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Appendix A

1. Calculation of the mole composition of Mg/Al/Li/0.2 Pr as a catalyst.

M.W. of MgO	= 40.311
The MgO was used	= 40.311/100 = <u>0.4031 g</u>
M.W. of Al_2O_3	= 101.957
The Al_2O_3 was used	= 101.957/2 = 50.9785
	= 50.9785/100 = <u>0.5098 g</u>
M.W. of $LiOH.H_2O$	= 41.941
The $LiOH.H_2O$ was used	= 41.941/100 = <u>0.4194 g</u>
M.W. of $Pr(NO_3)_3.6H_2O$	= 435.02
The $Pr(NO_3)_3.6H_2O$ was used	= 435.01 x 0.20
	= 87.004
	= 87.004/100 = <u>0.8700 g</u>

2. Calculation of the flow rate of gases $CH_4/O_2 = 1/1$ at the room temperature = 27 °c and at velocity 2000 h^{-1}.

The catalyst was weighed 0.2000 g and put in 0.6 cm. I.D. reactor. The height of catalyst in the reactor was 1.2 cm.

Temperature factor at the STP was (27 + 273.15)/273.15 = 1.0988

The volume of the catalyst was π x r^2 x h. of cat.

$$= 3.1416 \times 0.3^2 \times 1.2 \text{ cm}^3$$

$$= 0.33929 \text{ cm}^3$$

space velocity	= (flow rate) / (vol. of cat.)
then, flow rate	= 2000 h^{-1} x 0.33929 cm^3
	= 678.5840 $cm^3.h^{-1}$

that was the total flow rate of two gas of cofeed.

Considered at minute level	= 678.5840/60
	= 11.3097 $cm^3.min^{-1}$ of cofeed

The flow rate at the STP = 11.3097 x 1.0988

= 12.4271 $cm^3.min^{-1}$

Thus the only CH flow rate was 12.4271/2 = 6.2135 $cm^3.min^{-1}$

Checked the flow rate five cm at the seconds.

6.2135 cm^3 = 60 sec.

5 cm^3 = (60 x 5)/6.2135

= 48.28 sec.

The total flow rate at 5 cm^3 was (60 x 5)/12.4271 = 24.14 sec.

3. Calculation of CH_4 conversion

conversion (wt.%) = $\dfrac{\text{feed area of } CH_4 - \text{product area } of\ CH_4 \times 100}{\text{feed area of } CH_4}$

= $\dfrac{(1738286 - 947718) \times 100}{1738286}$ = 45.48 %

4. Calculation of CO and CO_2 products from GC-8A (TCD) to adjust for GC-GOW MAC (FID)

CO does not appear the peak on GOW MAC, but appears on the MS-5A of GC-8A. then it must be adjusted for the GOW MAC. (Fig. A4)

CO(GOW MAC) = CH_4(in GOW MAC) x b

b = area of CO(in GC-8A) / 1.13 x area of CH_4 (in GC-8A)

For example on figure

b = 47349 / 1.13 x 590356

= 0.070977

CO(in GOW MAC) = 0.070977 x 947718

= 67266.2963

For the GOW MAC at the same temperature(700 °c) :

The area 534481 = 30.38 wt %

Then area 67266.296 $= 30.38 \times 67266.296 / 534481$

$= 3.82$ wt %

For CO_2 (FIG - A5)

CO_2 (in GOW MAC) $= CH_4$ (in GOW MAC) x a

a $=$ area of CO_2 in GC-8A / 1.35 x area of CH_4 in GC-8A

For example in figure (Fig. A5)

a $= 57041 / 1.35 \times 792581$

$= 0.0533$

CO_2 in GOW MAC $= 0.0533 \times 947718$

$= 50522.9655$

Then the wt% of CO_2 is $(50522.9655 \times 30.38)/534481$ or 2.87 wt%

5. Summary of quantitative analysis of the metal elements of catalysts which be measured by ICP

	Mg	Al	Li	Mn	Ce	Pr	Sm
1. Mg/Al/Li/0.2 Ce	320.1	265.3	84.14	-	184.1	-	-
2. Mg/Al/Li/0.2 Pr	314.0	283.1	80.10	-	-	379.5	-
3. Mg/Al/Li/0.2 Sm	281.5	258.0	75.53	-	-	-	366.7
4. Mg/Al/Li/0.5 Pr	376.2	338.3	83.74	-	-	126.0	-
5. Mg/Al/Li/0.1 Pr	380.0	348.9	104.1	-	-	242.2	-
6. Mg/Al/Li/0.3 Pr	256.8	226.3	69.25	-	-	485.3	-
7. Mg/Li/0.3 Pr	274.2	-	74.93	-	-	525.6	-
8. Mn/Al/Li/0.2 Pr	-	207.7	73.08	548.0	-	307.8	

The unit of the data are mg/liter which would be transfered to mole ratios

Number of mole $=$ wt.(g) / atomic wt.(g)

For the example of Mg/Al/Li/0.1 Pr ; Mg , Al , Li , Pr have

the atomic weight of 24.312 , 26.98 , 6.939 , 140.91 respectively.

mole of Mg $\quad$ = 3.80/24.312 = 0.156
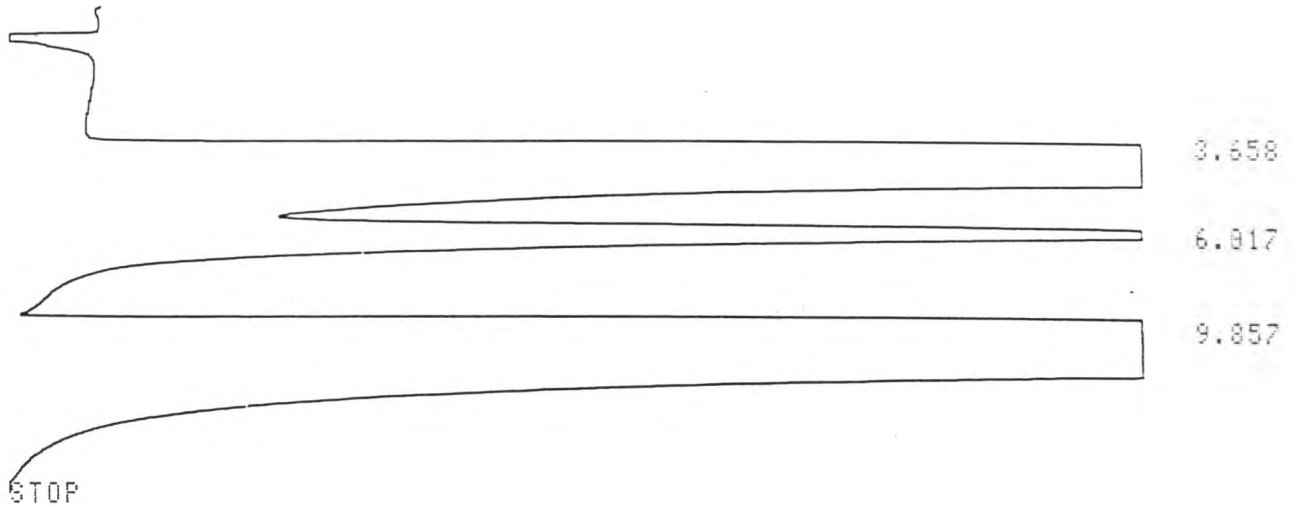
mole of Al $\quad$ = 3.489/26.98 = 0.129

mole of Li $\quad$ = 1.041/6.93 $\quad$ = 0.150

mole of Pr $\quad$ = 2.422/140.91 $\qquad$ = 0.017

Then Mg:Al:Li:Pr is 0.156/0.156:0.129/0.156:0.150/0.156:0.017/0.156 = 1:0.8:1:0.1

Catalyst : Mg/Al/Li/on Pr

START


```
                                                          3.658

                                                          6.017

                                                          9.857
```

STOP

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	3.658	1380040	S		49.964	O_2
2	6.017	33427	T		1.2102	N_2
3	9.857	1348603			48.8258	CH_4
	TOTAL	2762070			100	

Figure A-1 Peaks of feed from MS-5A (TCD) for checking the flow rate of CH_4/O_2 at room temperature

3.017

5.662

10.648

(product)

STOP
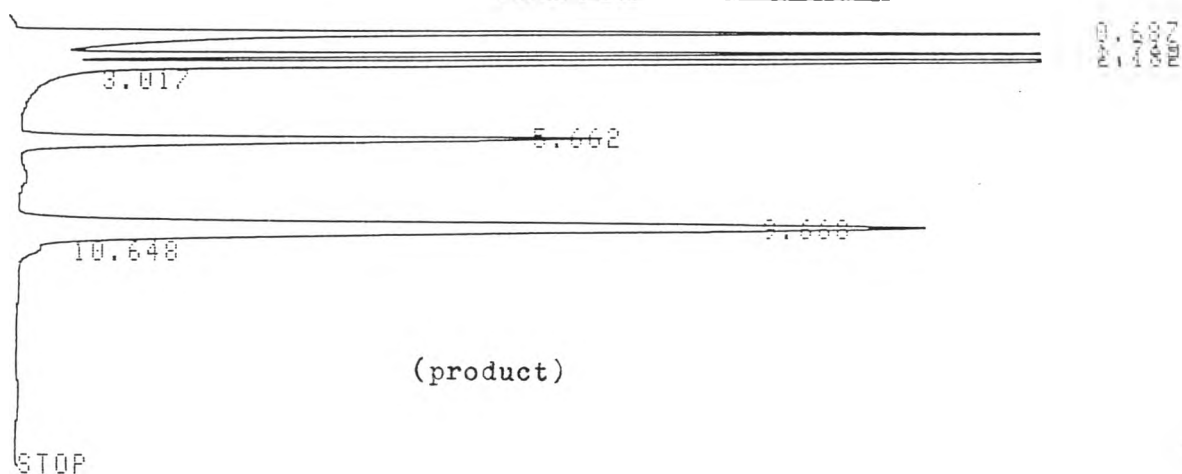
PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.687	947718			53.8712	CH_4
2	1.748	234472	W		13.3281	C_2H_6
3	2.182	534481	SV		30.3816	C_2H_4
4	5.662	11934			0.6784	
5	9.668	-30525	S		1.7352	
6	10.648	97	T		0.0055	
	TOTAL	1759227			100	

START

(feed)

STOP
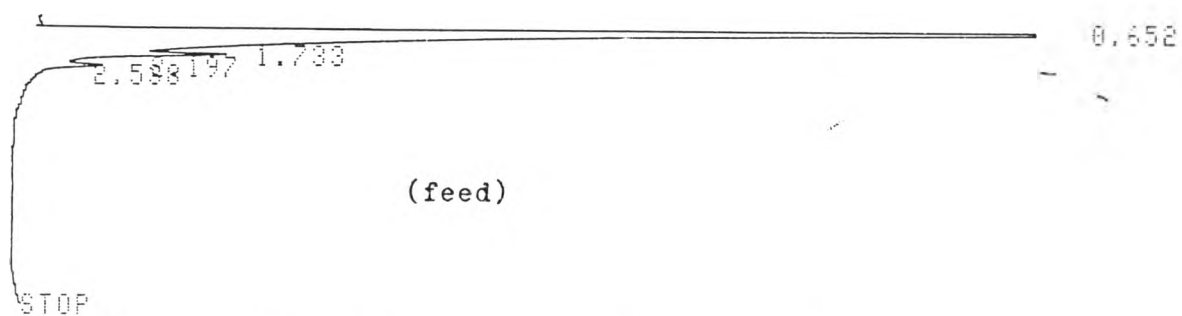
PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.652	1738268	S		99.9274	CH_4
2	1.733	848			0.0488	
3	2.197	414	T		0.0238	
	TOTAL	1739530			100	

Figure A-2 Peaks of products and feed from Gow Mac (FID)

at temperature of $700^{o}C$, space velocity of 2000 h^{-1}

START

2.067

3.787

5.922

10.228

14.65

STOP
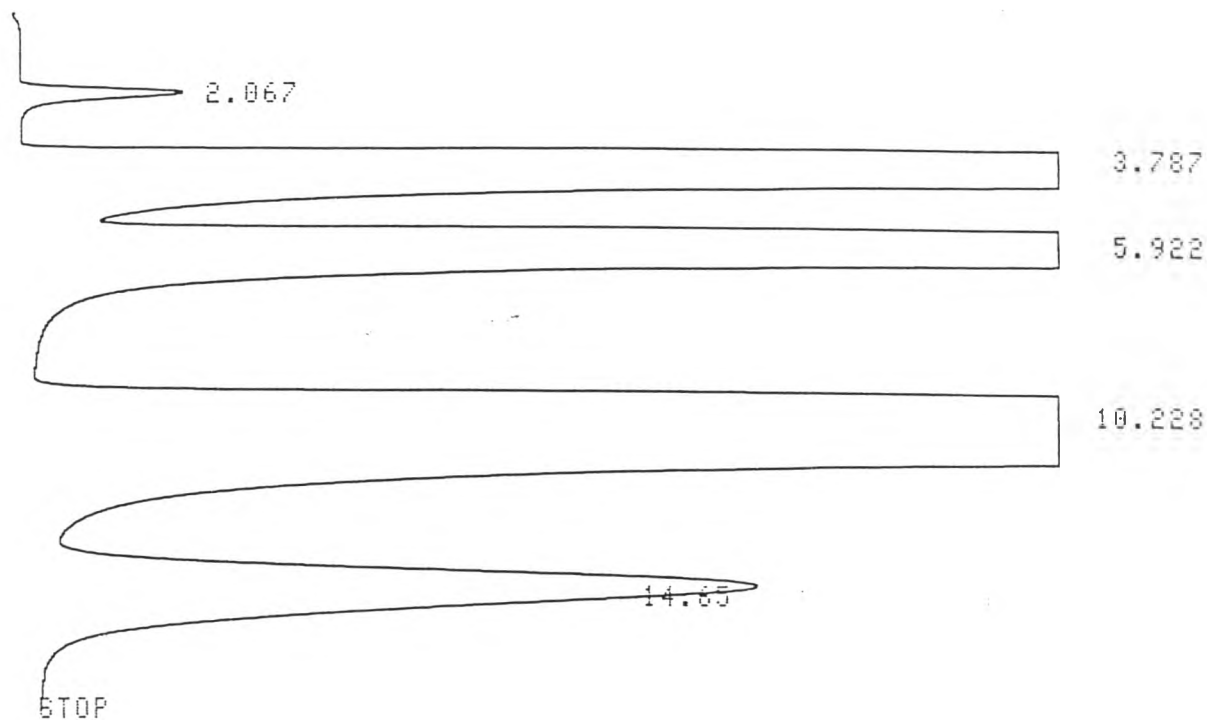
PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	2.067	2997			0.204	O₂
2	3.787	569401			38.7508	N₂
3	5.922	259289	V		17.646	
4	10.228	590356	V		40.1769	CH₄
5	14.65	47349	V		3.2224	CO
	TOTAL	1469392			100	

Figure A-3 Peaks of product from M₃-5A at temperature of

$700^{\circ}C$ and space velocity of 2000 h^{-1}

START


```
                                                              8:538
                                                              1.187
                                                              2.265
                                                              2.995

                                                              4.422
```

10.263

STOP11.693
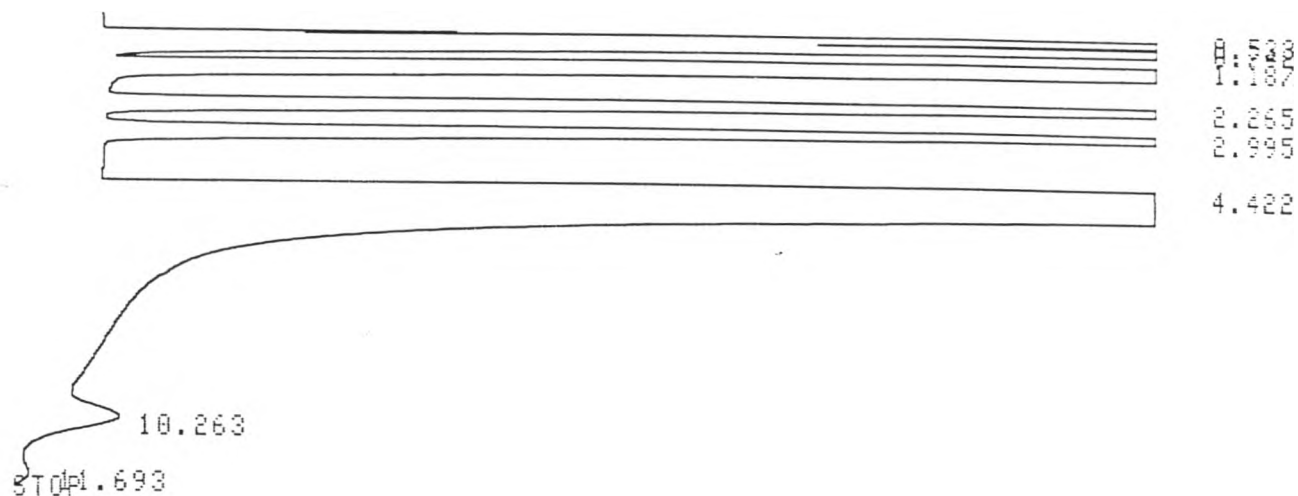
```
PKNO      TIME        AREA   MK   IDNO     CONC      NAME

  1       0.533     474584                23.0803 } air and O2
  2       0.742     349900   V            17.0166 }
  3       1.187     792581   V            38.5454 — CH4
  4       2.265      57041   V             2.7741 — CO2
  5       2.995      27277   V             1.3266
  6       4.422     352324                17.1345 — H2O
  7      10.263       2410                 0.1172
  8      11.693        108                 0.0052
                 ---------              -------------
         TOTAL     2056225                 100
```

Figure A-4   Peaks of product from Porapak Q (TCD) at

temperature of 700°C and space velocity of 2000 h^{-1}

VITA

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