

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
BUREAU OF MINES  
OFFICE OF SYNTHETIC LIQUID FUEL  
LOUISIANA, MISSOURI

B7-36

Two Short Papers on Dr. Baftschmidt's Oil Circulation Process

TOM Reel No. 1, Section 65, Iter 3, pp. 7-8

T-450

W. M. Sternberg  
March 24, 1948

I. DISCUSSION OF CARBON MONOXIDE-HYDROGEN  
SYNTHESIS IN BERLIN, JULY 1, 1941

Dr. Linck has discovered the fused iron catalyst in 1927 to 1929. At that time deposition of carbon caused difficulties when operating under high pressure in the vapor phase.

Experiments in the liquid phase were begun in 1934 and resulted in the development of the oil circulation processes, in which oil and gas were led concurrently over a fixed bed catalyst. It is important here that operations be conducted in the boiling phase, produced by the return of the relatively low boiling oil-constituents. The work was originally conducted at 100 atm, and subsequently at middle pressures in two stages.

With a 240°C reactor inlet temperature and 290°C reactor outlet, a total of 150 grams of primary products (liquid and gasol) were obtained in the two stages per norm of the ideal gas, with a 50% conversion in each stage. The composition of the primary products was:

40% primary gasoline, c.n. 62-68  
c.n. with 0.1% lead was 65  
2% oxygen content, removable by washing with water.

20% middle oil  
20% hard paraffin  
15% gasol (no C<sub>2</sub>)  
5% alcohols

cetane No. 78  
m.p. 95°C  
with 85% olefines  
with 25% methanol, 50% ethanol,  
25% higher alcohols, acetaldehyde,  
acetone, etc.

The space-time yield was

$$30 \text{ g/li cat/h} = 0.76/\text{li cat/day}.$$

Experiments at 25, 100, 150 and 180 atm. have shown that the oxygen content rises with increasing pressure, and at 180 atm. very much low boiling alcohols and very little higher alcohols are obtained.

The process can be used for alcohol production when operating with a low conversion and with a hydrogen-rich synthesis gas.

With a  $\text{CO:H}_2$  ratio of 1:1, at 180 atm. and 260-290°C, with a 23-30% conversion, 48.5% alcohols was found in the total liquid formed which consisted of

8.5% methanol  
21.0% ethanol  
10.0% propanol  
6.5%  $\text{C}_4\text{-C}_{11}$  alcohols  
2.5%  $\text{C}_{12}\text{-C}_{20}$  alcohols.

The 33.5% hydrocarbons consisted of

28.5% gasoline  
3.5% middle oil  
3.5% over 300°C.

The 18% fatty acids consisted of:

11% water solubles  
5%  $\text{C}_5\text{-C}_{11}$   
2%  $\text{C}_{12}\text{-C}_{20}$ .

The alcohols disappear in the liquid fraction

- (a) when the conversion is high,
- (b) when carbon is deposited upon the catalyst.

ECM Reel 13, Bag 5043, Item 2, p. 150

W. M. Sternberg  
March 24, 1948

II. DISCUSSION OF JULY, 1942

The process is practically identical with Michael's foam process with the exception that the catalyst is arranged in a fixed bed making the separation of the catalyst unnecessary.

Maximum reactor capacity	At present up to 1.5 ckm
Space time yield	0.72 kg/da/li catalyst
Conversion	87% in two stages
Oil circulation considerably smaller than in Michael's	CO <sub>2</sub> formation quite predominate over the formation of water
Composition of products	150 gram total products of which
	40% gasoline
	20% gas oil
	20% hard paraffin wax
	15% gasol
	15% alcohols

(It is assumed that the water formed amounts to 10% of the above and the total amount of liquid formed adds then up to 110%.)

THE COMPOSITION OF HYDROCARBONS

	C No.	Per Cent by Wt. in 150 grams	Per Cent Olefines*
	C <sub>2</sub>	8.6%	75-80%
	C <sub>3</sub>	7.4	75-80
20-50°C	C <sub>4</sub>	6.8	60-75
50-75	C <sub>5</sub>	6.6	60-70
75-100	C <sub>6</sub>	6.5	55-60
100-125	C <sub>7</sub>	6.2	50-55
125-150	C <sub>8</sub>	5.0	50-55
150-175	C <sub>9</sub>	2.7	40-50
175-200	C <sub>10</sub>	3.2	35-40
200-225	C <sub>11</sub>	3.1	35-40
225-250		3.6	
250-275		1.9	
275-300		3.0	
+300		11.4	
Hard Paraffin Wax		20.0	
Alcohols		5.7	

\*The olefines: 50% branched, 50% straight chain