Some Observations Regarding the Status of the Wood-Distillation Industry

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A marked decrease during the past 20 years in the number of wood-distillation plants was revealed through observations by the U. S. Forest Products Laboratory. The amount of wood consumed has been correspondingly reduced from about 1,000,000 cords per year in 1927 to about 550,000 cords per year at the present time. Competition for raw material with other purchasers is increasing, and, further, difficulties exist in the procurement of it because of diminishing supplies near the plants and higher labor costs. Markets have been a continuing problem and are of no less concern now. The sale of charcoal appears restricted to fewer large-tonnage markets, and wider outlets appear necessary in order to insure a satisfactory price level. Of the total amount of wood consumed in the 20 plants of the hardwood-distillation industry, about one-half is used by the eight plants of more modern design. Investigations into continuous carbonization, wider markets for charcoal, integration of processes for the recovery of acetic acid and methanol with modified forms of carbonization, and further mechanization of chemical-wood procurement are suggested as possible means of improving the status of the industry.

Introduction

The wood-distillation industry in the United States is faced with the twin problems of diminishing supplies of raw materials and dwindling markets for its products. Observations by the U. S. Forest Products Laboratory have revealed that despite the use of additional species of wood, made possible through continuing research, it has become increasingly difficult to supply the plants with raw material at a price that will permit profitable operation.

The supply of raw material through the course of years has determined both the location of the plants and the products that they manufacture. In consequence, although similar carbonization methods are employed, the industry is divided into branches; one for the distillation of hardwoods, the other of resinous woods.

Beech, birch, and maple provide the chief sources of raw material for hardwood processing. Large stands of these species occur in a rather wide belt extending roughly from the Central States through Pennsylvania and the New England States. It is within this area that the majority of hardwood-distillation plants are located. “Fatty” longleaf and slash pine stumpwood provide the most suitable source of raw material for resinous-wood processing and restrict plant locations, in general, within areas along the Gulf States.

Although each of these areas was once a source of abundant supply and raw material was both readily accessible and cheap, quite the reverse is true today. Careful forest management is essential as is the promotion of better utilization methods for forest and wood waste, if the plants in these areas are to continue operation. To this end, it is an advantage that the distillation industry can be easily fitted into both practices.

Since roughly 60 to 70 percent of the raw material consists of cull logs and sections, low-grade logs, and slab waste, chemical-wood operations are an aid to good forest management and industrial integration. Along with beech, birch, and maple, considerable amounts of ash, hickory, gum, tupelo, and oak are now used in the hardwood industry, and thus the dwindling supply of traditional species has been materially supplemented. Although good results are obtained with resinous-wood stumps removed from potential forest and agricultural lands, the supplies of such raw material are not perpetuated, since the value of second-growth stumpwood for distillation purposes is questionable.

The industry includes very old and small plants, some of average capacity, and some of more recent design and equipment with largest

1 Maintained at Madison, Wisconsin, in cooperation with the University of Wisconsin.
capacity. During the past 20 years the trend has been toward the elimination of the smaller plants. The margin of profit under the most favorable conditions has always been narrow and offers little protection to the weaker or marginal plants. Mounting wood and labor costs, particularly in recent years, together with highly competitive markets are factors of major concern to the industry at large, but have a more telling effect upon the small plants. Likewise, technological progress over the years has benefited the large plants more than the small ones, and the competitive position of the stronger plants has usually been improved, while plants of smaller capacity have earned decreasing returns and, in some cases, been forced to abandonment.

Observations Regarding Hardwood Distillation

The principal marketable products of the hardwood-distillation industry are acetic acid, methanol, and charcoal. In brief, hardwood processing, as shown in Figure 1, may be regarded as a two-step operation, wherein (1) the wood is predried and carbonized, and (2) the crude liquid products obtained are separated and partially or completely refined as facilities permit. Carbonization is carried out chiefly in the conventional, externally heated ovens, but in one instance in vertical, tube-type retorts. The standard oven operation is by batches and generally uses wood of cord or large-block size. The vertical retorts operate continuously on hogged or waste wood of similar particle size. The reaction heat given off as the wood distills is fully utilized and maintains continuous distillation conditions. Charcoal is obtained as a distillation residue from the ovens and retorts.

The procedure for refining the crude liquor depends primarily upon the available facilities for acetic acid recovery. In the older and, more particularly, the smaller plants, the acid is recovered indirectly as the calcium salt. The larger plants with more modern equipment recover acetic acid directly from the crude liquor, by means of extracting agents and subsequent distillation. Methanol is obtained by batches, when the acetic acid is recovered indirectly, and continuously when it is recovered directly.

On a rated cord basis, the capacity of the hardwood plants has steadily decreased and now is less than half that of 20 years ago. At the beginning of the period 1928–1948, 52 plants were operating with a yearly wood capacity of approximately 950,000 cords. The rated wood capacity of the 20 units now active is approximately 425,000 cords per year. These plants, known to be operating as recently as 1945, are located chiefly in the Northeastern States, the Lake States, and a few in the South Central States.

Deviation from traditional refining methods became apparent about 1928, at a time when much of the methanol market was being taken over by synthetic production. The newer methods adopted provided for the production of acid by direct means, with closer integration for recovery of methanol continuously. These more efficient refining steps were essential from the standpoint of market and plant protection, and represent the major technological development of the industry from this time on. The wood consumed in the plants using more modern equipment accounts for an increasingly large proportion of the total wood processed. Table 1 shows these estimated amounts over the past 20 years at 10-year intervals.

Table 1.—Estimated Consumption of Wood by Hardwood-Distillation Plants from 1927 to 1947

<table>
<thead>
<tr>
<th>Plants</th>
<th>1927</th>
<th>1937</th>
<th>1947</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire industry</td>
<td>575,000</td>
<td>600,000</td>
<td>490,000</td>
</tr>
<tr>
<td>Direct recovery plants</td>
<td>60,000</td>
<td>140,000</td>
<td>270,000</td>
</tr>
</tbody>
</table>

Both the older type of plant and the more modern processing units are active at the present time, with the older plants numerically stronger. Of the total now in operation, five establishments have capacities of 30 cords or less per day and the others increase in capacity to the three largest, which process 200 cords per day. These three, together with five of approximately 60 cords daily capacity each, are the more advanced units and recover acetic acid directly. Limited capacities of the 12 remaining acetate plants hardly justify the heavy investment that would be required for conversion to the more efficient operating methods. As shown in Table 1, over a period of
Fig. 1.—Procedures commonly applied for the distillation of hardwoods and principal byproducts obtained.

20 years new and modernized plants accounted for progressively larger amounts of wood processed each year. In 1927, 1937, and 1947 these amounts were 7.5, 25, and 54 percent of the total consumption of the industry, respectively. Comparatively, industry shrinkage of the total amount of wood consumed was roughly 25 percent in 1937, but in the succeeding 10-year period only 16.5. It is estimated that only 12 to 14 percent and 5 to 6 percent, respectively, of the total amounts of acetic acid and methanol produced in the United States are now obtained from wood distillation. The amounts of these products produced yearly by the acetate plants has decreased correspondingly and now might well be absorbed by the plants that recover the acid directly. Further, the quantities of acetic acid and methanol produced yearly by the acetate plants has decreased correspondingly and now might well be absorbed by the plants that recover the acid directly.
acid and methanol produced by both types of plants are largely incidental to the manufacture of charcoal and are relatively unimportant commercially.

In hardwood distillation, charcoal is returned to the plant at a rate of about 1,000 pounds for each cord of wood distilled and represents roughly a 275,000-ton output for the industry in 1947. Rapid removal to suitable markets is essential, and if this is not possible it is generally recognized that plants cannot remain active for any length of time. Reportedly, the demand for charcoal is about equal to production, with the price per ton as of February 16, 1948, at a high level of $39.50 f.o.b. plant. Unfortunately, this comparatively high return represents little more than is required to meet the increased costs of wood, labor, and materials. There is probably little difference between the profit per cord existing now and some five years ago, since in this same period wood costs alone increased from about $5.50 to $11 per cord.

Uses for large tonnages of charcoal have been lost to coke in the metallurgical field, and other carbons likewise have displaced it to a substantial degree in the chemical field. Recent estimates indicate that uses for the largest amounts of charcoal are confined to the domestic fuel, recreational, and several specialty fields. It is possible that these specialty fields may provide greater market opportunities. If so, a proper balance of supply and demand could be expected. Otherwise, with the trend toward diminishing industrial outlets, a further curtailment of production capacity would be inevitable.

The present status of the industry, as interpreted from rather limited observation and personal contact, is best shown perhaps by the better position of the plants now in existence to produce competitively. This has been achieved, in part through improved processing facilities of these plants, and in part through diminished production of the industry as a whole. The end result appears to be greater stability. Whether this apparent stability of the industry continues will be largely determined by further developments in these two directions.

Observations Regarding Resinous—wood Distillation

The marketable products from the distillation of resinous wood are chiefly turpentine, pine tar, pine oil, a dipentene fraction, and to a less extent, various types of solvent, wood-treating, and specialty oils. Resinous-wood processing, as shown in Figure 2, is similar to that employed for hardwoods with initial carbonization and subsequent refining procedures. The carbonizing equipment varies widely in design, construction, and capacity among the plants. The older, round retorts are rather widely used, along with ovens of large capacity and, in other cases, concrete chambers. Retorts with concrete chambers are referred to as “cold-bottom” retorts, since heating of the charge is accomplished with internally heated flues and not by direct bottom heating as applied to the steel retorts and ovens. In general, the end results of the two methods are similar, although higher yields of crude oils have been reported from cold-bottom processing. With the exception of two plants, one of which recovers the crude oil as a basic product and one as a light oil and pine-tar fraction, it is current practice to refine further and obtain additional products. These include turpentine, pine oil, and dipentene from the lighter cuts, together with “solvent” and tar oils, as the refining facilities of the plants permit. Pine-tar wood preservatives are also produced at a number of plants and are prepared in accordance with individual plant formulation.

As has been noted, not all the plants in this industry are in a position either to diversify their products for wider outlets or to meet a specialty market demand, as the case may be. Pine tar has been one of the important products and one of the main sources of revenue to the plants for many years. The older, simply equipped plants can produce marketable grades equally as well as the larger plants of more elaborate design. Both plant types are well represented in the industry, and each is capable of operating at a profit when good markets are available. Markets for tar, however, are becoming tighter with the development of competitive products. Possible lower domestic prices and restricted export shipments are
Fig. 2.—Procedure commonly applied for the distillation of resinous wood and principal byproducts obtained

RESINOUS WOOD

(Oven or retort distillation)

Charcoal
Crude liquor
Noncondensible gas

Lump, screened
(Settling)
Fuel or waste

(Separation)

Crude oil
Acid water

(Distillation)

Waste

Crude light oils
Pine tars
Pine tar

(Distillation)

Pine tar oils

Solvent oils
Turpentine
Tar oils
Pine tar pitch

Pine oil

Dipentene

problems of immediate concern, particularly to the units of limited capacity and products. Charcoal is obtained in about the same bulk amounts per cord of resinous wood as from hardwood distillation and its immediate sale, as in the latter industry, is equally important for profitable operation.

Recent markets for this product have not been encouraging, with respect either to traditionally good domestic outlets or to industrial applications. Resinous-wood and hardwood charcoals have properties that are similar and they may be considered competitive products in the markets. On a tonnage basis, however, returns to the plant from the sale of resinous-wood charcoal based on current market prices, are about one-half the returns from the hardwood charcoal. Adjustments to wider and more diversified outlets and to a more favorable market price appear essential if present production in the industry is to be maintained.

On a cord basis, the wood consumed in the resinous-wood distillation industry has remained fairly constant during the past 15 to 20 years. Within close estimates, the establishments then operating correspond in number
with those now active. Three of the nine plants now operating are located in Louisiana, four in Florida, and two in Georgia. Estimated wood consumption is at the rate of about 120,000 cords per year. Wood procurement problems appear as numerous and as serious as those affecting the hardwood-distillation industry. There is no reason to believe that solution of these problems will be immediately forthcoming. The present status, therefore, is not too clearly defined, but prospects are none too encouraging under the adverse conditions now prevailing.

General

The wood-distillation industry, like so many others today, is confronted with serious problems of raw material, markets, and processing. Because of variations in capacity, methods of processing, and other conditions, no one solution to any of the problems will benefit all plants alike. A number of these same problems have been with the industry for years, while others are of more recent origin. In contributing to the solution or adjustment of some of the problems, the results of individual plant efforts are not always widely known. It would seem in this connection that unified effort would be helpful in overcoming difficulties common to the industry.

Although it is recognized that many of the problems and difficulties that may become apparent to an observer are only too well known to those within the industry itself, the following are some that have appeared in this manner and are likely possibilities toward which research might be profitably directed.

Continuous Carbonization

The more favorable aspects of continuous carbonization include less handling and plant labor, lower fuel costs per cord of wood carbonized, and probably reduction in maintenance charges throughout. Converting resinous wood by this type of processing might be expected to result in economies allowing greater plant return and the possible use of "leaner" wood, when highly resinous stumpwood is no longer available.

Charcoal Properties and Markets

A study of the properties of charcoal and possible correlation of them with end uses of the product may reveal possible means of market promotion and protection.

In general, both hardwood and resinous-wood charcoals are used in the same large-tonnage outlets, but the hardwood charcoals, as a rule, have commanded the higher price. The present price spread might indicate the profitability of further processing of the resinous-wood charcoal, particularly with regard to briquetting and the production of a specialty product.

Byproducts from the Resinous-wood Crude-acid Fraction

Economical recovery of acetic acid and methanol is not now possible. Possibilities toward this end might be greater through integration with continuous or other modified forms of carbonization.

Chemical-wood Procurement

Some progress has been made in applying mechanization methods to chemical-wood procurement. Further studies toward more complete mechanization appear essential, as a means of making more wood readily available, and as a further means of reducing abnormally high wood costs.