Report 3

LIQUID HYDROCARBON FUELS FROM SYNGAS

R. Eschenbach/J. Rabo
Union Carbide Corporation

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DE-AC22-81PC40077

Tarrytown Laboratory
Molecular Sieve Department
Engineering Products Division
Union Carbide Corporation

OBJECTIVE: To develop catalysts for the direct synthesis of of liquid hydrocarbon fuels from syngas.

APPROACH: Synthesize and evaluate for catalytic performance a variety of microporous crystals, alone and in combination with transition metals.
Study reaction intermediates to elucidate reaction mechanisms.
Use mechanistic concepts derived above to synthesize, then test improved catalysts.

FIG. 2 OBJECTIVE

ORGANIZATION

TASK 1: Evaluate shape-selective catalyst (SSC) candidates for converting low molecular weight liquids and small olefins to LHF.

TASK 2: Evaluate combinations of transition metal component (MC) and SSC for converting syngas ($CO + H_2$) to LHF.

TASK 3: Study surface effects and reaction intermediates in the hydrogenation of carbon monoxide.

FIG. 3 ORGANIZATION

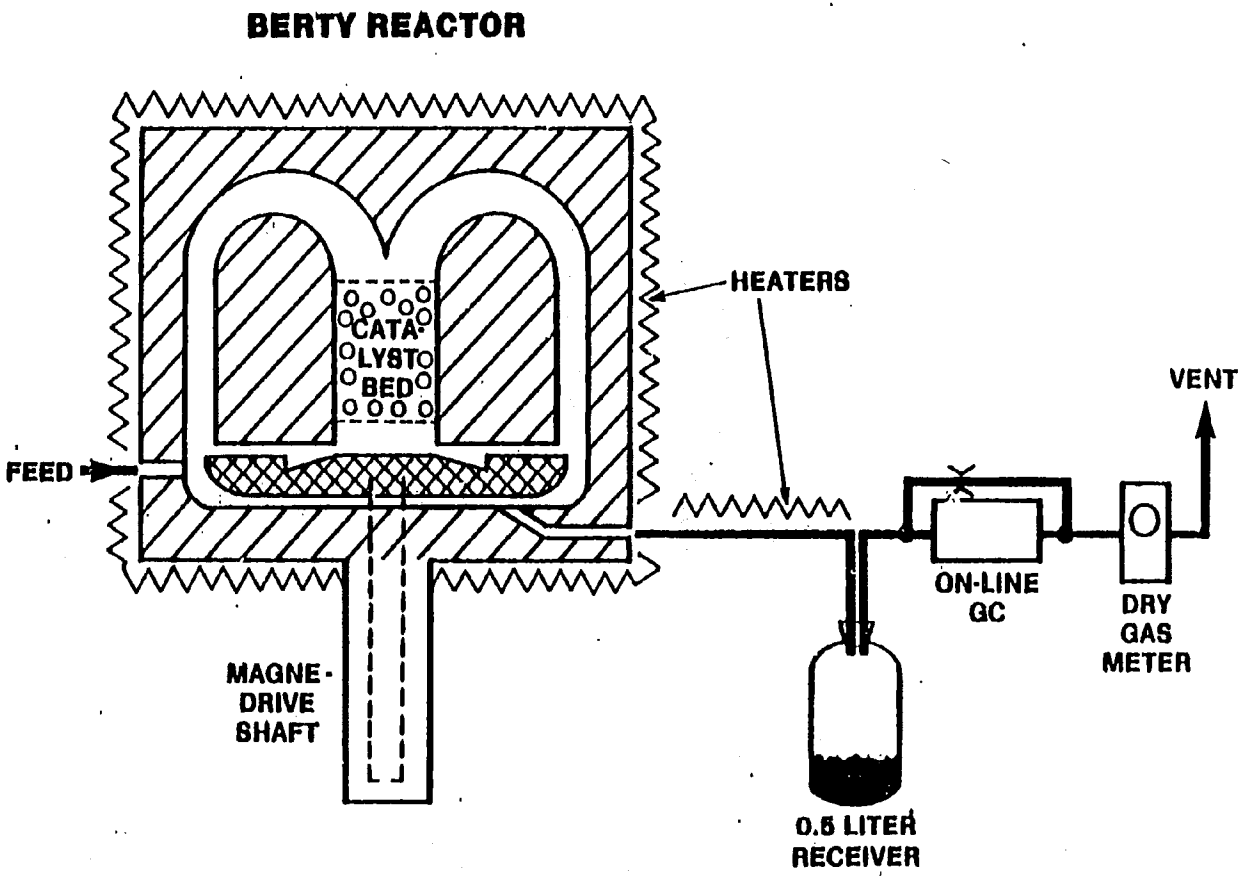


FIG. 4 BERTY REACTOR

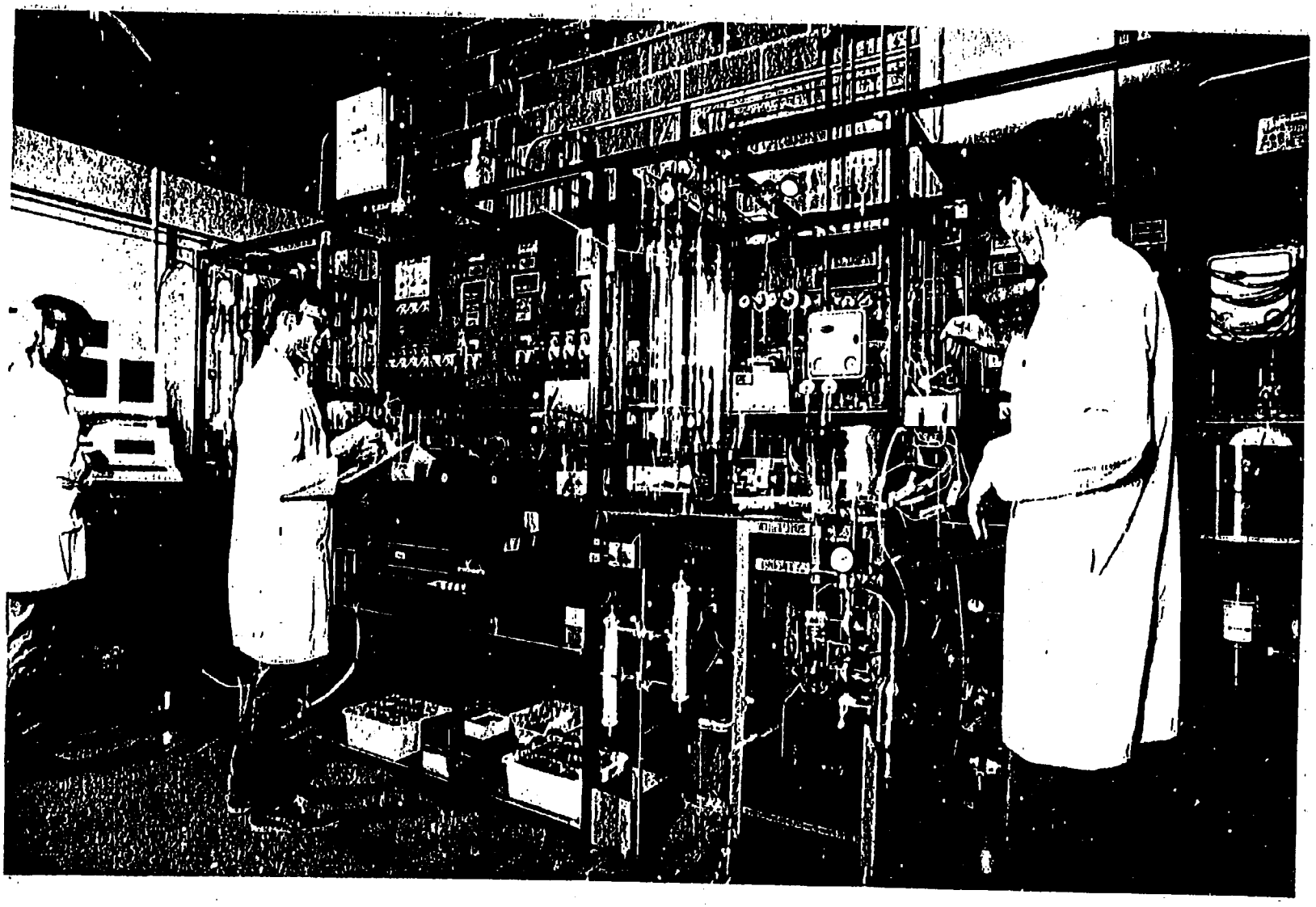


FIG. 5 CATALYST TEST LABORATORY

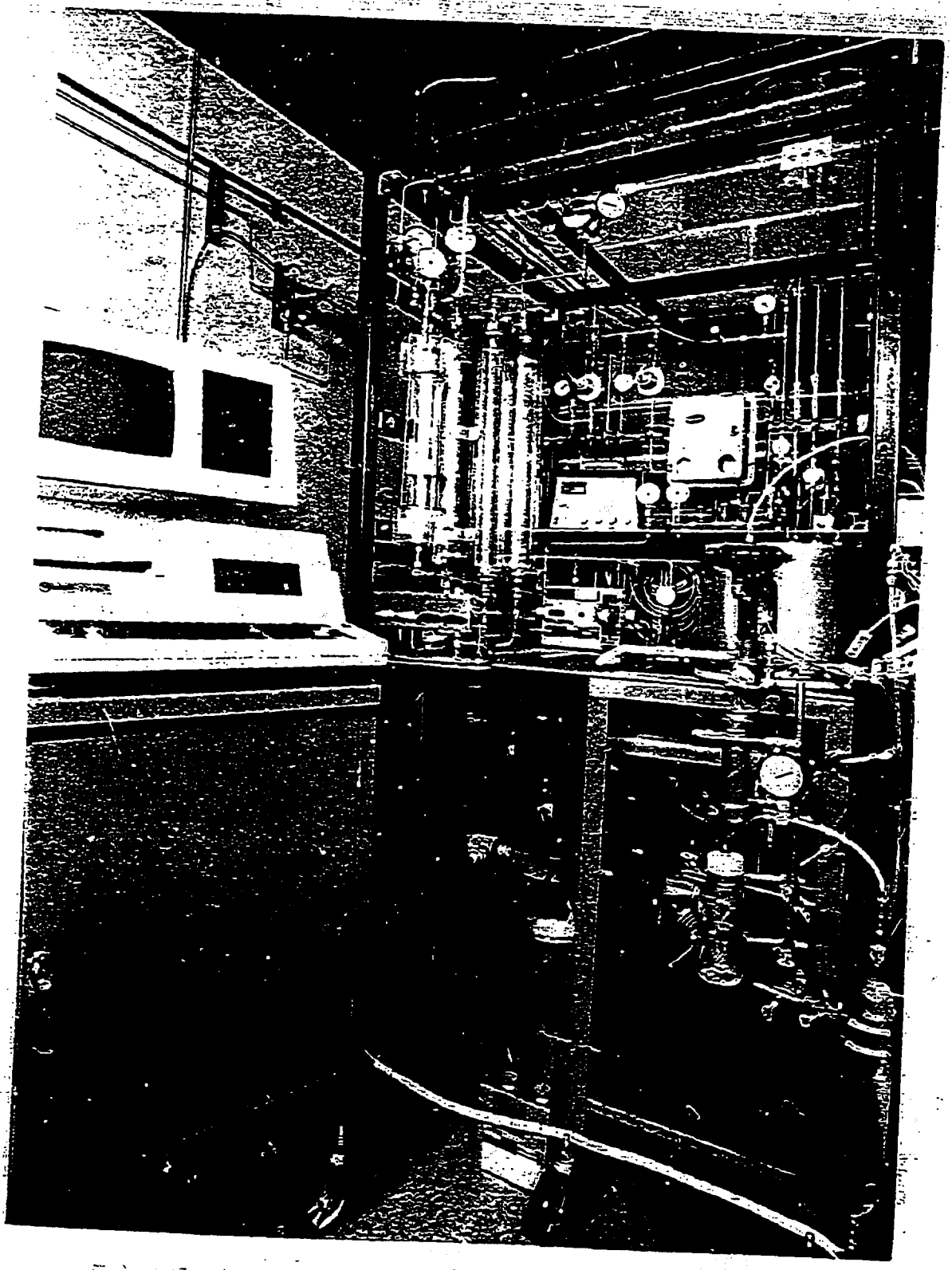


FIG. 6 GC DATA CONSOLE AND BAY 1

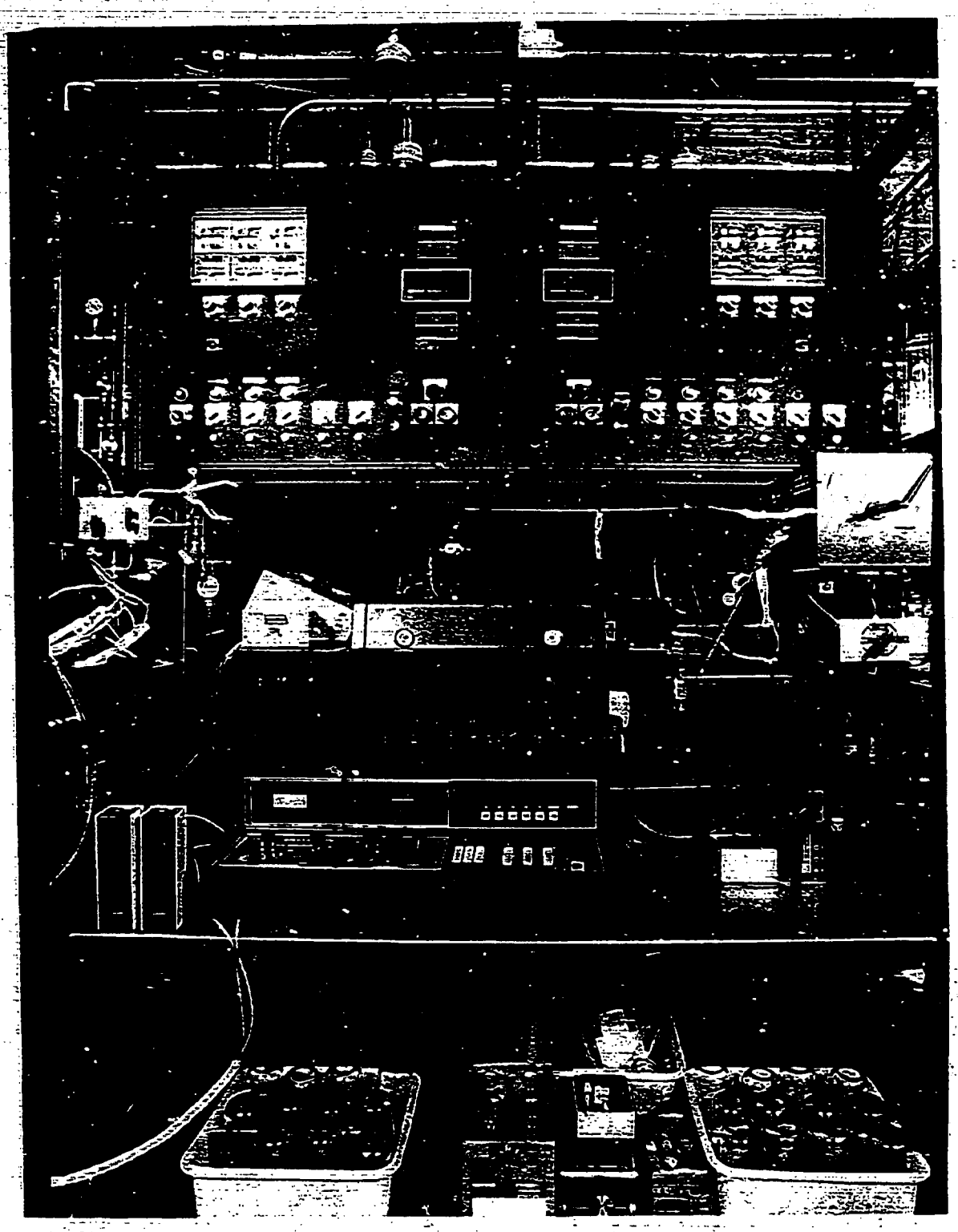


FIG. 7 CARLE CGC, SERIES 500

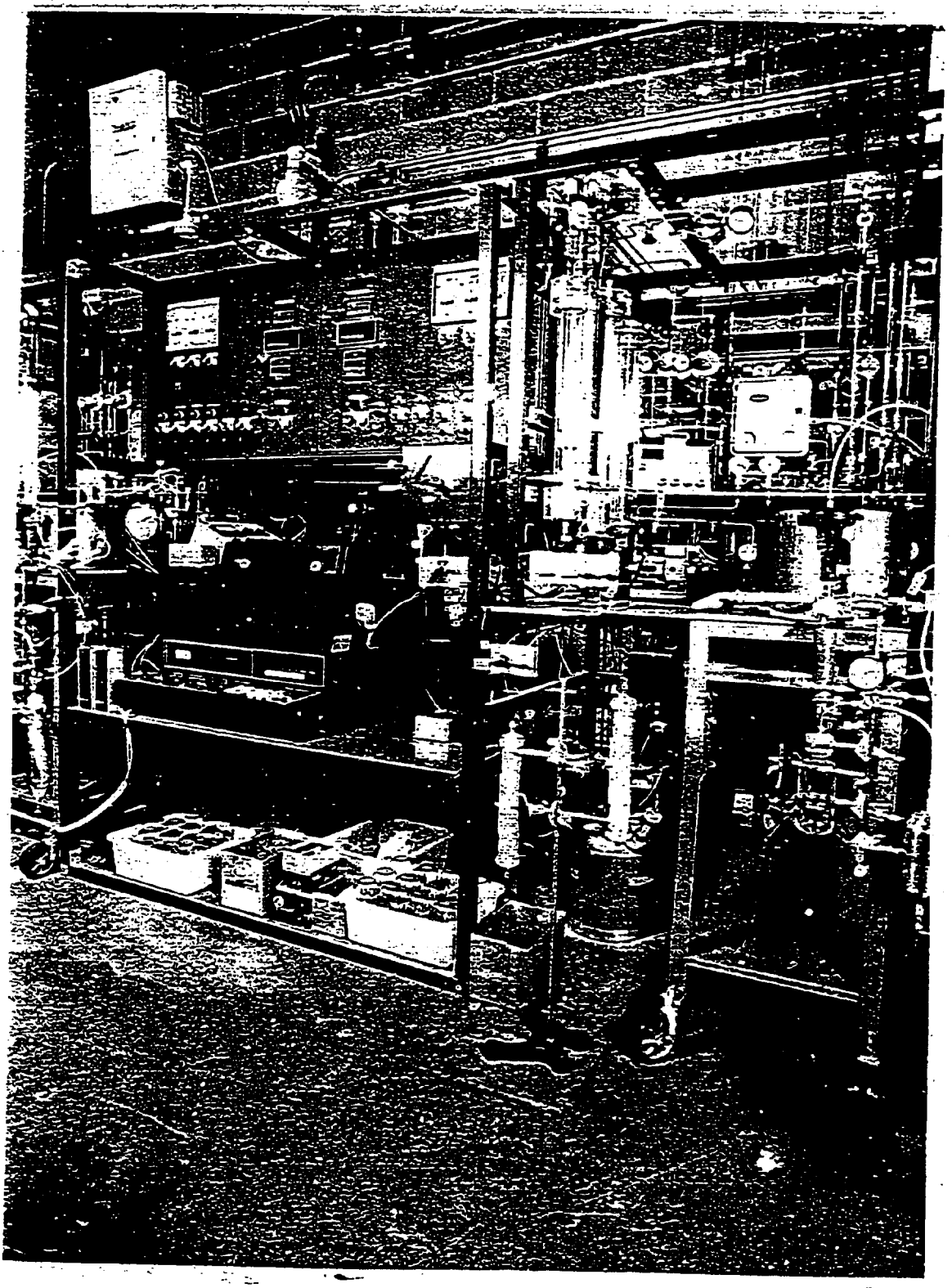


FIG. 8 BAY 2

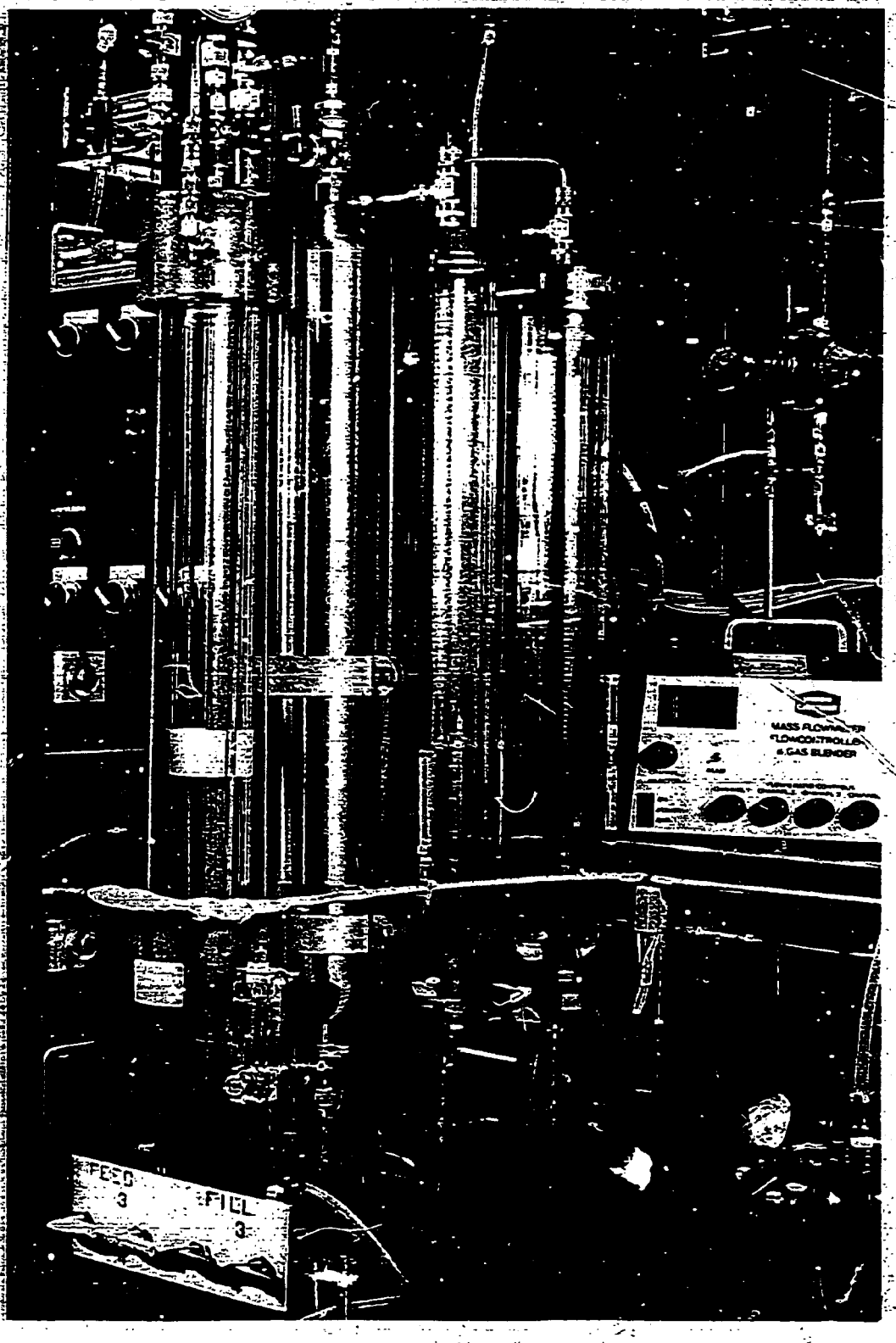


FIG. 9 LIQUID FEED SYSTEM, BAY 2

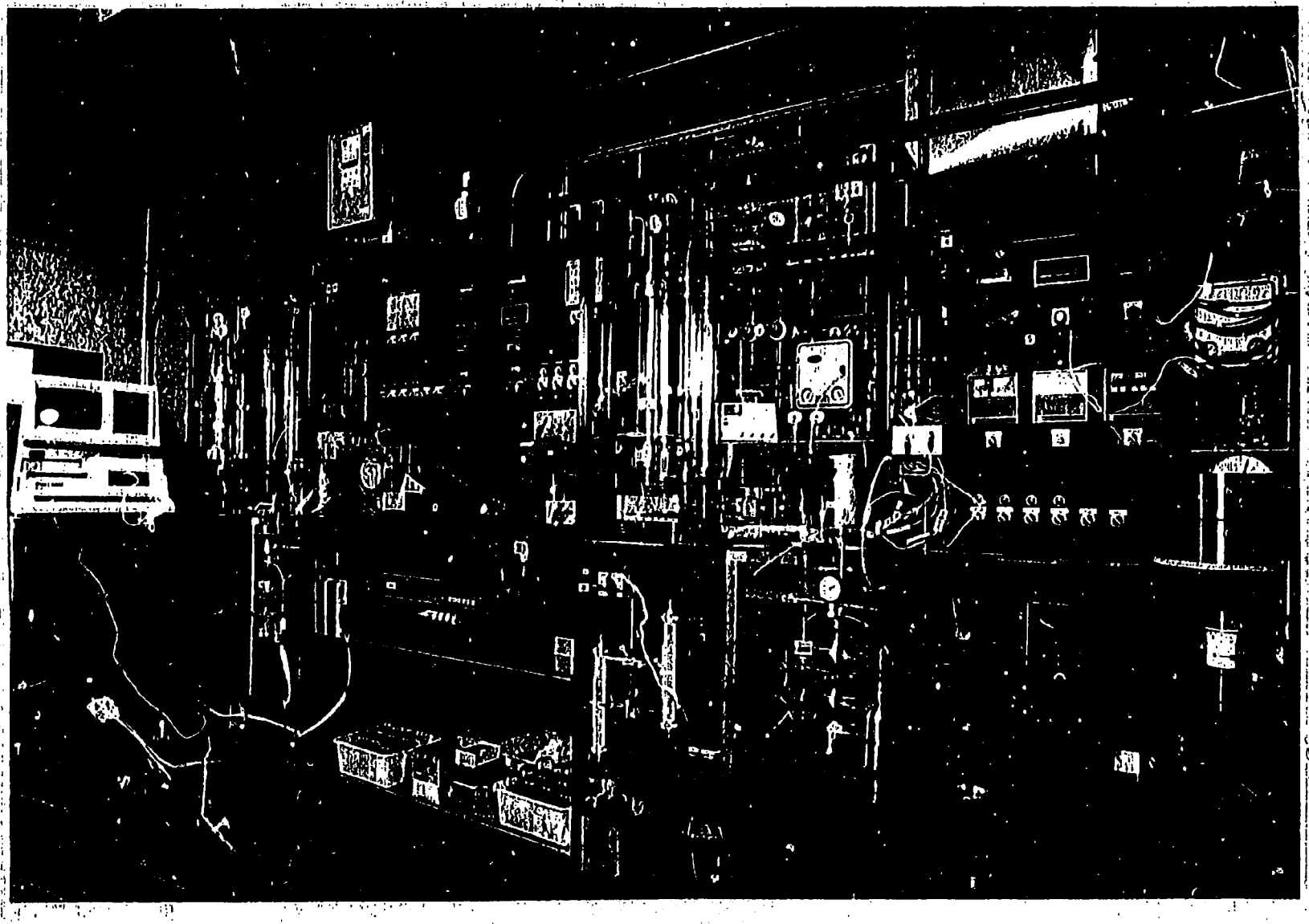


FIG. 10 BAYS 2 AND 3

TASK 1

EVALUATION OF THE MOLECULAR SIEVE COMPONENT

CATALYSTS STUDIED

NEW UNION CARBIDE MOLECULAR SIEVE CATALYSTS

UCC 101 UCC 104

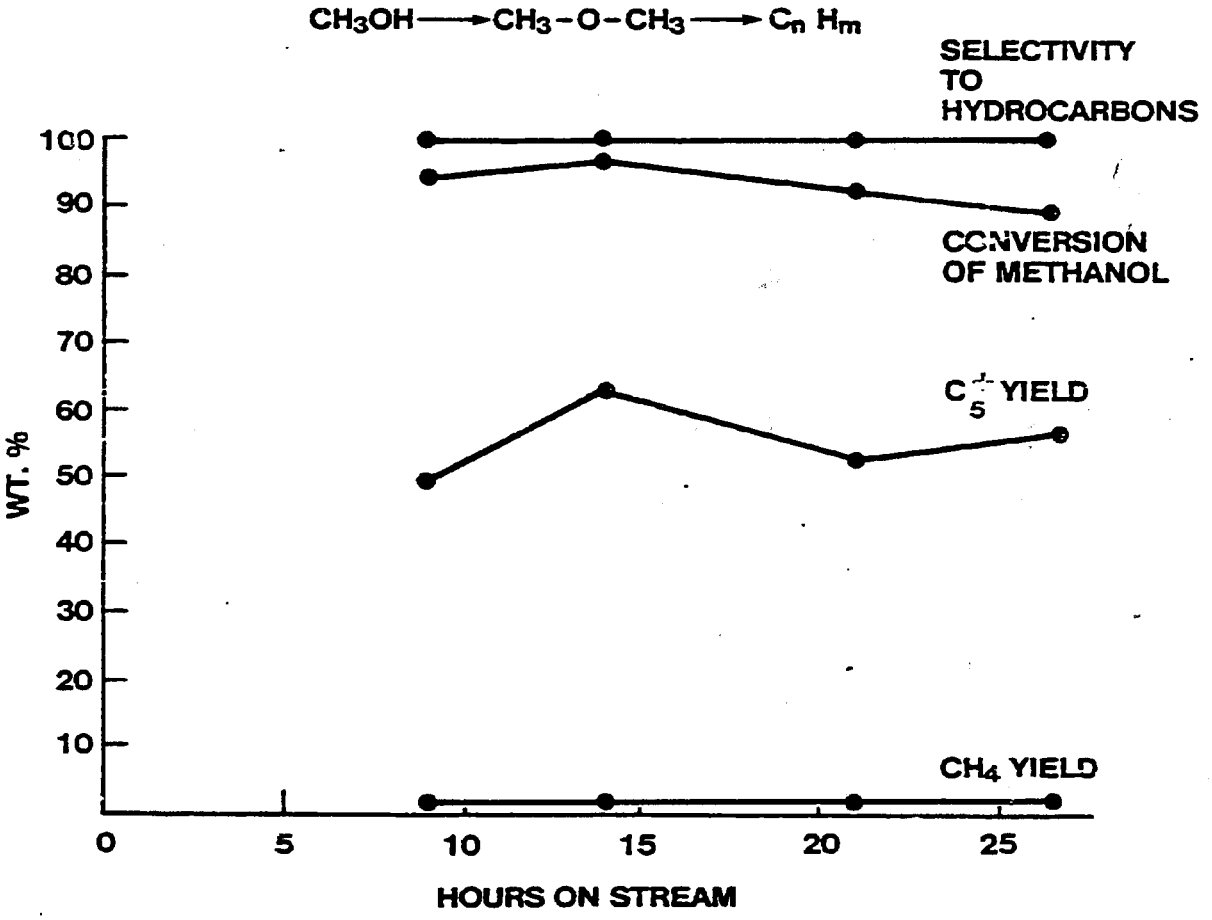
REFERENCE CATALYSTS

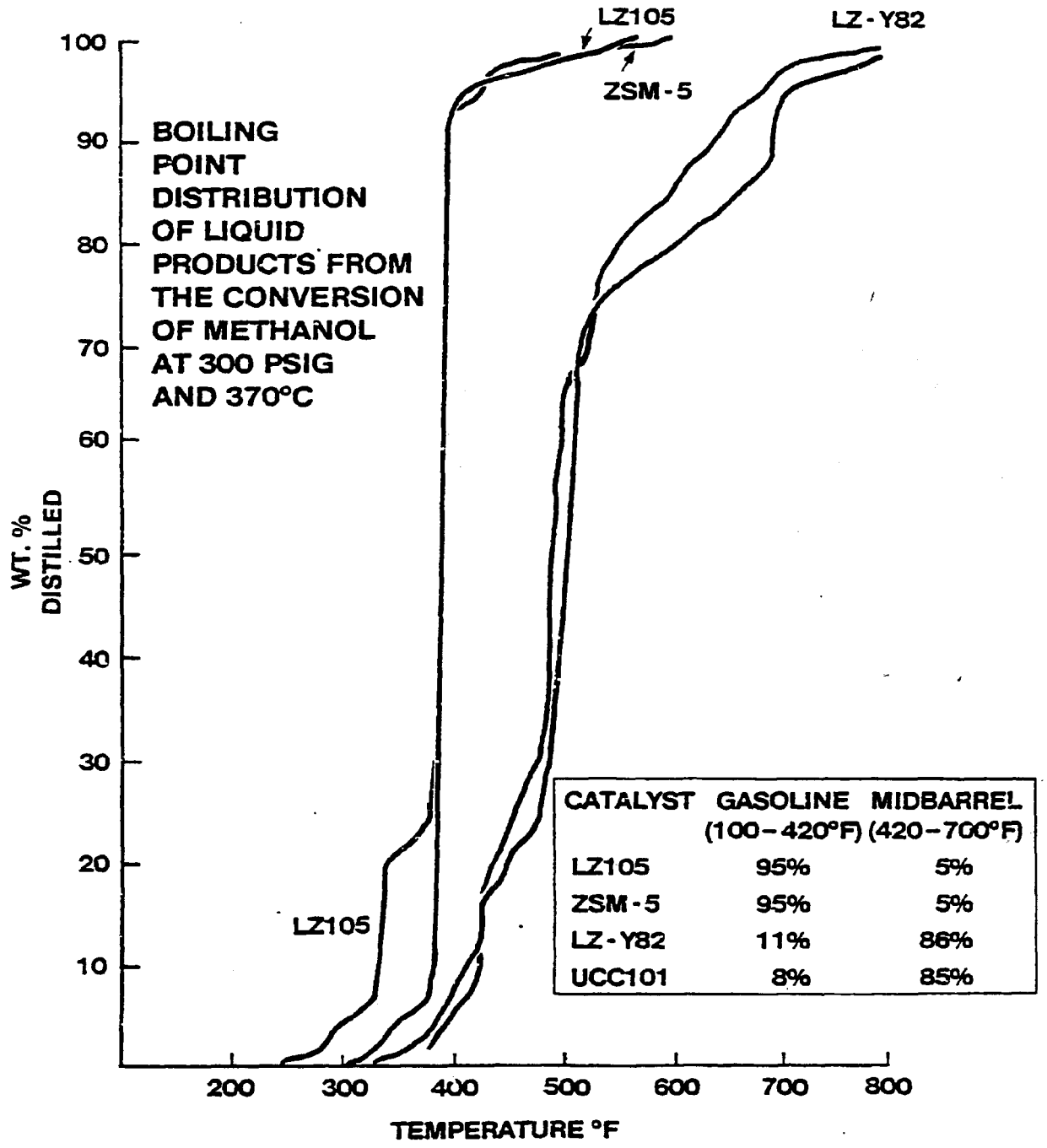
LZ105 A UNION CARBIDE MEDIUM PORE MOLECULAR SIEVE HAVING A STRUCTURE SIMILAR TO ZSM-5 $SiO_2/Al_2O_3 \sim 35$

ZSM-5 $SiO_2/Al_2O_3 \sim 75$ DATA FROM U.S. PATENT 4,105,062 ASSIGNED TO MOBIL OIL.
$SiO_2/Al_2O_3 = 35$ SYNTHESIZED AT TARRYTOWN, BASED ON PROCEDURES DESCRIBED BY MOBIL OIL.

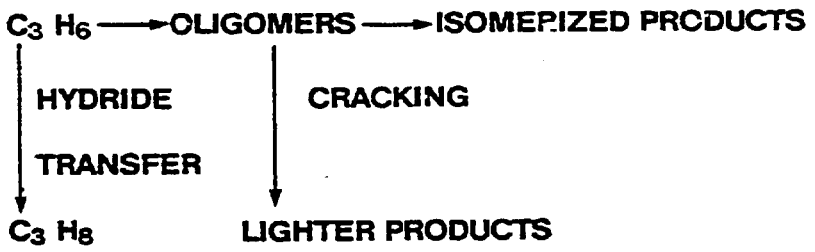
LZ-Y82 UNION CARBIDE COMMERCIAL CATALYST.

CATALYST AGING IN THE METHANOL TC HYDROCARBONS REACTION AT 410°C, 25 PSIG USING ZSM-5 CATALYST




LZ105
LZ-Y82
ZSM-5
BOILING POINT DISTRIBUTION OF LIQUID PRODUCTS FROM THE CONVERSION OF METHANOL AT 300 PSIG AND 370°C
WT. % DISTILLED
100
90
80
70
60
50
40
30
20
10
LZ105
200
300
400
500
600
700
800
TEMPERATURE °F
CATALYST | GASOLINE (100-420°F) | MIDBARREL (420-700°F)
LZ105 | 95% | 5%
ZSM-5 | 95% | 5%
LZ-Y82 | 11% | 86%
UCC101 | 8% | 85%

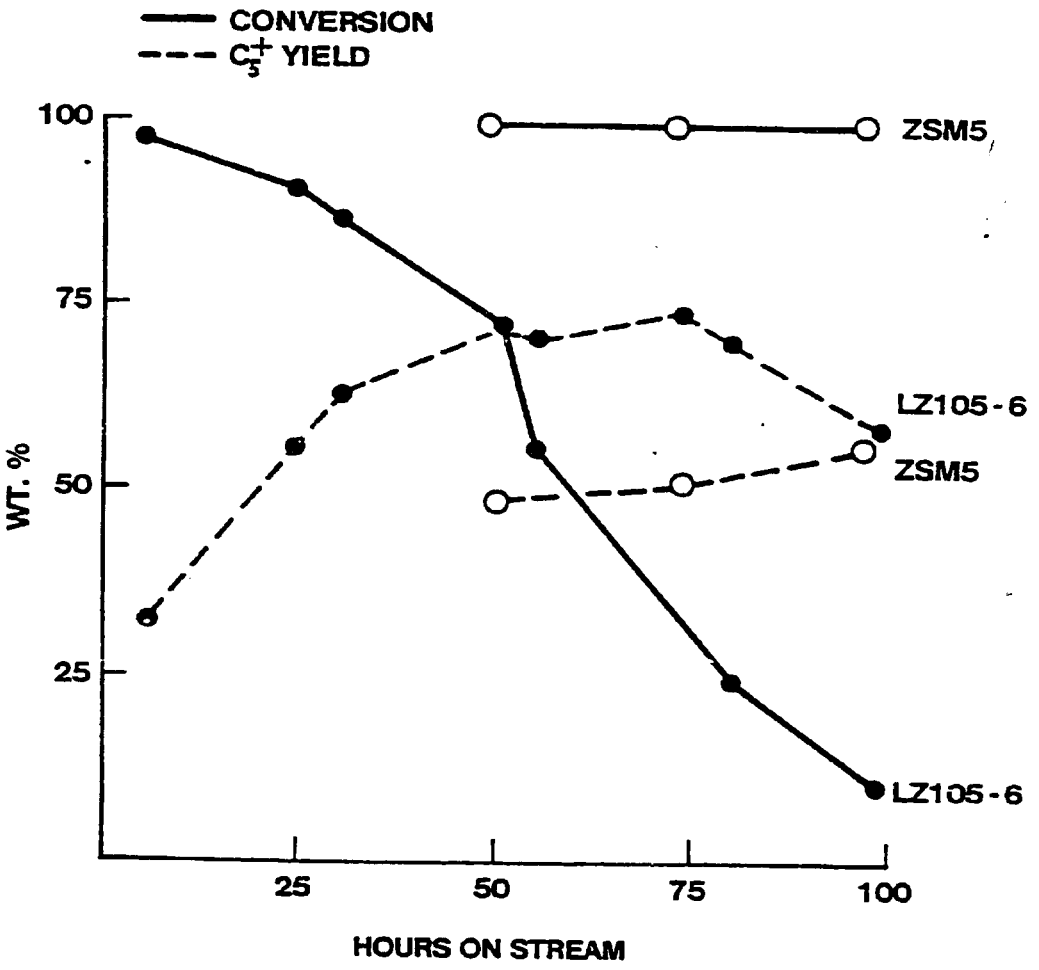
PROPYLENE OLIGOMERIZATION



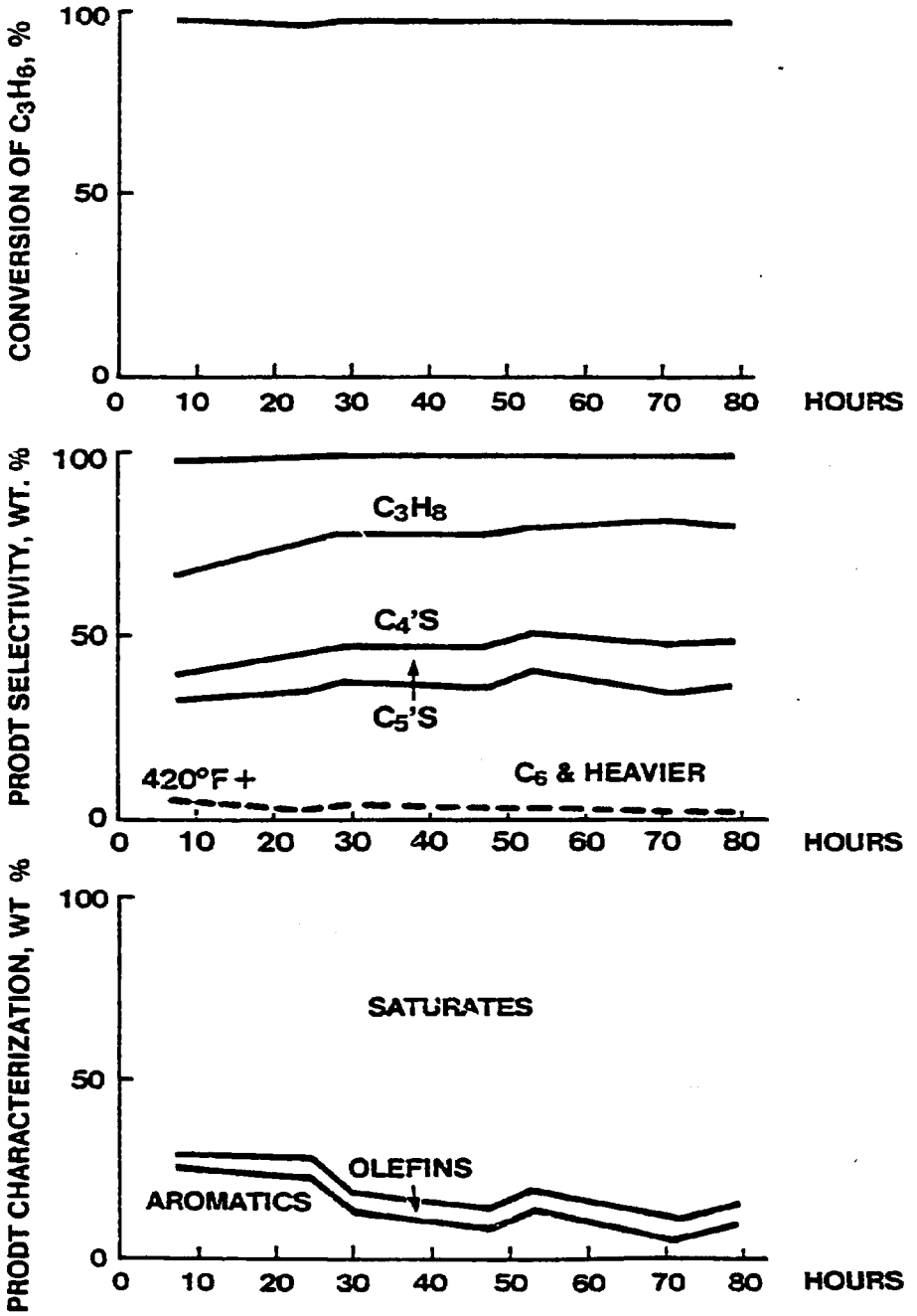
CATALYST AGING IN PROPYLENE OLIGOMERIZATION AT 410°C USING LZ105-6 AND ZSM5 CATALYSTS

○ ZSM5 $SiO_2/Al_2O_3 \sim 75$ DATA FROM US PATENT 4,105,062 ASSIGNED TO MOBIL OIL. FIXED BED, ATM. PRESS.

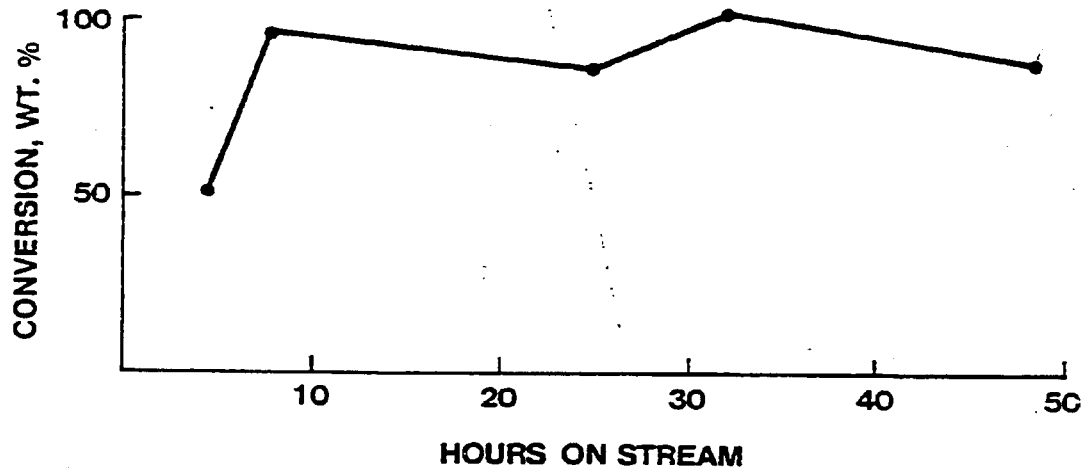
● LZ105-6 $SiO_2/Al_2O_3 \sim 35$ BERTY REACTOR 150 PSIG

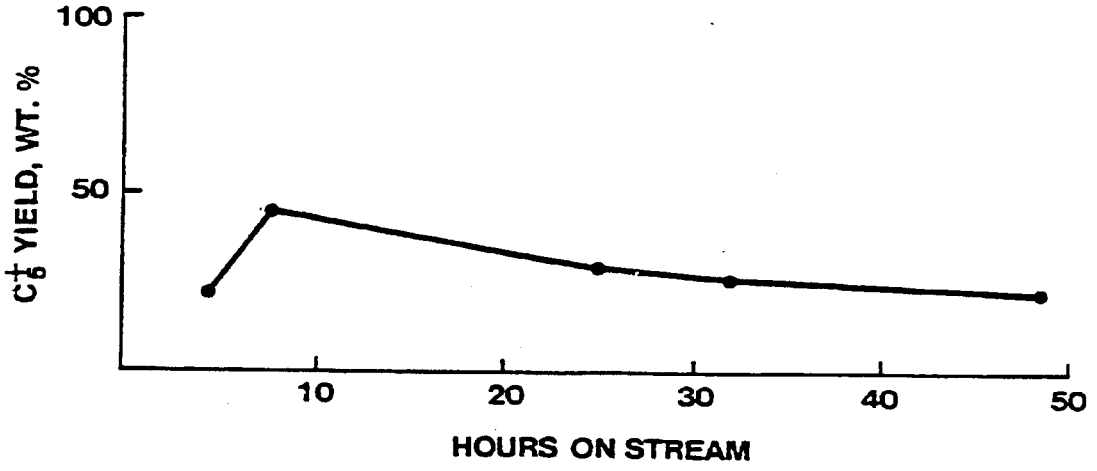


CATALYST AGING IN PROPYLENE OLIGOMERIZATION AT 410°C 150 PSIG USING A LZ-105 CATALYST WITH COFED WATER AND HYDROGEN (C_3H_6 : H : H_2O, 1 : 1 : 2)

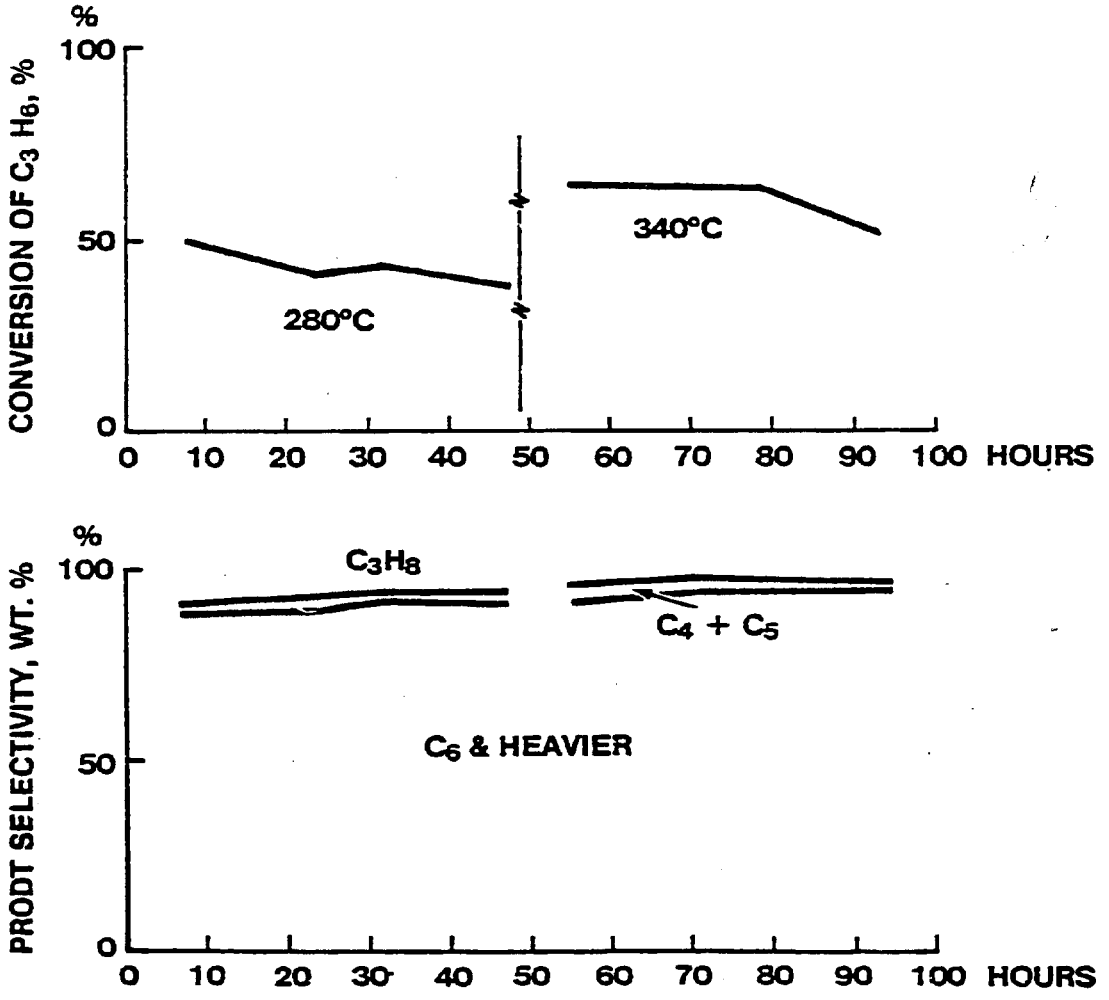


CATALYST AGING IN PROPYLENE OLIGOMERIZATION AT 410°C, 175 PSIG USING UCC 101 CATALYST WITH COFED WATER AND HYDROGEN (C_3H_6 : H_2 : H_2O, 1 : 1 : 2)

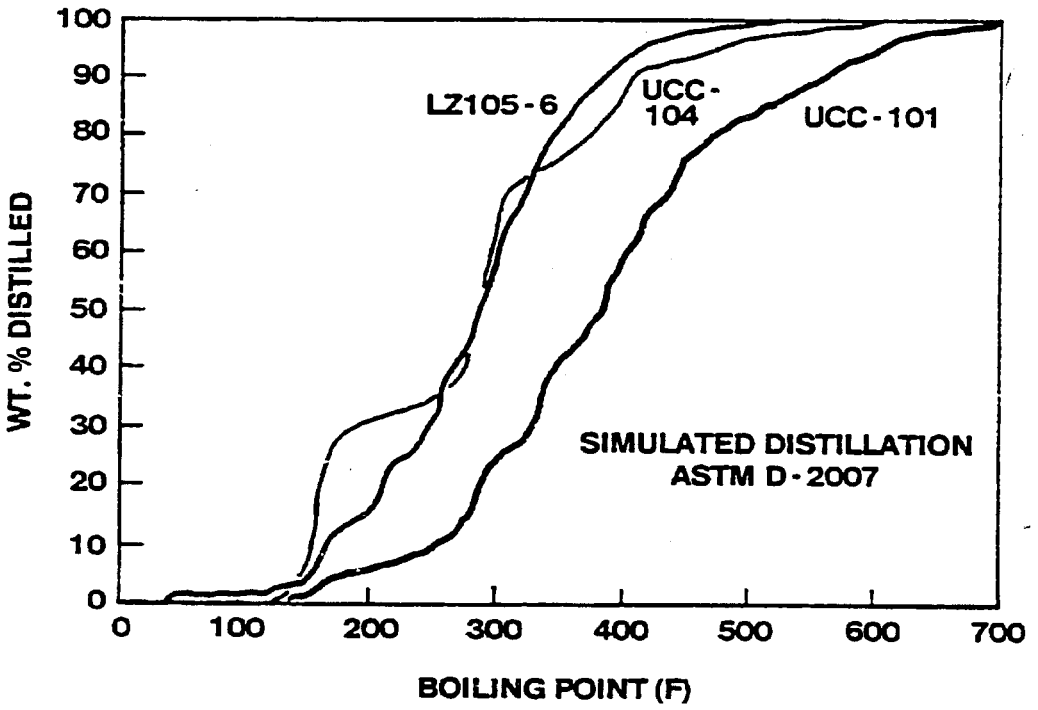




ACTIVITY AND SELECTIVITY OF UCC 104 IN THE PROPYLENE OLIGOMERIZATION REACTION WITH COFED WATER AND HYDROGEN (C_3H_6 : H_2 : H_2O, 1 : 2 : 1)



BOILING POINT DISTRIBUTION OF THE LIQUID PRODUCT OF PROPYLENE OLIGOMERIZATION USING LZ105-6, UCC 101,AND UCC 104 AS CATALYSTS.



CATALYST	GASOLINE (100-420°F)	MIDBARREL (420-700°F)
LZ105	96	4
UCC-101	68	32
UCC-104	90	8