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PROGRESS REPORT
(January-February, 1981)

MASTER

Report No.: C00-2982-66
Project: Conversion of Cellulosic Wastes to Liquid Hydrocarbon Fuels
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Progress for the month was as follows:

Integrated Runs. The integrated runs have been temporarily halted for the installation of new equipment and a characterization of alternative cobalt catalyst materials. Installation of the revisions have been stalled by a delay in bringing additional electrical power into the laboratory (originally scheduled in January, started in late February). The revised predictions for completion are as follows:

1. steam system: April 3
2. new feeder: March 13
3. new compressor: April 3
4. new liquefaction reactor: March 27
5. sparge gases control system: March 20

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High temperature butterfly valves were installed in the gasification system solids transfer loops. A leak developed in one of the flanges thus requiring new gaskets. The positive shutdown function at high temperature worked satisfactorily. A project to assess alternative transfer loop configurations with plastic simulators has started. The incentive is to economize on required sparge gas and improve operational reliability.

A number of alternative cobalt catalysts are being assessed via experimental runs on synthetic pyrolysis gas (cylinders) and characterization by surface area,

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porosity and elemental analysis (surface and bulk). The characterization analysis (Amoco Research Center) will require about one month. Screening runs on non cobalt alternative catalysts continues with a report (thesis) to be completed in May.

Factor Studies. Residence time, steam and liquefaction reactor recycle gas studies await the installation of the new equipment. A larger particle dolomite is on order.

Alternative Feedstocks. The following materials were processed thru gasification: sugarcane bagasse, smooth sumac, coralberry, wild bergamot, pokeweed, cornstarch, Portugese oak cork and hog fuel. A data summary is given in Table 1. The high H_2/CO ratio at low temperature for pokeweed is of significance ($>T$, $>H_2$). Also the high olefin content of Portugese oak cork (commercial cork) is of major interest. The most promising feedstock to date with regard to synthesis gas composition has been guayule cork. A comparison of data for the two cork materials is given in Table 2. An explanation for the outstanding performance of cork feedstocks is being pursued via compound analysis of the materials (and thus hopefully extrapolation to near term commercially viable feedstocks).

A detailed breakdown for corn starch (Table 3) reveals an exceptionally high methane content (35.50 mole %). Methane normally has been in the 10-20 mole % range for biomass type feedstocks. The data is masked somewhat by the low reactor temperature level. Again, this run was aimed at isolating the effect of compound types in the feedstocks on conversion system performance.

Other. The Principal Investigator presented a paper at the Fourth Annual Wood Energy Program and Contractor Review Meeting in Washington, D.C. in February (submitted under C00-2982-67). *Revised*

Table 1.
Alternative Feedstock Pyrolysis Gas Composition

<u>Feedstock</u>	<u>Temp(°F)</u>	<u>H₂/CO mole ratio</u>	<u>Mole % olefins</u>
sugarcane bagasse	1400	0.64	10.48
smooth sumac	1330	0.88	14.66
coralberry	1200	0.66	14.04
wild bergamot	1260	0.78	10.66
pokeweed	1260	1.53	13.67
corn starch	970	0.43	10.08
Portugese oak cork	1160	0.22	25.53
hog fuel	1200	0.21	13.23

Note: fluidizing gas = 30-45 lbs/hr steam + 6 lbs/hr recycle gas.

Table 2.
Cork Feedstock Gasification Performance Data

	<u>Guayule Cork</u>	<u>Portugese Oak Cork</u>
<u>Operating Conditions:</u>		
temperature, °F	1200	1160
pressure, psig	0.9	0.9
residence time, sec	1	5
heat transfer media	70 mesh sand	60 mesh sand
fluidizing gas ²	(recycle pyrolysis gas + steam)	
<u>Pyrolysis Gas Composition (mole%)¹:</u>		
H ₂	24.51	10.39
O ₂	0.47	0.01
CO	10.87	47.44
CO ₂	10.76	4.34
H ₂ S	0.00	0.00
CH ₄	10.95	10.00
C ₂ H ₂	0.04	0.00
C ₂ H ₄	16.67	11.56
C ₂ H ₆	3.24	1.94
C ₃ olefins	6.49	5.52
C ₃ H ₈	0.25	0.24
C ₄ olefins	2.65	1.63
C ₄ H ₁₀	0.21	0.10
C ₅ H ₁₂	0.00	0.00
C ₅ + olefins	12.88	6.83
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total unsaturated	38.73	25.53
H ₂ /CO ratio	2.25	0.22

¹water, nitrogen free basis

²steam flow = 95 lbs/hr for guayule cork, 30 lbs/hr for Portugese oak cork

Table 3.
Gasification Data-Corn Starch Feedstock

Operating Conditions:

temperature, °F	970
pressure, psig	1.0
residence time, sec	5
heat transfer media	60 mesh sand
fluidizing gas	recycle pyrolysis gas + steam

Pyrolysis Gas Composition (mole%)¹:

H ₂	10.41
O ₂	0.12
CO	24.10
CO ₂	18.51
H ₂ S	0.00
CH ₄	35.50
C ₂ H ₂	0.00
C ₂ H ₄	1.98
C ₂ H ₆	1.12
C ₃ olefins	1.33
C ₃ H ₈	0.09
C ₄ olefins	0.52
C ₄ H ₁₀	0.08
C ₅ H ₁₂	0.00
C ₅ + olefins	6.25

total unsaturated	10.08
H ₂ /CO ratio	0.43

¹water, nitrogen free basis