

**SIMULTANEOUS PRODUCTION OF WOOD PULP AND THE  
CONVERSION OF THE NONCELLULOSIC CONSTITUENTS  
OF WOOD INTO ALCOHOLS, OILS, AND RESINS**

**February 1940**



(Report)

UNITED STATES DEPARTMENT OF AGRICULTURE  
FOREST SERVICE  
FOREST PRODUCTS LABORATORY  
Madison, Wisconsin  
In Cooperation with the University of Wisconsin

SIMULTANEOUS PRODUCTION OF WOOD PULP AND  
THE CONVERSION OF THE NONCELLULOSIC CONSTITUENTS  
OF WOOD INTO ALCOHOLS, OILS, AND RESINS<sup>1</sup>

By

ELWIN E. HARRIS, Chemist  
and  
E. C. SHERRARD, Principal Chemist

-----

In an earlier paper<sup>2</sup> it was shown that lignin that has been freed of cellulosic material can be hydrogenated in a water suspension to produce methanol, several derivatives of propyl cyclohexane, and a high-boiling resin. When wood in the form of chips or sawdust was subjected to hydrogenation, the lignin was similarly hydrogenated with the production of oils and resins and some of the hemicellulosic material converted into alcohols, leaving the cellulosic material as a pulp.<sup>2</sup> Because acidic substances were liberated from wood which inhibited the reactivity of the catalyst, it was desirable to add sufficient alkali to keep the solution alkaline at all times. Alkali corresponding to 8 to 10 percent of the weight of the wood was usually used.

At higher pressures of hydrogen large amounts of hydrogen were taken up and pulp, methanol, propyl alcohol, propyl cyclohexane derivatives, and a resin were obtained. It was found that it was possible to obtain sufficient pulp-  
ing by controlling the extent of the hydrogenation through the use of lower pressures. The pulping solution, which normally becomes dark brown from the action of alkali on the lignin, remained light colored. Most of the lignin may be obtained from this liquor, upon acidification, as a low-melting, resin-like material that darkens on exposure to air. Methyl and propyl alcohols are recoverable from the liquor by distillation.

---

<sup>1</sup>Application for U. S. patent covering this process has been made.

<sup>2</sup>Presented before the Cellulose Division, American Chemical Society, Boston, Mass., September, 1939, by E. E. Harris.

<sup>3</sup>A general description of this process was presented before the Engineers' Club of Birmingham, Ala., February 12, 1940 by C. P. Winslow.

## Experimental

Thirty grams of air-dried wood chips were placed in a 600 cc. hydrogenation bomb, 300 cc. of a solution containing sodium hydroxide and 0.05 gram of Raney nickel catalyst were added. The bomb was closed and hydrogen pumped in to give the desired starting pressure. The bomb was heated until hydrogen was no longer absorbed, after which it was allowed to cool. The bomb was then opened and the contents filtered to recover the pulp. Compounds boiling below 100° C., consisting of methanol and propyl alcohol, were removed from the filtrate by distillation. The remaining filtrate was acidified, throwing out an oily resin. Several propyl cyclohexane derivatives were obtained by distillation of this resin. The acidified filtrate remaining after removal of the resinous material was evaporated and a residue obtained. Table 1 gives the conditions for the various experiments and the yields of products obtained.

The pulp obtained without further treatment was about the color of newsprint paper. It was quite free from shives and easily bleached by a mild treatment with chlorine.

Table 1.---hydrogenation of wood in aqueous alkaline solution

Kind of wood	Weight of sample	Water	Alkali	Initial hydro- pressure	Temperature	Time	Yield of products (Percent of original wood)													
							Grams	Cc.	Lbs. per sq. in.	°C.	Hours	Per- cent	Per- cent	Per- cent	Per- cent	Per- cent	Per- cent	Per- cent	Per- cent	Per- cent
Aspen	30	300	3	1,000	170	3	44	3	10	(1)	17	20+								
Aspen	30	300	2-1/2	3,000	180	4	40	5.1	16	20	14	2								
Maple	30	300	3	3,000	175	4	45	4.9	16	18	15	3								
Slash pine	30	300	4-1/2	1,000	175	1-1/2	44	2-1/2	8	(1)	24	20+								
Aspen	30	300	3	3,000	200	12	None	4.6	16	(1)	20	(1)								
Red gum	30	300	3	1,000	175	3	42	3	11	(1)	17	22								

<sup>1</sup>Determination not made.