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TBP distillation of condensate from 1/9-6 DST 4

STATOIL
EXPLORATION & PRODUCTION
LABORATORY

by

Kjell Øygard

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LAB.83.06

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Prepared

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Approved

9.03.21 A

SUMMARY.

This report presents the results from a true boiling point distillation, performed on a 179 ml sample from a single flash of separator condensate, bottle no. 8207521 from 1/9-6 DST 4.

The sample was fractionated by distillation from room temperature to 331°C, the molecular weights and densities were measured at 15°C.

Table 1.

Summary of representative data for condensate from 1/9-6 DST 4.

	Density at 15°C (g/cm^3)	Molecular Weight	Weight % of the condensate
Condensate	0.786	147	100
C_{10}^+	0.828	223	66.00
C_{20}^+	0.873	377	23.45

2. METHODS AND EQUIPMENT.

2.1 Distillation.

TBP distillation was performed according to ASTM D-2892, with a Fisher HMS 500.

The fractions were collected according to the boiling point range of the various hydrocarbon groups (D.L.Katz and Firoozabadi, Journ. Petr. Tech., Nov. 1978, s. 1650).

From room temperature to 151.3°C the sample was fractionated at atmospheric pressure, the heavier fraction were separated at reduced pressure (12.5 mbar).

2.2 Compositional analysis.

Component analysis of the gas and the liquid fractions were performed using a Hewlet Packard 5880 gas chromatographic system.

Chromatographic conditions:

Column for the liquid: Chrompack 25m x 0.22mm WCOT, Cp sil 5 on fused silica, filmthickness 0.14 µ m.

Column for the gas: Chrompack 50m x 0.23mm WCOT, Cp sil 5 on fused silica, filmthickness 0.3 µ m

Carrier gas: Helium, 22 cm/sek. linear velocity at 10°C.

Detector: Flame ionisation, Nitrogen make up gas, temp. 320°C.

Injection: All glass splitter, with a packed "Jennings tube". Split ratio 1:80, temp. 310°C for the liquid. Temp. 200°C for the gas.

Temp. program: For the first fractions the injection temp. was 10°C, isothermal for 4 min., then 4°C/min. The injection temp. was 100°C for the C_{12}-C_{19} fractions. For the gas -30°C isothermal 4 min., then 8°C/min. to 160°C isothermal.

Gas Chromatograms of the different carbon to carbon cut are enclosed in the appendix.
The molecular weights was determined by freezing point depression using a Knauer molecular weight instrument, with benzene as a reference substance.

The density was determined by Paar DMA 602 frequency densiometer.

Since the residue of C_{20}^{+} - fraction was very viscous, the density could not be measured directly. However, dilution of a C_{20}^{+} sample with toluen in a known ratio C_{20}^{+} fraction/toluene and measuring the density of this solution, the density of C_{20}^{+} could be calculated after the following equation:

$$\rho_{20^+} = \frac{gC_{20^+}}{\frac{gs}{\rho_s} - \frac{gt}{\rho_t}}$$

gC_{20}^{+} - the weight of C_{20}^{+}

gt - the weight of toluene

ρt - the density of toluene

gs - the weight of the solution

ρs - the density of the solution

In a series of measurements of C_{20}^{+} distillation fractions in this manner, we have found that to the measured values of the desities it should be added empirically 0.009 g/cm^3 to obtain a correct value of the density.

3. RESULTS.

The composition of the whole condensate from the TBP distillation is given in table 2.

The calculated density of the distillate

$$S = \frac{\text{Cum. weight}}{\text{Cum. volum}}$$

and % by volum distilled are given in table 3 whereas the calculated molecular weight and densities are given in table 4.

Table 5 gives the weight % of the fraction overlap of each cut. The gas chromatograms of each fractions are enclosed in the appendix.

The composition of the gas and the light end fractions determined by gas chromatography is given in table 6.

Table 2. TBP distillation of single flash oil from separator liquid 1/9-6 DST 4.

Hydrocarbon group	boiling ranges (°C)	% by weight destillation	% by weight distilled	Density at 15°C (g/cm³)	% by volum of condensate	Mol. weight
gass		0.410	0.410	0.410*	0.788	29.7*
C_5	<36.5	8.152	8.562	0.626*	10.261	68.5*
C_6	69.2	4.567	13.129	0.682	5.276	85*
C_7	98.9	6.380	19.509	0.726	6.924	95*
C_8	126.1	7.839	27.348	0.747	8.270	106
C_9	151.3	7.518	34.866	0.769	7.703	116
C_{10}^+	>151.3	66.000		0.828	62.788	223
C_{10}	174.6	5.875	40.741	0.781	5.926	133
C_{11}	196.4	5.290	46.031	0.778	5.358	152
C_{12}	216.8	4.231	50.262	0.785	4.229	164
C_{13}	235.9	5.014	55.276	0.802	4.926	179
C_{14}	253.9	4.375	59.651	0.815	4.230	193
C_{15}	271.1	3.695	63.346	0.817	3.557	209
C_{16}	287.3	3.379	66.725	0.824	3.231	218
C_{17}	303.0	3.922	70.647	0.825	3.747	239
C_{18}	317.0	3.140	73.787	0.831	2.977	250
C_{19}	331.0	2 766	76.553	0.841	2.592	264
C_{20}^+	>331.0	23.447	100.000	0.873	21.116	377

* Calculated valus from the GC-composition.

Table 3: Cumulativ weight, cumulativ vol. and calculated $S = \frac{\text{cum.weight}}{\text{cum. vol.}}$ and % by volume of distillate from from 1/9-6 DST 4.

Fraction	Cum. weight	Cum. vol.	$\frac{\text{Cum.weight}}{\text{Cum.vol.}}$	% by volume distilled
gas	0.582	1.420	0.410	0.788
C_5	12.164	19.922	0.611	10.049
C_6	18.652	29.435	0.634	16.325
C_7	27.716	41.920	0.661	23.249
C_8	38.852	56.832	0.684	31.519
C_9	49.532	70.722	0.700	39.222
C_{10}	57.879	81.407	0.711	45.148
C_{11}	65.394	91.068	0.718	50.506
C_{12}	71.411	98.693	0.724	54.735
C_{13}	78.534	107.575	0.730	59.661
C_{14}	84.750	115.203	0.734	63.891
C_{15}	90.000	121.616	0.740	67.448
C_{16}	94.801	127.442	0.743	70.679
C_{17}	100.373	134.198	0.748	74.426
C_{18}	104.834	139.565	0.751	77.403
C_{19}	108.763	144.238	0.754	79.995

Table 4:

Measured and calculated molecular weights and densities from destillation of 1/9-6-DST 4

	Condensate	C_{10}^+	C_{20}^+
Measured mol. weights		223	377
Calculated mol. weight using C_{10}^+ mol.weight	146,5		
Calculated mol. weight using C_{20}^+ mol.weight	146,5	224,3	
Measured densities (g/cm^3)	0.786	0.828	0.873
Calculated density (g/cm^3) using C_{10}^+ density	0.779		
calculated density (g/cm^3) using C_{20}^+ density	0.779	0.829	

Table 5.

Distribution and % overlap of each carbon to carbon cut from destillation of 1/9-6 DST 4.

Component	Weight % of the condensate	Weight % of fraction overlap
gas	0.410	90 -10
C_5	8.152	70 -30
C_6	4.567	2-82-16
C_7	6.380	5-75-20
C_8	7.839	12-84-4
C_9	7.518	12-86-2
C_{10}	5.875	10-85-5
C_{11}	5.290	16-75-9
C_{12}	4.231	15-72-13
C_{13}	5.014	14-73-13
C_{14}	4.375	13-69-18
C_{15}	3.695	18-71-11
C_{16}	3.379	10-76-14
C_{17}	3.922	14-66-20
C_{18}	3.140	10-69-21
C_{19}	2.766	10-77-13

Table 6

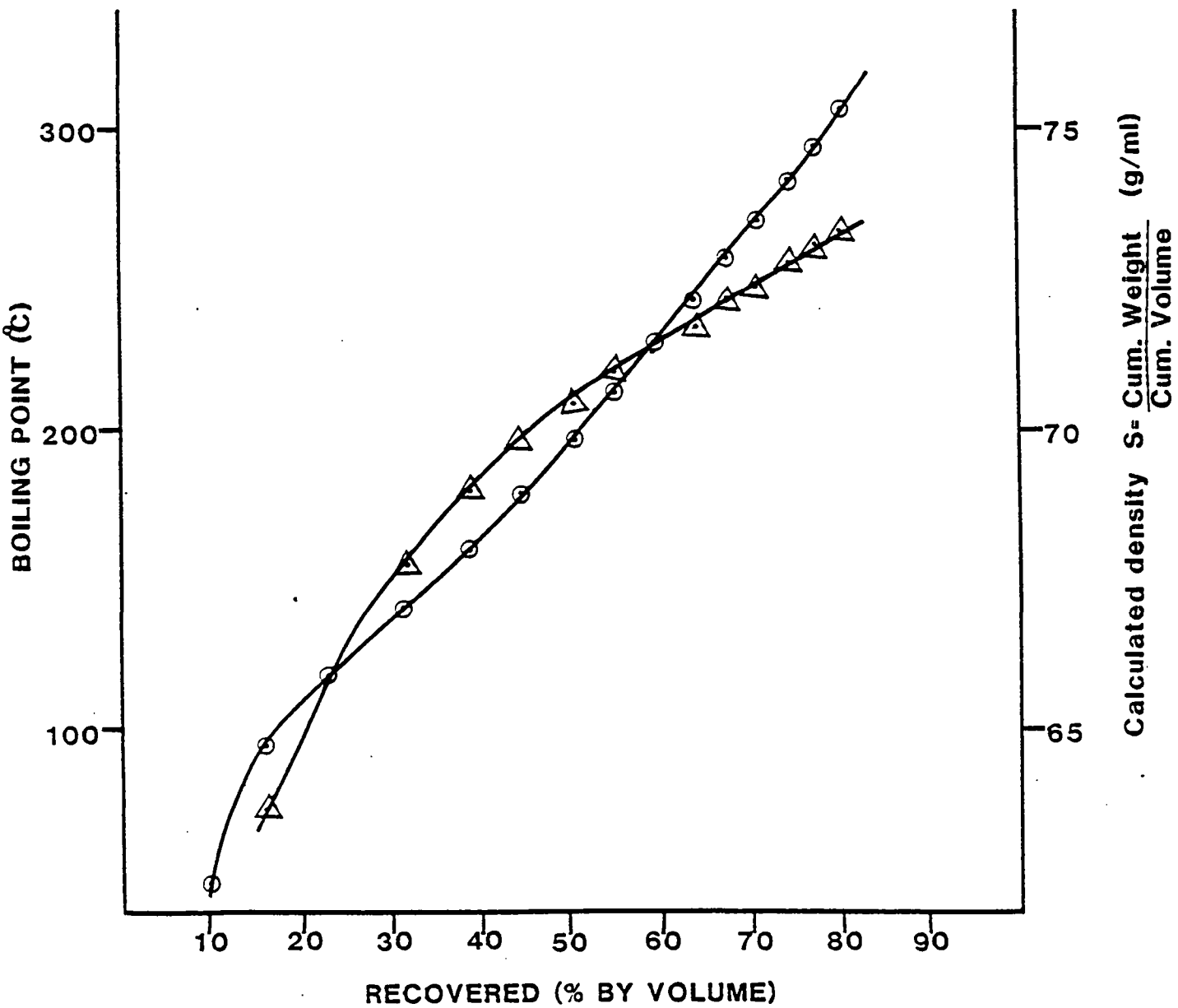
Total composition of the gas and the light-end fractions determined by G.C. Weight % of the condensate: 8.562%.

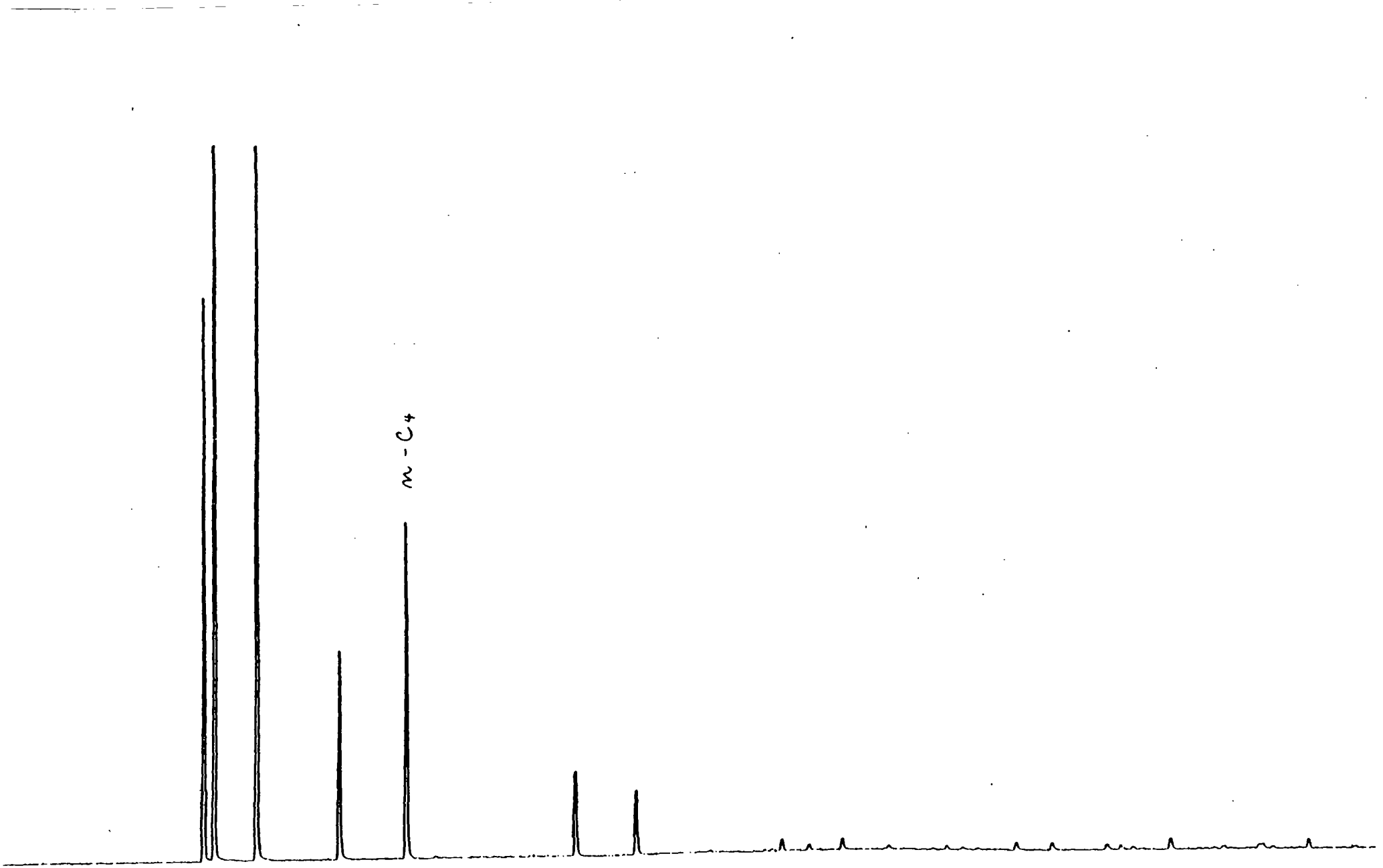
Hydrocarbon group	Weight % of condensate
C_1	0.067
C_2	0.180
C_3	0.621
i-C_4	0.451
n-C_4	1.451
i-C_5	1.374
n-C_5	1.927
C_6	1.890
C_7	0.551
C_8	0.049

⊙ Boiling point VS. % by volume recovered

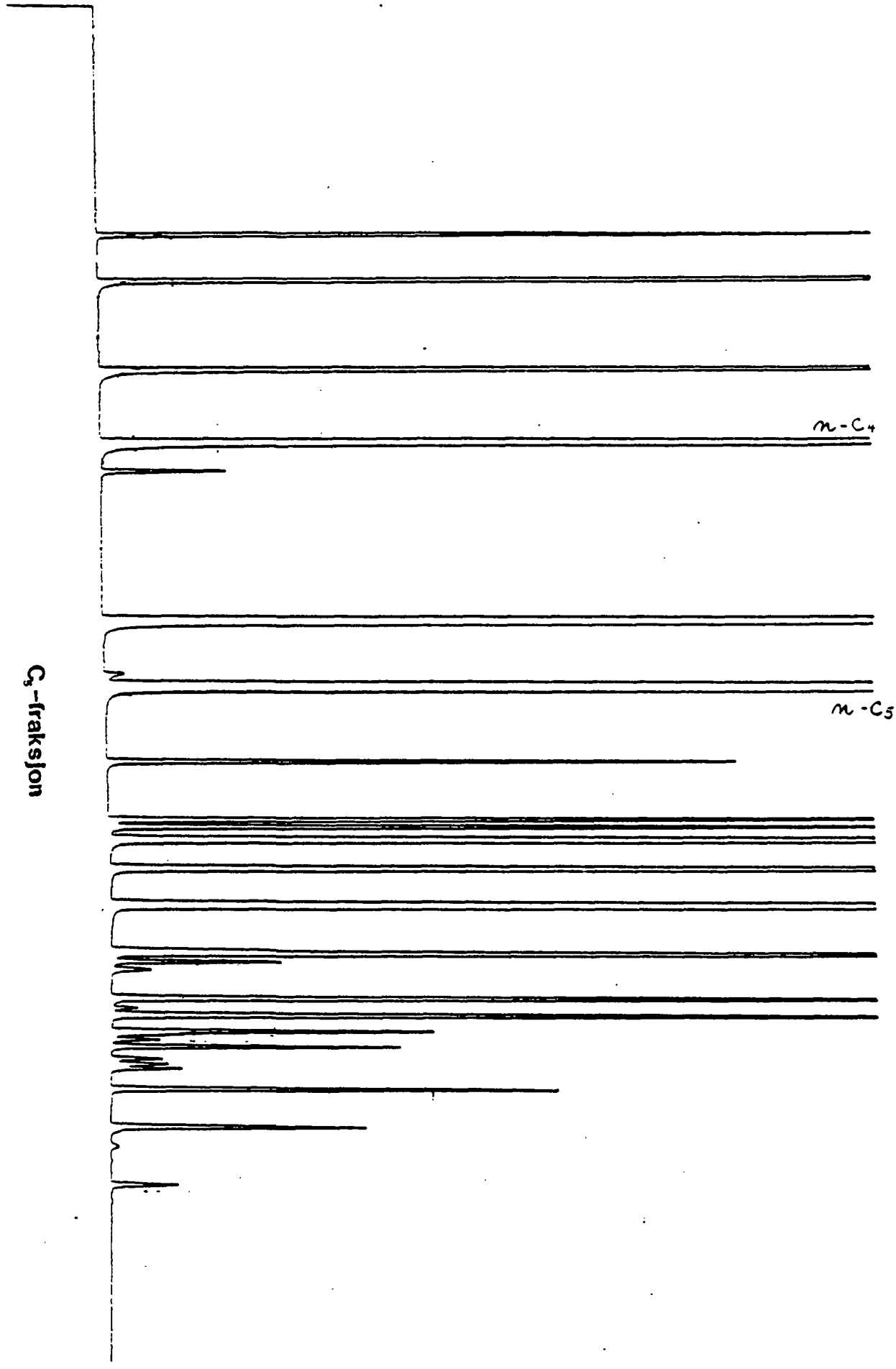
△ Calculated dessity of distillate recovered

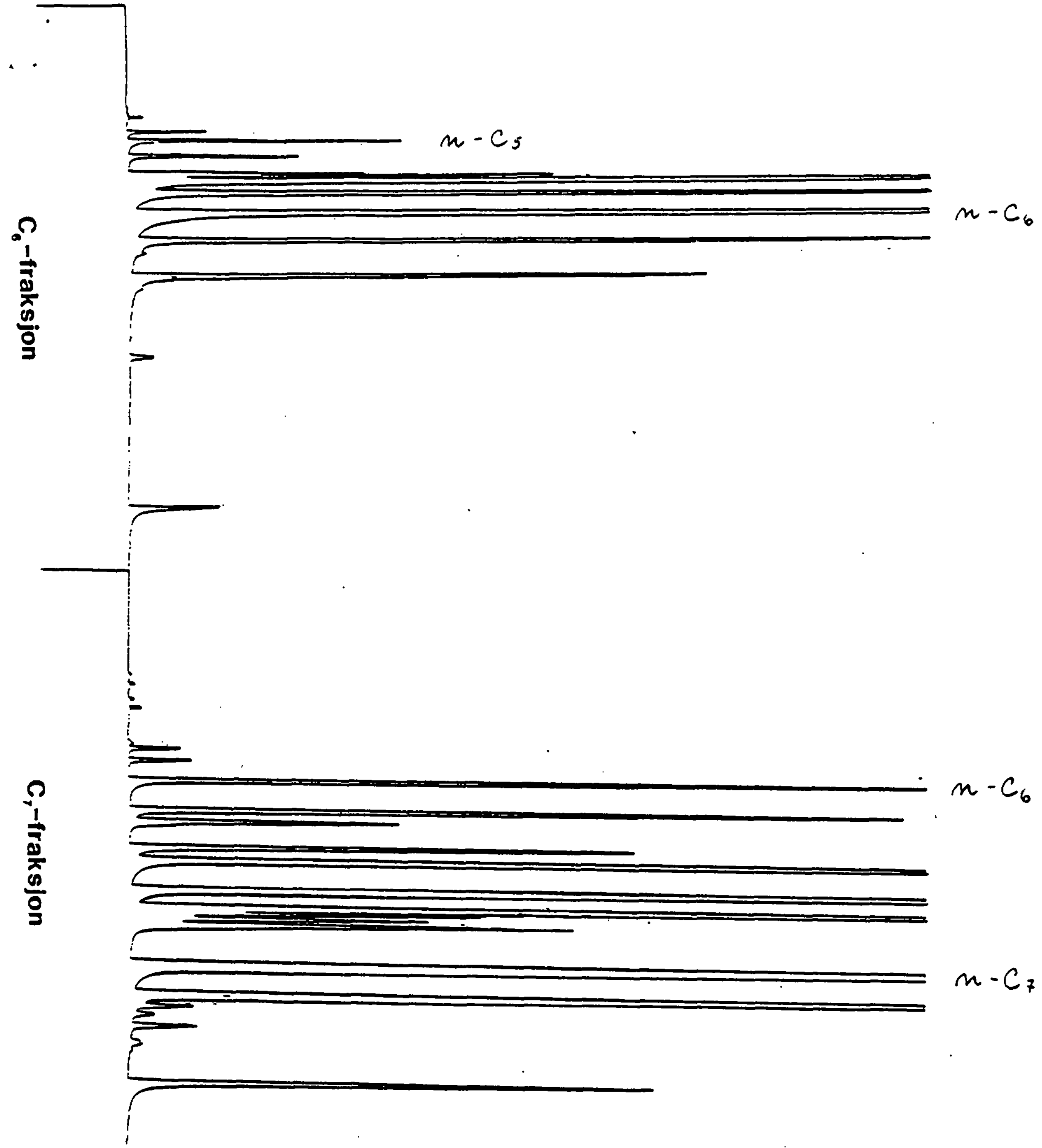
S= $\frac{\text{Cum .weight}}{\text{Cum. Volume}}$ VS. % by volume recovered





Gas


n-C4
n-C5
C5-fraksjon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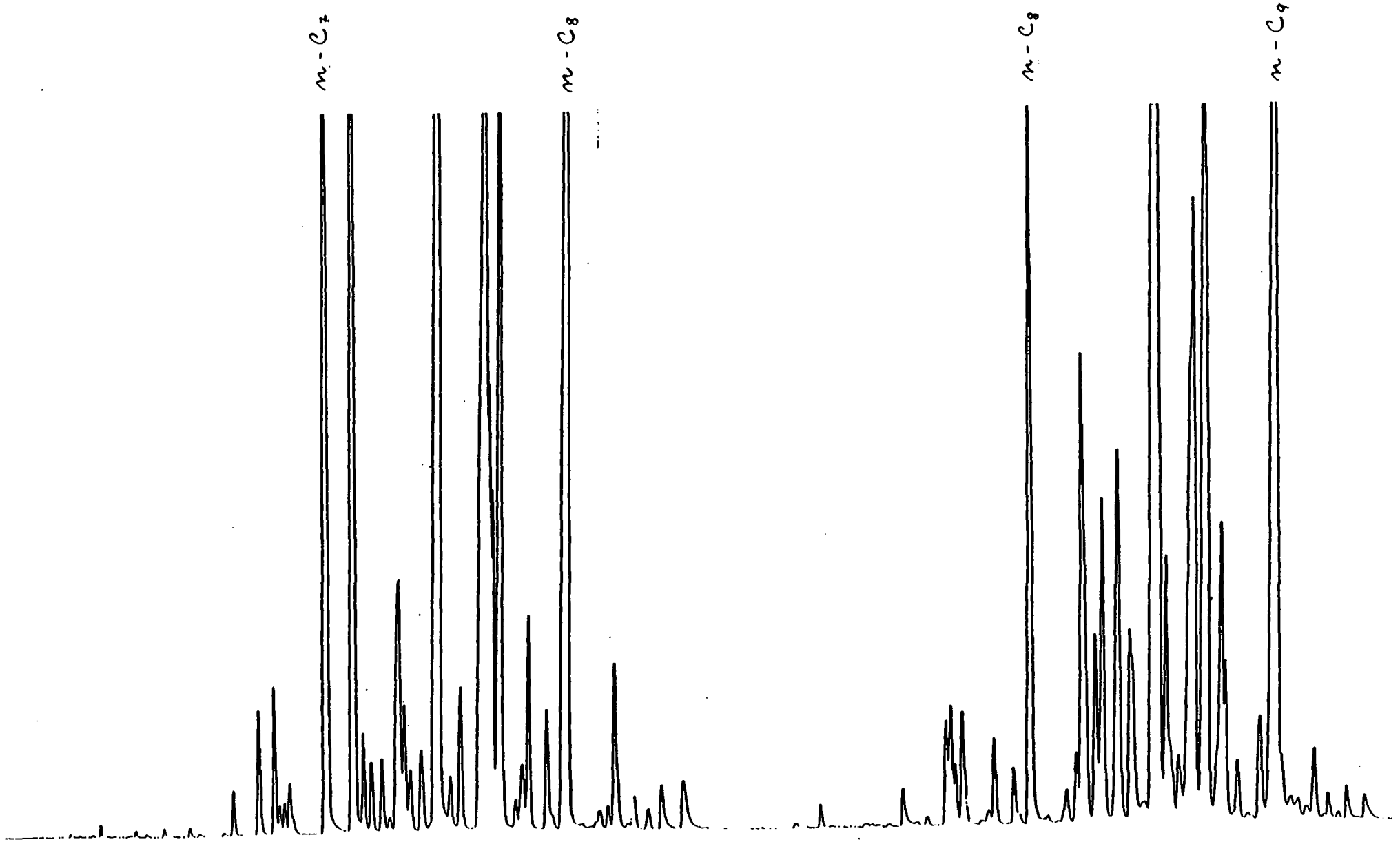
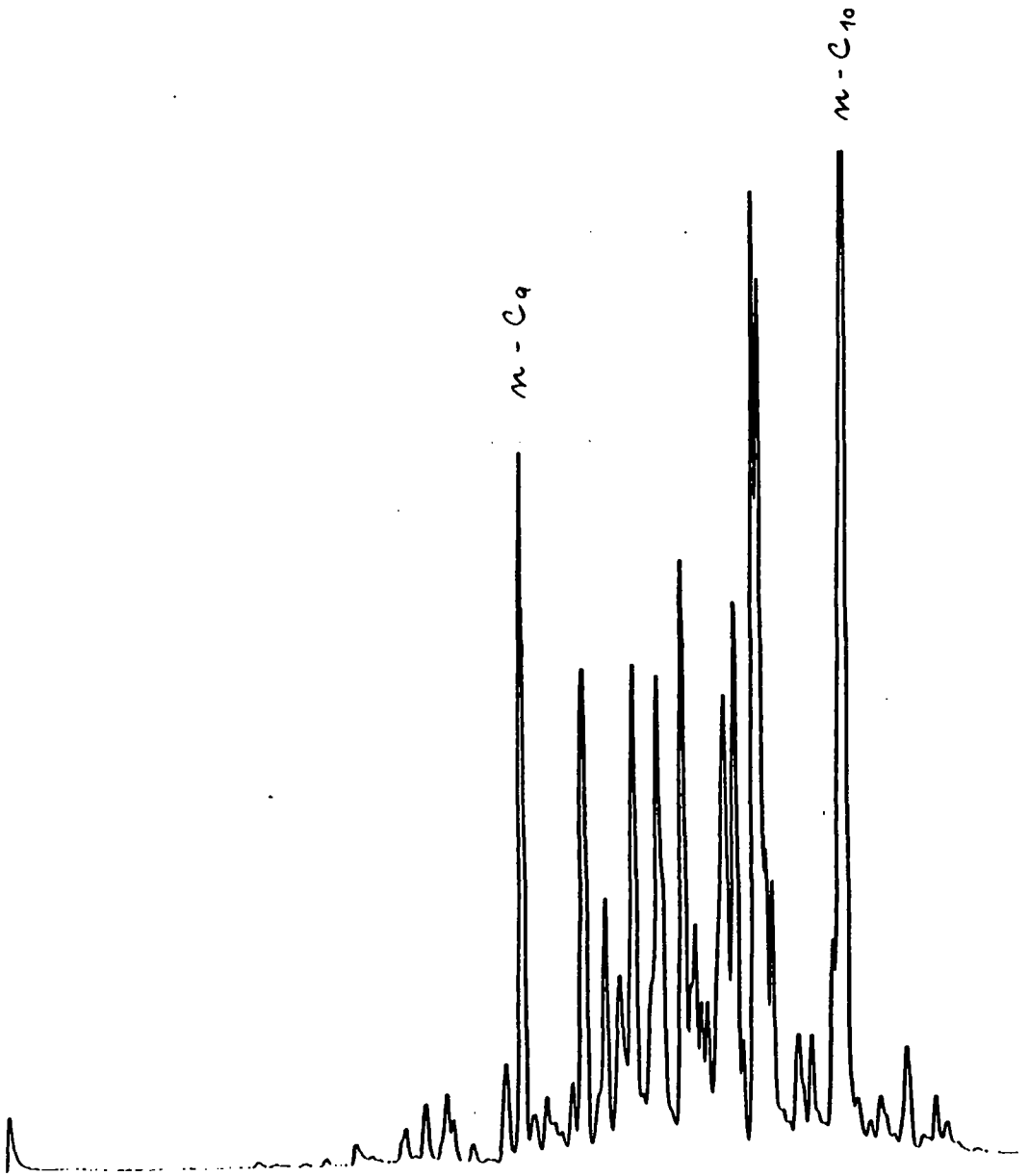
C7-fraksjon
n-C5
n-C6
n-C6
n-C7

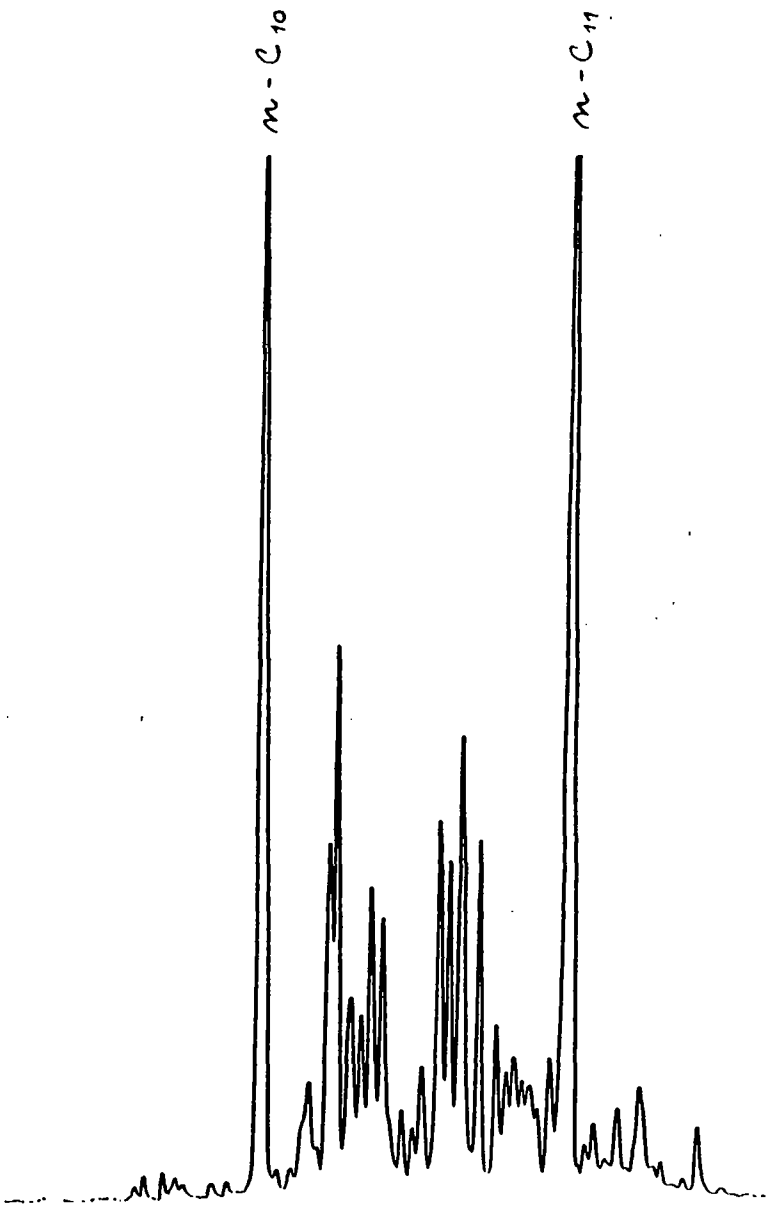


C_8-fraksjon

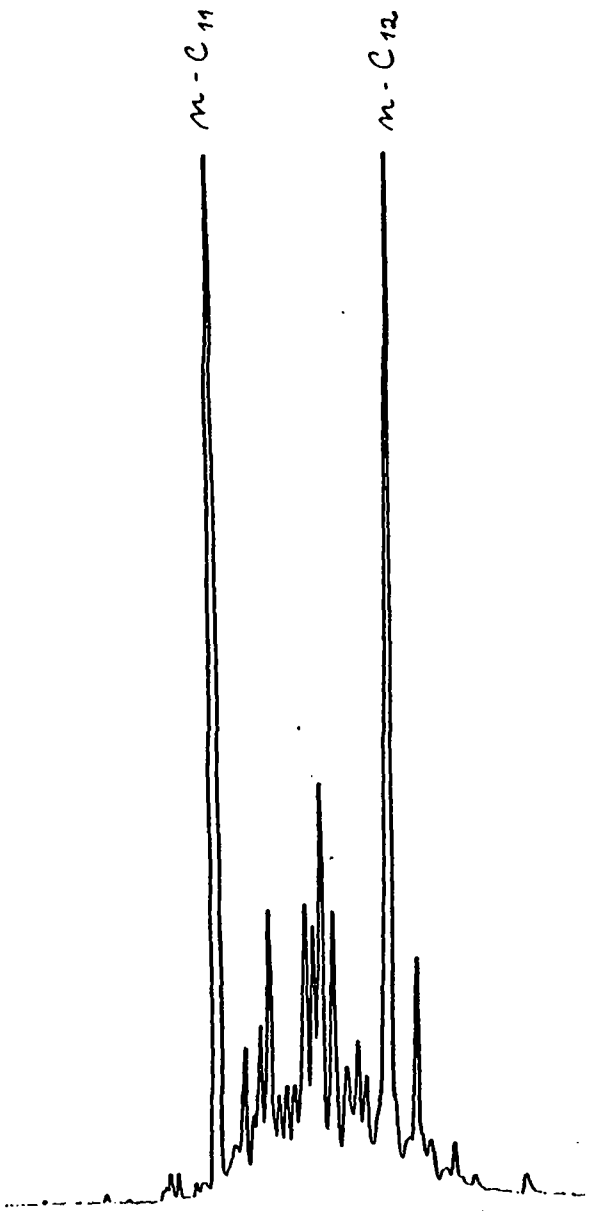
C_9-fraksjon



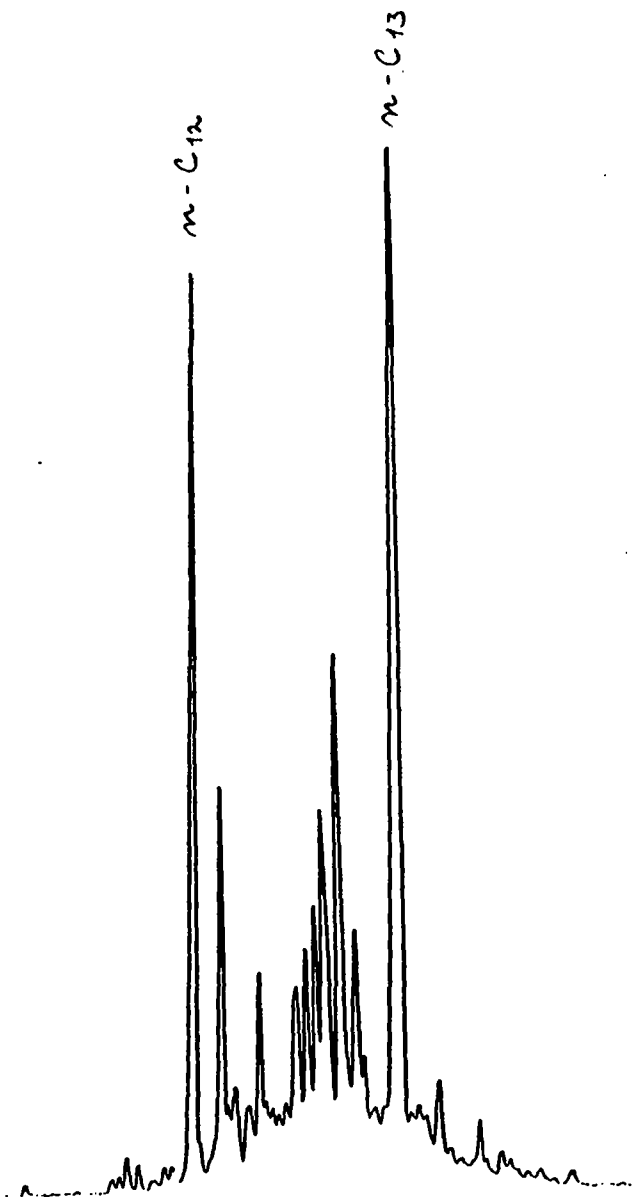
C_{10}-fraksjon



C_{11}-fraksjon



C_{12}-fraksjon



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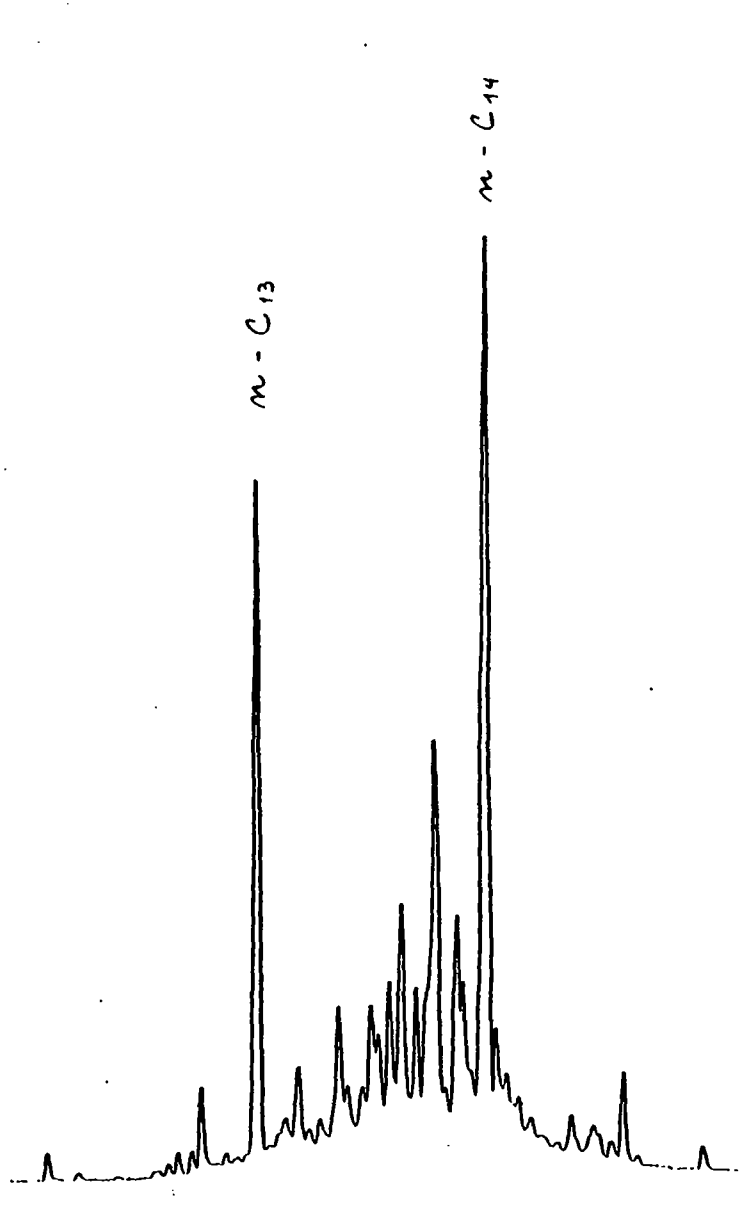

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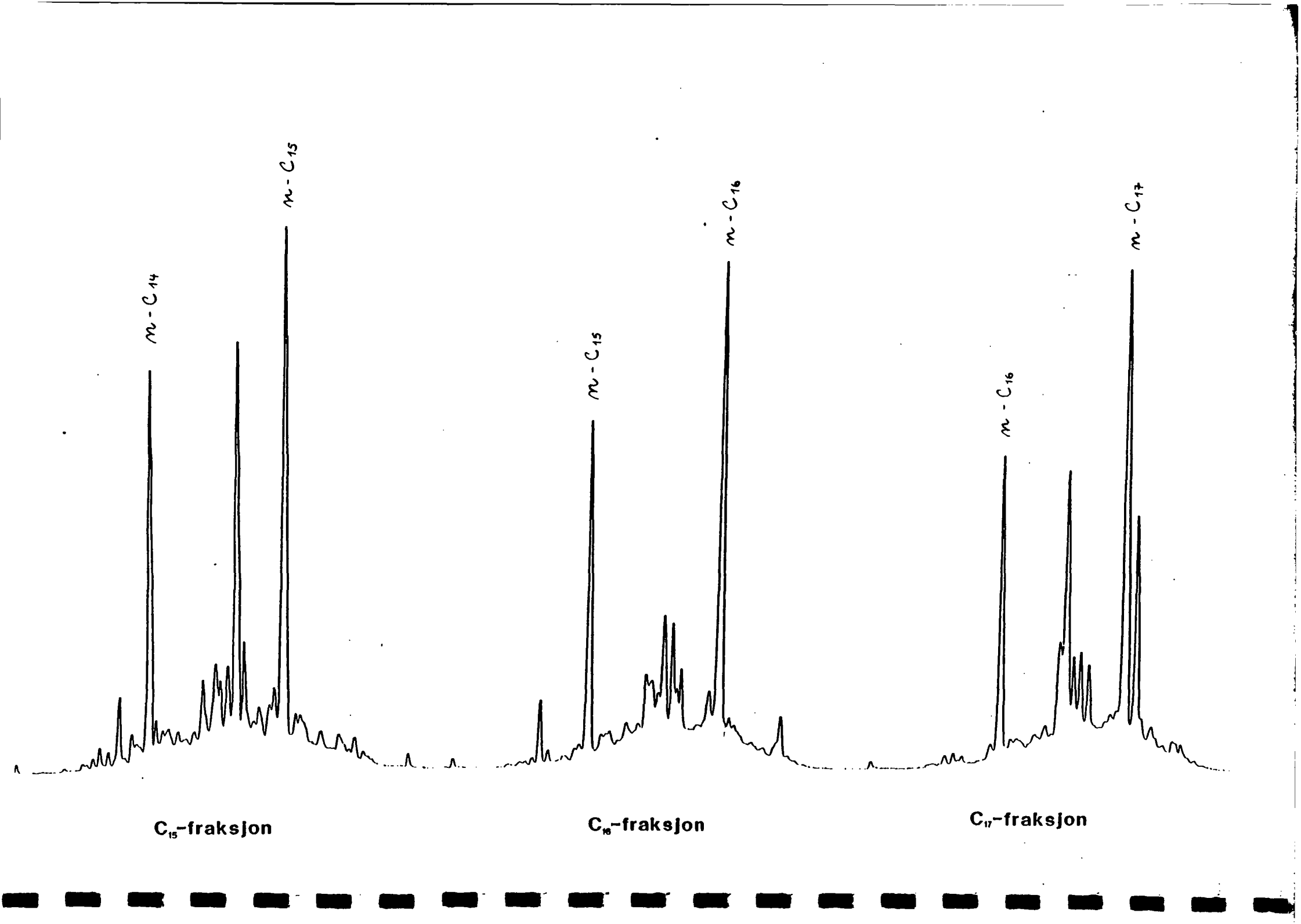
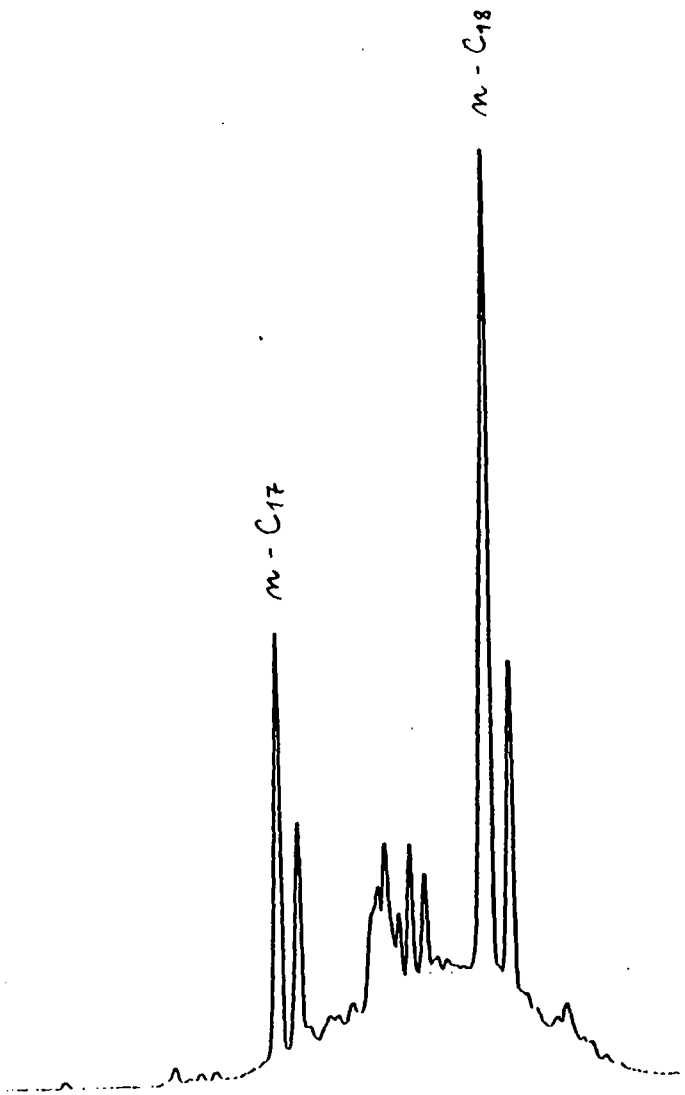


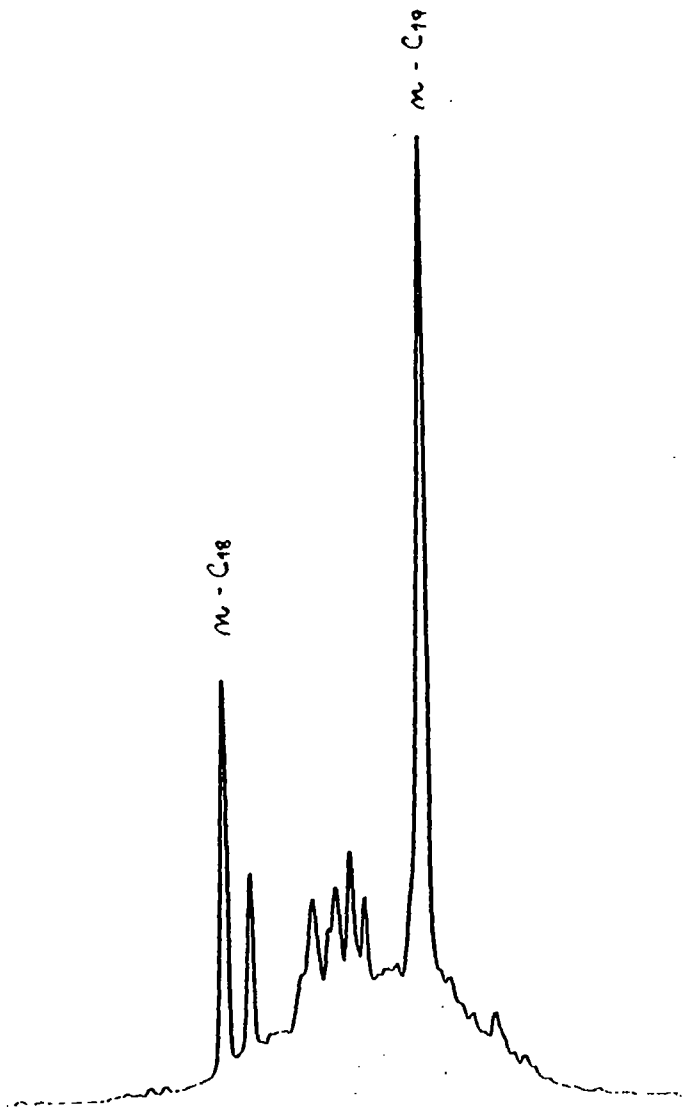
C_{15}-fraksjon

C_{16}-fraksjon

C_{17}-fraksjon



C_{18}-fraksjon



C_{19}-fraksjon