REPORT ON HYDROCARBON SAMPLES FROM

WELL 1/9-2

STATOIL RESERVOIR LABORATORY

Introduction

This present report presents the results from analysis on oil and gas samples from DST No. 1, 2, 2A field 1/9-α, well 1/9-2.

The report includes density and viscosity determintation on oil samples and chromatographic analysis on gas samples.

Further studies will be done to see if there are correlation between samples from 1/9-1 and 1/9-2. Results will be presented in a later report.

Stavanger 1/9-77

Per Thomassen

Karl Sigurd Årland

Methodes

1. Sampling

Due to the low production in 1/9-2 the separator was not put into operation, therefor sampling was mainly done on choke-manifold by the bubble hose and occasionally at wellhead and shale shaker.

Two gas samples was collected at wellhead in high pressure bottles and the rest was sampled by putting the bubble hose into a 20 liter plastic can and venting the gas out a valve and into special gas sampling bas or glass cylinders. The fluid samples studied consisted of varying amount of oil, water and mud (and solids). To get enough oil for density and viscosity measurements we had to pour the fluid into a separating funnel and then sentrifuging the oil collected. In one instant oil separated from BS&W measurements had to be lumped together to give enough sample for viscosity measurement.

2. Measuring equipment

2.1 Density and API

These measurements are made on the Paar Digital Density Meter. This instrument measures the natural frequency of a small glas tube filled with the fluid we want to study. The frequent is directly related to the density of the fluid at the temperature set by and extrenal thermostat. For determentation of API the temperature is maintained within 0.05°C of 15.56°C (60°F).

The interesting features of this equipment is:

a) Only a small sample is reguired (0.7 cc)

b) High accuraly (0.01 deg API)

c) No temperature correction is necessary

d) The result is obtained within 2 minutes.

2.2 Kinematic viscosity.

Measurements are made according to ASTM D 445-72 using and Lauda Ultrathermostat with Cannon-Fenske viscometer.

The standard reference temperature is now (since 1/1-77) 40°C (104°F) but we have been using the former base temperature 37.78°C (100°F) in these measurements to be able to apply the UOP correlation for characterization of the oil.

2.3. GAS ANALYSIS

Measurements was made on the Hewlett-Packard 4712A gas chromatograph having a thermal conductivity detector and using the Hewlett-Pachard 3385 intergrator. The sample is introduced into the chromatograph either by a syringe or a gas sampling valve. The instrument is calibrated by using certificated gas mixture delivered by Norsk Hydro. See enclosure no. 1.

A calibration run is made at least once a day. There is no accepted standard as to what kind of column to use for analysis of natural gases and there is probably no single column which can separate all the organic and non organic components in one run. We have therefore been using to different columns:

a) Carbosive B for O_2, N_2, CO, CH_4, and CO_2.
b) 10% KCl on alumina for hydrocarbons.

See enclosure no 2 for calibration run on these two columns. Each sample was run on both columns and by using calibration factor and the fact that the consentration of CH_4 is determined in both runs the consentration of every component up to C_5 is calculated.

3. UOPK-FACTOR

This factor is much used to characterize crude oils as either parafinic or napthenic.

$K \geq 12,1$ indicate parafinic oil
$11,5 \leq K \leq 12,1$ indicate mixed oil
$K \leq 11,5$ indicate napthenic oil

RESULTS

COMPANY: STATOIL
FIELD : 1/9-α
WELL : 1/9-2

Table 1: DENSITY AND VISCOSITY MEASURED ON OIL FROM DST NO.1

Oil samples collected from bubblehose

DATE, TIME	DENSITY at 60°F (g/cc)	°API	KINEMATIC VISCOSITY (cst)	UOPK
27/7/77, 0530-0730	0,8950	26,6		
27/7/77, 2230	0,8667	30,6		
28/7/77 0930 Rev.out	0.8533	34,3	7.35	12.1

COMPANY:STATOIL
FIELD :1/9-α
WELL :1/9-2

TABLE 2. DENSITY AND VISCOSITY MEASURED ON OIL FROM DST NO.2

Oil samples collected from bubblehose. Third flow.

DATE, TIME	DENSITY AT 60°F (g/cc)	°API	KINEMATIC VISCOSITY (cst)	UOPK
1/8/77,1206 Rev.out.before acid.	0.8514	34,6		
2/8/77,0400	0.8551	34,0		
2/8/77,0600	0.8461	35,7		
2/8/77,0800	0.8508	34,8		
2/8/77,1000	0.8474	35,5		
2/8/77,1100	0.8465	35,7	6,4	12,1
2/8/77,1300	0.8447	36,0		
2/8/77,1626 (rev.out)	0.8639	32,3		

COMPANY:STATOIL
FIELD :1/9-α
WELL :1/9-2

TABLE 3: DENSITY AND VISCOSITY MEASURED ON OIL FROM DST 2A

Samples of oil collected from Bubblehose. Second flow.

DATE, TIME	DENSITY at 60°F (g/cc)	°API	KINEMATIC VISCOSITY (cst)	UOPK
5/8/77,2023	0.8492	35,1		
6/8/77,0430	0.8456	35,8		
6/8/77,1000	0.8467	35,6		
6/8/77,1913	0.8456	35,8		
7/8/77,0816	0.8479	35,4		
7/8/77,1850	0.8562	33,8		
7/8/77,Rev.out (55bbl)	0.8625	32,6		
7/8/77,Rev.out (60bbl)	0.8666	31,8		
Oil collected from B.S.&W determination (average oil from DST2A)	0.8473	35,5	7,0	12,1

COMPANY:STATOIL
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TABLE: 4 COMPONENT ANALYSIS OF GAS FROM DST NO. 1

SAMPLE POINT: DATE, TIME:	GAS FROM BUBBLEHOSE 27/7/77,1030 *	GAS FROM WELLHEAD 27/7/77,2100 *
N_2	0.50	0,40
CO_2	74,50	52,60
CH_4	20,70	37,10
C_2H_6	2,20	4,50
C_3H_8	1,20	2,60
$i\text{-}C_4H_{10}$	0,15	0,40
$n\text{-}C_4H_{10}$	0,45	1,30
$i\text{-}C_5H_{12}$	0,15	0,50
$n\text{-}C_5H_{12}$	0,15	0,60
C_6	Traces	Traces
C_7	Traces	Traces

* Values given in table are mole percent.

COMPANY:STATOIL
FIELD :1/9-α
WELL :1/9-2

TABLE 5: COMPONENT ANALYSIS OF GAS FROM DST NO 2A

SAMPLE POINT DATE,TIME:	BUBBLEHOSE* 5/8/77,2235	BUBBLEHOSE 6/8/77,0118	BUBBLEHOSE 6/8/77,1120	BUBBLEHOSE 7/8/77,1645
N_2	0.90	0.50	0.95	0.70
CO_2	69.72	65.50	61.40	53.50
CH_4	20.50	23.80	26.05	32.40
C_2H_6	3.70	4.30	4.70	5.55
C_3H_8	2.70	3.10	3.55	4.12
$i\text{-}C_4H_{10}$	0.40	0.48	0.53	0.61
$n\text{-}C_4H_{10}$	1.30	1.46	1.68	1.92
$i\text{-}C_5H_{12}$	0.35	0.38	0.50	0.52
$n\text{-}C_5H_{12}$	0.43	0.47	0.65	0.68
C_6	Traces	Traces	Traces	Traces
C_7	Traces	Traces	Traces	Traces

* Values given in table are mole percent.

SUMMARY OF RESULTS

In the following we will summarize the results obtain in the lab and compare with measurement from the Rig and point out what seems to be interesting features.

DST 1 shows an increasing API during the test. Viscosity is measured on one sample giving 7,35 cst, the UOP correlation gives K=12,1 indicating a parafinic oil. Gas analysis are made on two samples and shows a high CO_2 concentration which decreases as time goes by. Concentration of methan increases from 20,7 to 37,1 molprocent in the same period, with the other hydrocarbon component varying in the same way. See enclosure 3. This coresponds fairly well with result obtain on the rig, all though rig measurement are not giving correct absolute quantities.

DST 2 gives API gravities varying around 35,5° going down to 32,3° on the reversed out sample. Viscosity is 6.40 cst which again gives K=12,1 indicating parafinic oil as in DST 1. Measurements on the rig gives gravity about 35°API. No gas analysis is made during this test.

DST 2A gave more samples than the other tests and 9 density and 4 gas measurements was made in the lab. API gravity varies around 35,6 for quite a long time then it drop to a low 31,8 during reversing out. Viscosity on an "average" sample gave 7,0 cst again indicating parafinic oil.

Gas analysis showed the same trend as in DST 1, CO_2 going from a high 69,7% to 53,5% when the well was shut in after 42 hours. Methan increases in the same period from 20,5% to 32,4%. The other hydrocarbon components shows a similar variation. See enclosure 4.

Gas measurements on the rig gave total different picture with considerably less hydrocarbons having a peak of 7% in the middle of the test.

ENCLOSURE 1

Norsk Hydro a.s

Porsgrunn Fabrikker

Postboks nr. 110
3901 Porsgrunn, Norway
Telefon: (035) 51 120
Telegram: norskhydro
Telex: 17064 hydro n
Bankgiro: 7147.05.01841

Kunde / Buyer

STATOIL - Karl Sigurd Årland
POSTBOKS 3000
4000 STAVANGER

Analysesertifikat
Certificate of Analysis

Kjøpers ordre nr. / Buyers order no. B-937 | Hydros ordre nr. / Hydro's order no. 15120P | Ekspedisjons nr. / Consignment no. 780/RF | Dato / Date 10.06.1977

Flaske nr. / Cylinder no. K 25154 | Flaske vol. l / Cylinder vol. l 10

Gass-komponent	Bestilling Kons. C %	Bestilling Usikkerhet ΔC/C	Gravimetrisk blandet Kons. C mol.%	Gravimetrisk blandet Usikkerhet ΔC/C	Analyse Kons. C vol.%	Analyse Usikkerhet ΔC/C
Nitrogen N_2	0,5	-	0,61	0,05	0,66	0,07
Carbondioksyd CO_2	2,0	-	1,88	0,03	1,90	0,05
Metan CH_4	82,5	-	80,35	0,01	80,35	0,01
Etan C_2H_6	9,0	-	8,75	0,05	8,75	0,02
Propan C_3H_8	3,0	-	4,81	0,02	4,60	0,04
n-butan C_4H_{10}	1,5	-	1,58	0,03	1,51	0,05
iso- " "	0,5	-	0,56	0,02	0,56	0,07
n-pentan C_5H_{12}	0,5	-	0,48	"	0,46	"
iso- " "	0,5		0,47	"	"	"
Sum	100,0		99,99		99,75	

For nøyaktige analyseresultater anbefales et gasstrykk på ikke under 10 atm.
For exact results of analysis the gas pressure should not be below 10 atm.

Komponenten N-pentan + I-pentan **kondenserer ved** +10 °C
The component **condenses at** °C

Ved mistanke om kondensering, må flasken oppbevares i 10 **dager ved 20 °C før bruk.**
If condensation is suspected the cylinder must be stored for 10 **days at 20 °C before being used.**

Fulltrykk/Pressure at filling atm 40 | Temperatur Temperature °C 20

J. Kirkerød
Analysert av/Analysed by

for **Norsk Hydro a.s**

Thor. D. Aamodt

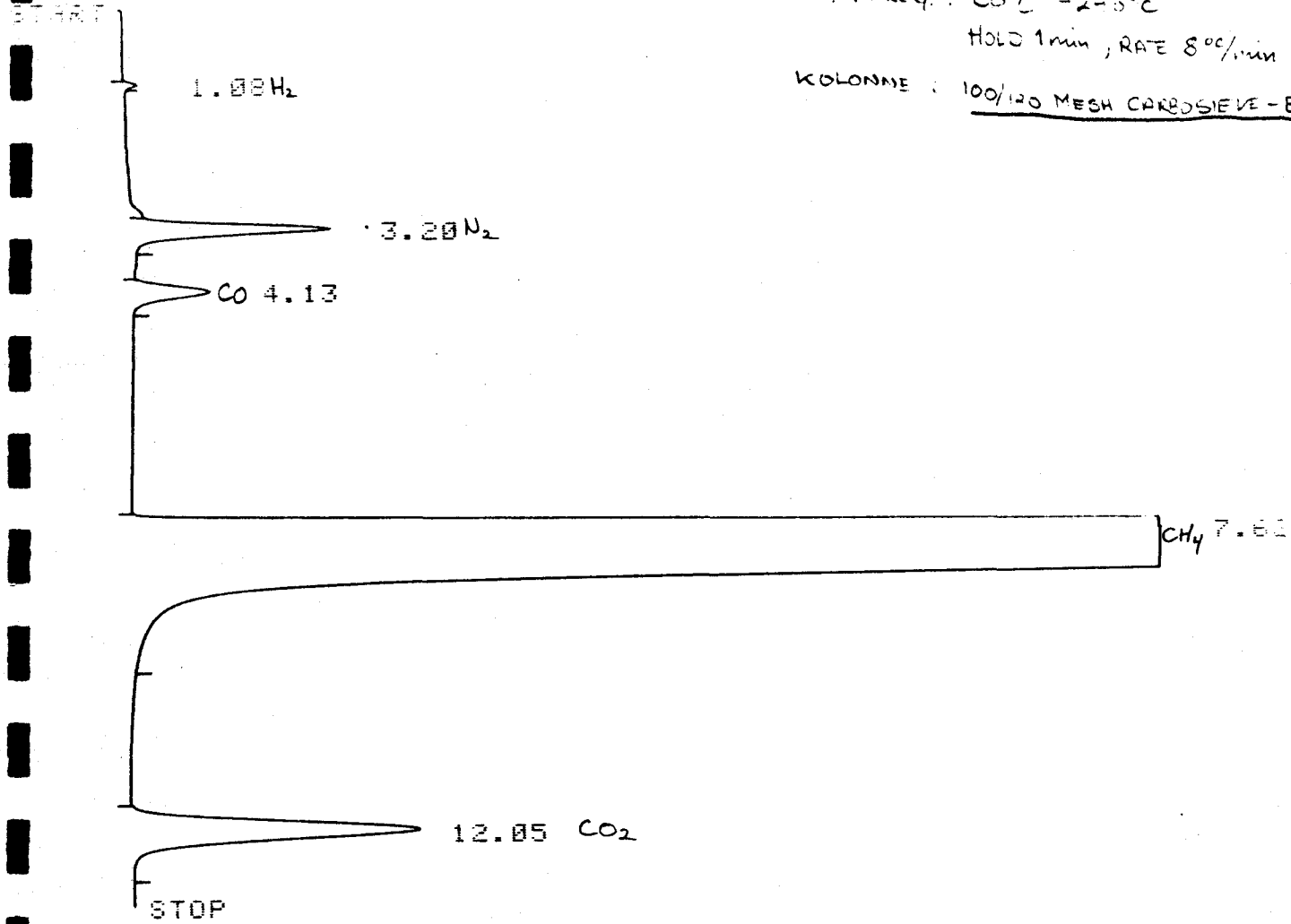
ENCLOSURE (A

DATE: [illegible]
TIME: 12:26:14

KALIBRERING:

TEMP. PROG. : 30°C - 250°C
HOLD 1 min, RATE 8°C/min

KOLONNE : 100/120 MESH CARBOSIEVE-B



HP RUN # 66 AUG/10/77 TIME 12:29:57
AREA %

RT	AREA	AREA %	cal. gas analyse	kalibreringsfaktor
3.20	1983	1.123	0.791	0.695
4.13	864	0.489		
7.62	168400	95.358	96.931	1.012
12.05	5351	3.030	2.278	0.731

IL FACTOR: 1.0000 E+ 0

ENCLOSURE 2 B

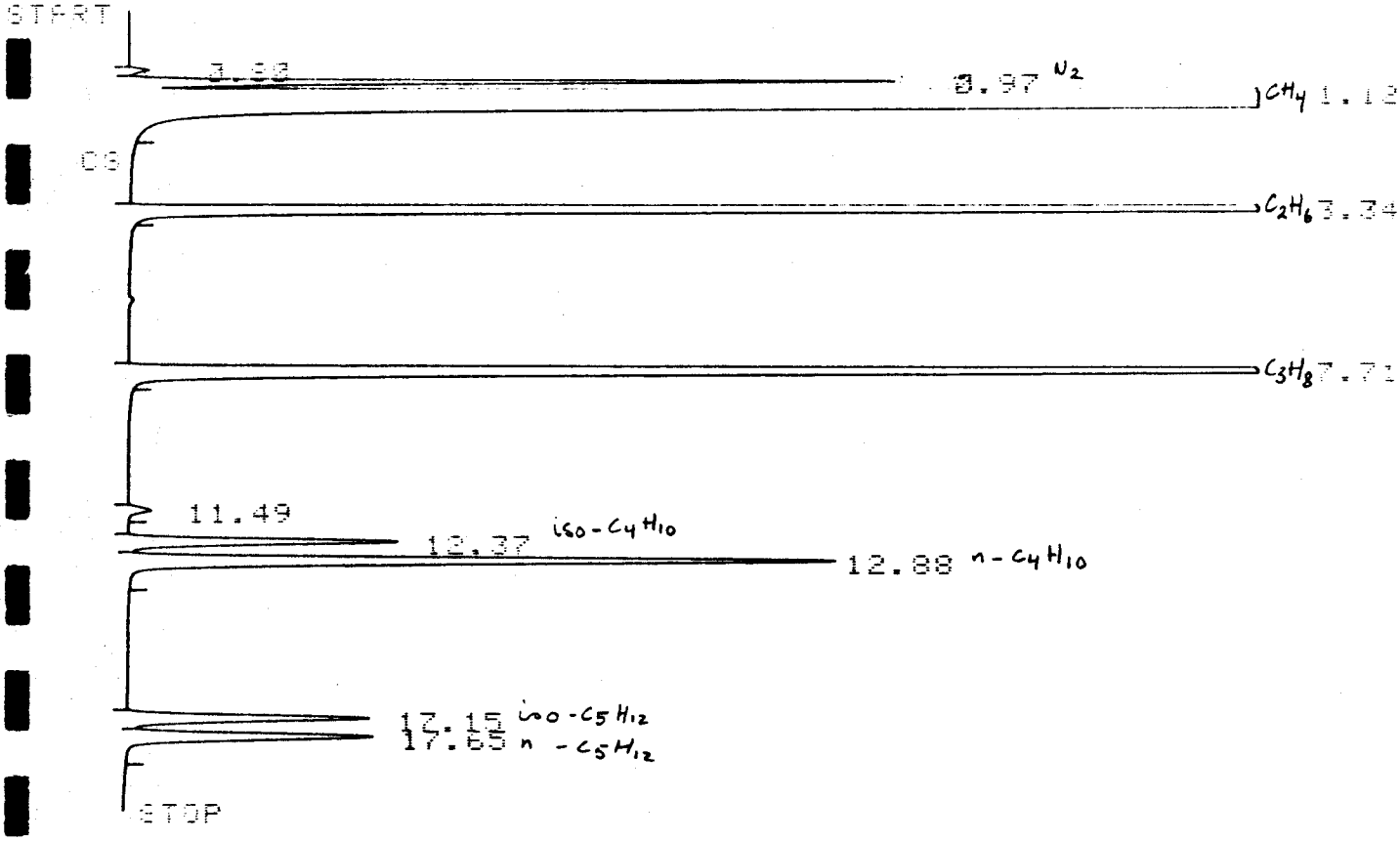
CHT ATTD 1.00
ZERO 13.0
ATTN 32 3
SOML 4
ELE TEMP 0.05
ATEN REJ 300

KALIBRERING

TEMP. PROG.: 30°C - 240°C
HOLD 1min., RATE 8°C/min

KOLONNE: 10% KCL/ALUMINA

2.00 CHT SPD 0.50

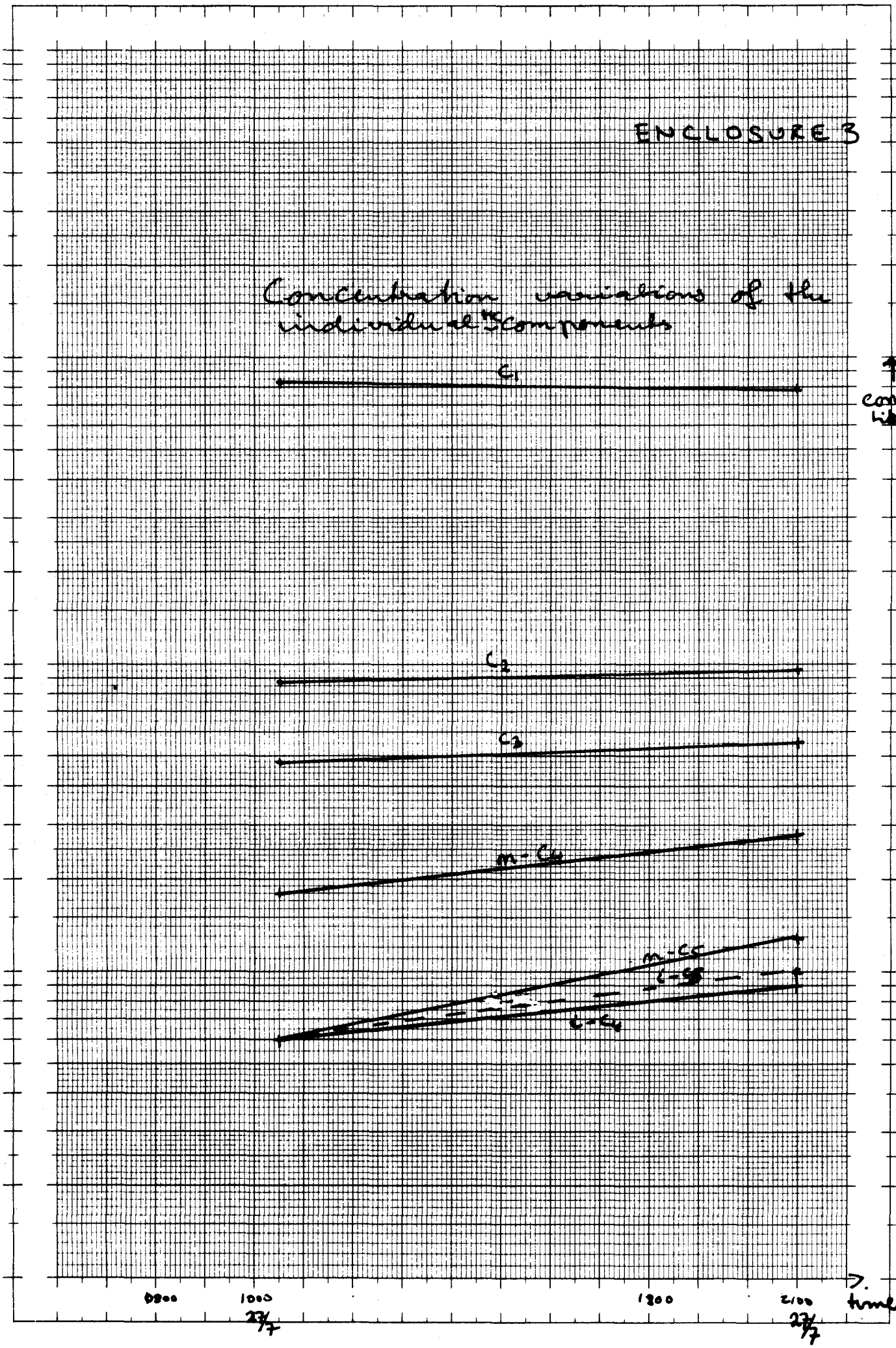


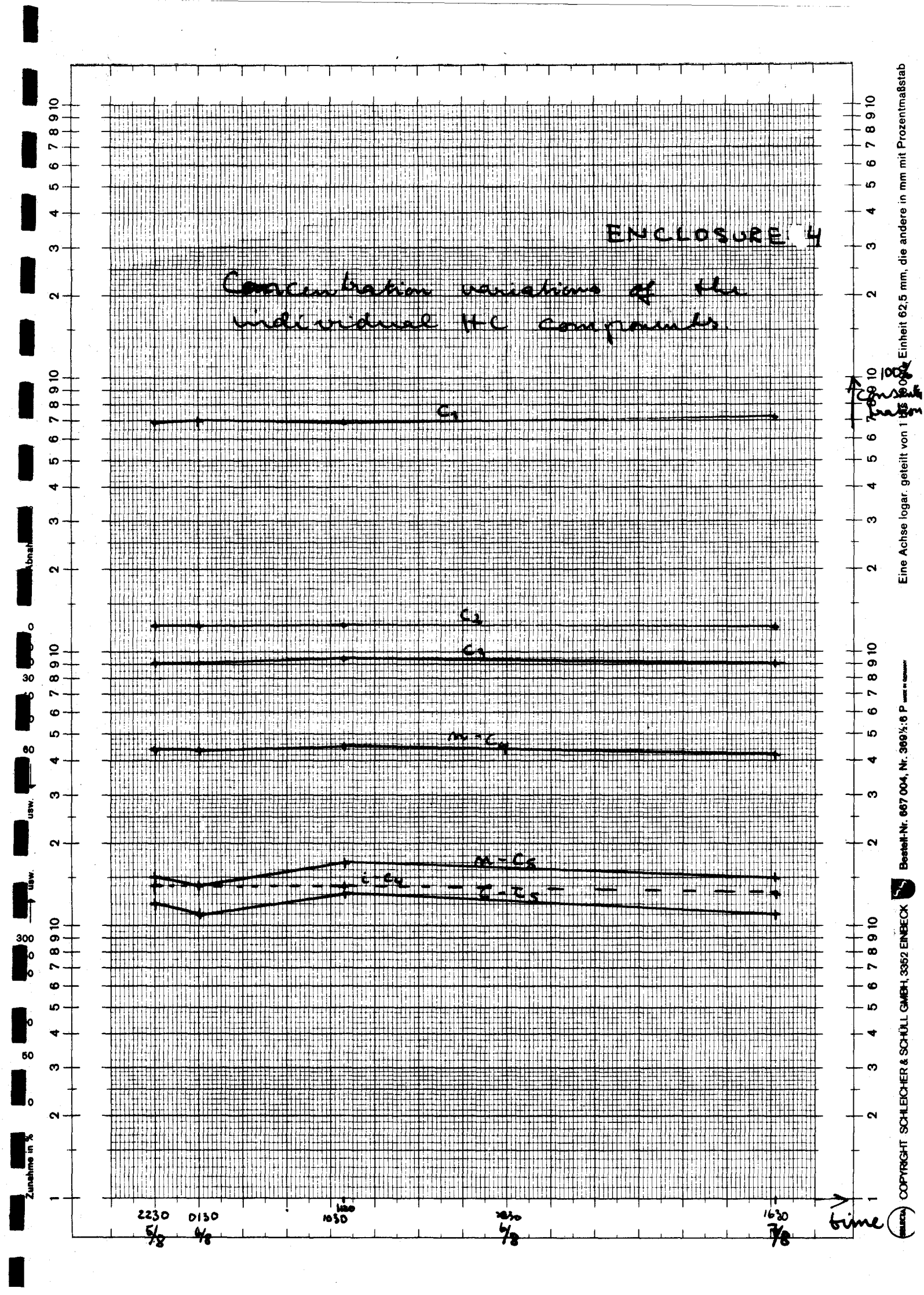
P RUN # 41 AUG/01/77 TIME 13:22:44
REA %

RT	AREA	AREA %	Cal.gas analyse	Faktor
0.97	2308	0.977	0.65	0.667
1.12	168900	71.504	80.25	1.121
3.34	29010	12.281	9.75	0.793
7.71	19790	8.378	4.65	0.549
12.37	2768	1.172	1.51	1.288
12.88	7880	3.336	0.56	0.168
17.15	2688	1.138	0.45	0.404
17.65	2866	1.213	0.45	0.370

IL FACTOR: 1.0000 E+ 0

ENCLOSURE 3




ENCLOSURE 4
Concentration variations of the individual HC components
C_1
C_2
C_3
$n\text{-}C_4$
$n\text{-}C_5$
$i\text{-}C_4$
$i\text{-}C_5$
2230 5/8
0130 6/8
1030
1630 7/8
time
Zunahme in %
Abnahme
usw.
usw.
Eine Achse logar. geteilt von 1 bis 100 Einheit 62,5 mm, die andere in mm mit Prozentmaßstab
COPYRIGHT SCHLEICHER & SCHÜLL GMBH, 3352 EINBECK Bestell-Nr. 867 004, Nr. 369/2:6 P