvent	8052-41-3	AccuStandard
	Parrafin Wax	N/A	Druchema
	Sheron Konkor 101	N/A	Paramo
	Sonax Lax Reiniger	N/A	Sonax
Heating Fuel Oils	Fuel Oil #1	70892-10-3	AccuStandard
	Fuel Oil #2	68476-30-2	AccuStandard
	Fuel Oil #3	N/A	AccuStandard
	Fuel Oil #4	68476-31-3	AccuStandard
	Kerosene I	8008-20-6	AccuStandard
	Kerosene II	N/A	Customer STD
	Fuel Oil #6	68553-00-4	AccuStandard
Other Natural Matter	Compost	N/A	N/A
	Acacia Wood Sawdust	N/A	N/A
	Peat	N/A	N/A

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