Development of the Wood Rosin Industry

Address Presented Before The Third Fall Meeting of The American Oil Chemists' Society

By E. V. ROMAINE

IN ORDER that you may obtain a clearer understanding of the beginning of the wood rosin industry, permit me to present briefly the history of the gum products class (gum rosin and turpentine). The year 1606 marks the beginning of the naval stores industry in North America. The French, then located at Port Royal (Annapolis, Nova Scotia), produced some turpentine. In the United States the industry had its beginning in 1642 in the New England States, principally along the Connecticut River. Here the industry developed quite rapidly but was comparatively short lived. The yield per tree was small, due to the type of tree and the short working season, and the forest soon became depleted.

We first hear of the production of naval stores in the South (North Carolina) in 1665, but it did not become well founded until the period of 1710-1715 which marks the beginning of the industry on a commercial basis in the South. Here the industry took a new lease on life. There was apparently an unending supply of virgin timber, and the type of pine tree, the long leaf yellow pine, (*Pinus Palustris*), was rich in oleoresin, the working season was long, therefore the yield of crude gum per tree was much greater than in the North, and the cost of production was less. Consequently, the industry developed rapidly and by 1770 had practically supplanted the industry of the North. The South, therefore, became the permanent home of the naval stores industry of the United States. In 1720, the industry in the South produced 6,000 barrels of tar and pitch; by 1753, the total annual production had increased to 84,000 packages of tar, pitch and crude gum. In 1850, one hundred years later, the total production was 617,588 barrels of rosin, pitch and turpentine. During the next 50 years, 1850 to 1900, the industry experienced its most rapid growth, and in 1900 produced 620,000 bbls. (50 gals.) of turpentine and 2,065,000 bbls. (500 lbs.) of rosin, a total of 2,685,000 packages, an increase of 435%.

It was during this period, particularly the last ten years, that rosin became recognized by other industries as a very valuable raw material, and many large uses were developed, with the result that it soon advanced to a very important position, being today perhaps the most important industrial commodity of the naval stores industry. The industry, being planted and entrenched in those fertile surroundings and enjoying the prosperity justly due it, paid little heed or gave little attention to what the future held for it. It was the belief of many that these immense virgin forests would never cease to produce, and so, as many in the case of other industries whose raw materials are nature's gifts to man, this industry ruthlessly squandered its gifts. The inevitable approached. Production was increasing at a rapid rate, but increased naval stores operations, lumbering, fires, etc. took their toll and the magnificent, tall, stately pine trees, from which flowed these valuable products, so necessary for modern industries, were vanishing at an alarming rate. By 1900, or shortly thereafter, the future for the naval stores industry became somewhat problematic. At this time the Government issued several publications calling attention to the seriousness of the situation and requesting that something constructive be done for the future of naval, particularly rosin. Some people, realizing that in that vast expanse of cut-over land lay many millions of pine stumps, tops, limbs, etc., each having locked within its fibrous walls those valuable and essential products which would if permitted to remain there, be forever lost, gave their time and money to thought and experiments relative to the recovery of those products.

The first successful process developed was the "Destructive Distillation Process" in 1872. A second, known as the "Steam Distillation Process" was tried quite extensively, but did not prove to be commercially successful, due to the low yields and price of turpentine. These two processes, though they produced satisfactory products and the former proved commercially successful, came far from relieving the situation, since only the volatile products were recovered and the rosin, the most desired naval stores product, was either destroyed or left in the wood. It was evident, therefore, that a

process should be sought and developed by which the rosin as well as the volatile products could be recovered. Such a process was developed by Homer T. Yaryan, and in 1909 a plant was erected at Gulfport, Mississippi, which, in the first year of its operation produced 14,300 bbls. (500 lbs.) of wood rosin, 1,700 bbls. (50 gals.) of steam distilled turpentine and 1,700 bbls. (50 gals.) of steam distilled pine oil, a total of 17,700 packages. The Yaryan process consisted of first hogging the wood, second, steaming it to remove the volatile products, and third, extracting the rosin with a volatile solvent, which in principle is the present "Steam and Solvent Process." Since its beginning, however, many changes have taken place. The process has been developed to a very high degree of efficiency, and with these changes have come changes in the products, so that today these are of high quality indeed.

The process in general, which is under very careful chemical control, is as follows: The stump and lightwood (branches) of the long leaf yellow pine tree (*Pinus Palustris* or *Pinus Australis*) is collected and transported to the plant in various kinds of conveyances, such as wagons, auto trucks and freight cars, the latter being specially designed for the purpose. The wood, as it is received at the plants, is very carefully graded, the grades properly mixed and prepared for treatment by first hogging and then shredding into small chips.

The prepared wood, as required, is charged into the retorts where is is treated first with superheated steam and then with a solvent. As the steam passes upwards through the mass of chipped wood, it carries with it the turpentine and a certain amount of the Pine Oil. The mixed vapors as they leave the retort are condensed and led into tanks known as separating tanks where the mixed oils are separated from the water. After separation the oils are chemically treated, after which they are transferred to stills equipped with fractionating columns and separated very carefully by fractional steam distillation. The turpentine and pine oil thus obtained are analyzed to determine whether or not they conform to specifications, and if found to do so are transferred into storage tanks or directly into tank cars or drums as required.

After the chipped wood has been treated with steam for a certain length of time, or until the turpentine has all been removed, it is treated with the solvent which extracts the balance of the pine oil and the rosin. At the conclusion of this treatment the pine oil rosin solvent mixture is transferred to tanks, where it is partially refined and the wood, which is now known as spent wood, is removed from the retorts and either used as fuel or for other purposes. The partially refined mixture is transferred into stills where the solvent and pine oil are removed from the rosin and very carefully separated from one another by fractional steam distillation. Since the rosin does not distill with steam it remains in the still as a residue and its treatment from this point on depends upon the grade and brand required, that is to say, the rosin is treated according to the chemical and physical properties desired.

The present year is the twentieth anniversary of the wood rosin industry, and in this short period the annual production has increased approximately 3000%. During the season of 1928-1929, 431,654 bbls. (500 lbs.) of rosin, 77,896 bbls. (50 gals.) of turpentine and 53,542 bbls. (50 gals.) of pine oil, a total of 563,092 packages, were produced. Shortly after 1909 others entered the field, and in the season of 1913-1914, 129,168 bbls. (500 lbs.) of rosin, 19,532 bbls. (50 gals.) of turpentine and 5,836 bbls. (50 gals.) of pine oil, a total of 154,536 packages, were produced, an increase of 878%. Then followed the war period, the inflation period and the depression in 1921. During the period from 1913-1914 to 1922-1923 production varied considerably, and in 1922-1923, 166,146 bbls. (500 lbs.) of rosin, 33,743 bbls. (50 gals.) of turpentine and 18,805 bbls. (50 gals.) of pine oil, a total of 218,424 packages, were produced, which represents an increase of 141% over 1913-1914.

From 1922-1923 to 1928-1929 the production has increased at a regular rate, and in the latter year it was as previously stated, which represents a percentage increase of 246%, and in rosin was equal to about 19% of the total rosin, (wood and gum) or about 23% of the gum rosin produced in the same year. Until 1928 only one color grade, "FF" of wood rosin was produced, but in the early part of that year "I" grade became a reality, and in the early part of 1929 paler grades than "I" were being produced. From this date it is evident that the wood rosin industry has enjoyed a rapid but healthy growth, that its principles and purposes are sound and logical and that its products are considered and accepted by the consuming industries today as desirable and standard commodities.

Throughout the development and growth of the Industry many problems were encountered and many achievements accomplished. Certainly no more conclusive proof could be desired to show the successful solution of the problems than is evidenced by the statistical information just quoted, for an industry can

(*Turn to p. 29*)

Nutrition and Mayonnaise

(*From p.* 13)

A deficiency of vitamin A manifests itself by a disease of the eye called ophthalmia, and changes in the mucous membranes of the respiratory and urinary tracts. Infections of the respiratory tract and ear are common when vitamin A is lacking. Beri beri, a disease characterized largely by a degeneration of the nervous system, results from a lack of vitamin B. In scurvy, which is caused by insufficient vitamin C, the bones become brittle, the joints and gums sore and swollen, the teeth loose, and there is evidence of the rupture of small blood vessels usually localized in certain areas. In the absence of vitamin D calcium and phosphorus are not properly utilized and in the young child rickets will develop. Deficiency of vitamin G leads to pellagra, a disease which is prevalent in the Southern States.

Let us now consider what mayonnaise contributes toward furnishing the essentials of a diet which have been mentioned. Analyses show that commercial mayonnaise contains approximately 77 to 83 per cent of vegetable oil, 7 to 11 per cent of commercial egg yolk, from 0.3 to 0.5 per cent of acetic or other organic acid, a small amount of condiments, and water. The vegetable oil can be utilized almost completely as a source of energy. Experiments have shown that approximately 98 per cent of vegetable oils of the type used in mayonnaise are digestible. The egg yolk is a satisfactory source of four of the vitamins, A, B, D, and G. In fact, the egg stands out as an important source of vitamin D among the foods which are extensively eaten. The protein of egg yolk contains all the amino acids known to be necessary for body protein formation. Egg yolk is a good source of mineral elements, being particularly rich in the elements iron and phosphorus, which may be low in the average diet. The relative distribution of the other mineral elements in egg yolk is not much different from their distribution in milk. Fat and fatlike materials which yield energy are important constituents of egg yolk. The acetic acid or other organic acid in mayonnaise will yield some energy, but the amount is negligible. The condiments are used to increase palatability.

There has been a growing tendency of recent years to emphasize far beyond justification the nutritive value of this or that food or food product because it contains one or more of the essential components of a complete diet. It is quite probable that any one of these products could be removed from our reach entirely without noticeably affecting the health of the nation. The American people who consume mayonnaise are eating about as satisfactory a diet as they can be induced to consume. That the American will not make his diet an ideal one is well exemplified by the extensive use of many substances of little or no nutritive value. It can truthfully be said that mayonnaise is in part responsible for making the diet of a great many people approach the ideal. Although we may maintain health with little or no milk, green, leafy vegetables or fruit, the probabilities are that our diets will be much more adequate if these foods are included, and there is no denying that a salad dressing, such as mayonnaise, increases the quantity of green, leafy vegetables and fruits consumed. The enhanced palatability and attractiveness of a lettuce or tomato salad with a "dab" of mayonnaise leads to a greater consumption of such raw foods. Green, leafy foods have been classed with the so-called protective foods in that they supply some dietary essentials which are frequently lacking in our food. Calcium is one of the mineral elements which is frequently low in the diet, particularly if milk and dairy products are used only in limited amounts. The green, leafy foods help to make up the deficiency. The indigestible residue or roughage in leafy vegetables is particularly desirable when a large part of the diet consists of concentrated foods. Raw foods can also be depended upon to furnish vitamin C in greater amounts than foods subjected to cooking. The selection of a salad at a cafeteria or the desire to eat one at home is largely dependent on its appearance which is made more attractive by a suitable dressing.

Food Appeal

THERE is another aspect in the use of mayonnaise which is not so readily defined or described, and that is with reference to appetite and digestion. A healthy man whose occupation calls for tremendous physical exertion can consume a very large meal amid surroundings that would be repulsive to many of us, and yet he enjoys his food to the utmost. He is accustomed to such surroundings, and his appetite is so great that it is not dependent on the appearance of food. On the other hand the sedentary worker, whose exertions are largely confined to that part of the body above the shoulders, does not have a desire or need for large quantities of food Many of these people have become accustomed to associate palatable meals with pleasant surroundings and the attractive appearance of

(*Turn to p.* 33)

(8) Any comments which we might make on your paragraph *"Caution"* would involve needless repetition of comments already made above.

4. We now return to the specific questions in your letter of October 1, 1929:

(1) The instrument mentioned in the last paragraph on p. 27, No. 9, Vol. VI of *"Oil and Fat Industries,"* about which you inquire consists essentially of:

(a) A Martens photometer, used as a convenient means of bringing the oil color and the color of the glasses into immediate juxtaposition to facilitate their comparison, and as a means of equating the brilliance of the two, and (if desired) as a means of measuring the white light transmission of the oil relative to that of the glasses.

(b) A series of wheels carrying red and yellow glasses arranged so that, by merely turning the wheels, any combination of glasses required to match the oil may be brought into the field of view. (This, of course, is a mere matter of mechanical convenience in selecting the proper combination of glasses to match the oil. It would save a great deal of time in the handling of glasses and would, to a considerable degree, prevent their becoming soiled, scratched, and broken by accident.)

(c) A suitable tank and support for holding the oil sample.

(d) Two gas-filled tungsten lamps to provide light.

(e) A white lined housing for the lamps.

(f) An optical train which receives light from the interior white wall of the lamp housing and passes it through the oil and the glasses, so that light from the same source illuminates the two halves of the photometer field, that which illuminates one half having passed through the oil while that which illuminates the other half has passed through the glasses.

(g) A Davis-Gibson filter (Cf. [1] Proceedings of the Seventh International Congress, held in London, July, 1928, pp. 161-173; [2] B. S. Tech. News Bulletin No. 138, pp. 143-144, October, 1928; and (3) J. O. S. A. & R. S. I., *16*, p. 332; May, 1918. Copies enclosed.) designed to convert the light from the lamps into artificial daylight of prescribed quality (spectral distribution).

This instrument has not been used except in our preliminary experiments with it. Only one model has been completed; and we are not in position to send you one.

(2) We have done considerable work on the calibration of the glasses which you sent us; but cannot set a definite date for their return. The red glasses have been compared with our red standards by one observer. We intend to have them compared independently by one or two other observers. Spectral transmission measurements have been made on all of the yellow glasses and 18 red glasses; but these data are not final. We would remind you that we only offered to calibrate twenty *red* glasses for you free of charge (paragraph 7, our letter of January 5, 1928). We find that you have sent us 35 red glasses, 30 yellow glasses and 29 blue glasses. We are expediting the calibration of the red glasses. We have never standardized blue glasses because there has been little or no call for us to do so. Since American interests do not demand it of us, it now seems unlikely that we shall undertake to complete a fundamental standardization of the blue glasses. There would seem to be little or no excuse for our doing so except on your request; and we infer from your several letters that you would deprecate and discourage such standardization rather than request it.

(3) In comment upon your statement, "We would appreciate communications concerning our glasses being sent to us direct rather than seeing them by chance in the press," we submit the following statement:

We have taken care to send you our publications, and trust that you have received them, although they have not always been acknowledged by you. The article to which you now refer (*"Oil and Fat Industries"* p. 27, September, 1929) was not an official publication and we had no convenient means of sending it to you. It was not published on our initiative. The material therein was merely sent to Mr. Putland, President of the American Oil Chemists' Society, as a summary of our findings on 1000 glasses which he had submitted for calibration, these glasses being the property of individual members of the society. Mr. Putland evidently thought (quite properly, we believe) that this summary would be of sufficient interest to the members to justify publication in their journal. We are now preparing the same material for official publication with a more detailed treatment of it; but as to the present publication, we obtained our first knowledge of it in the same manner in which you did, namely by seeing it in print when the journal came in our mail. We never had any extra copies of this publication, and so have not been in position to send you one.

Respectfully,
(Signed) L. J. Briggs, Acting Director,
George K. Burgess, Director.

Enclosures:
Davis & Gibson: "Artificial Sunlight . . . ", 7th Intern. Con. of Phot. Davis & Gibson: JOSA & RSI, *16*, p. 332; May 1928. T. N. B., October, 1928.

Wood Rosin

(*From p. 22*)

only grow through the profitable sales of its products. Among the achievements, the most notable is the production of an oil soluble rosin and the medium and pale grades. Included in the many factors contributing to the successful solution of the problems, particularly those involving some of the physical and chemical properties, there is one which I consider, and I believe I express the consensus of opinion of those in our Industry, has lent invaluable assistance, and that factor is the consumer, for with his close cooperation we have been permitted to enter his plants and make a thorough study of our products under actual operating conditions. In this way, we could correctly determine which property or properties were necessary for his particular conditions, and with this authentic data our Research Department could formulate a logical plan to attack the problem. As a result, we have not only been able to raise the grades of our regular products to their present high standards, but have developed special products for special uses. Through cooperative efforts both the consumer and producer share a mutual benefit and now that pale wood rosins are a reality, may your industry and the wood rosin industry join in this cooperative spirit.

Reminiscences

(*From p. 12*)

in presses such as were used for making lard oil. At the plant of the American Cotton Oil Company in Cincinnati the winter oil plant consisted of the cellars of an old wine house.

The last paragraph of the report is worthy of note. It reads as follows:

"Your committee desires to add to the above report that we find at all points of our investigation we have been continually confronted with questions requiring for their solution, careful and scientific study. In order to obtain such definite information as is necessary to carry the manufacture of the various products of the cottonseed to its highest perfection, the committee advises the establishment of a Chemical Bureau, which will be competent to cope with the many problems continually being presented."

One of the results of this report was the establishment of a laboratory at the N. K. Fairbank Company plant in Chicago.

The writer received samples of cake, meal, meats and oil from all the plants of the Cotton Oil Trust. Many of the meal samples ran as high as 18 or 20% oil. The meals ran pretty high in ammonia, as the art of incorporating the hulls had not been invented. The only test given to the hulls was the inspection for free meats. The oils were tested for free fatty acids and refining tests were made. A complaint was made to the general manager about the large amount of free fatty acid found in the oil from a certain mill. The manager replied that he had never had any free fatty acid on the place and it could not have been in his oil.

In about 1893, Henry Eckstein found out, in England, that blowing steam through refined oil would remove its odor. In conjunction with James Boyce of the N. K. Fairbank Company and with the help of the engineering department of the same company, apparatus was evolved for heating the oil very hot by means of closed steam coils and blowing the steam through the hot oil, which was afterwards cooled. The work was carried on under atmospheric pressure and was known as the Eckstein process. In 1900, the writer found that he could improve on the Eckstein process by conducting the deodorization of oil in vacuum. This was a marked improvement over the Eckstein process, and forms the basis of modern practice, each refiner working in his own manner. In addition to the use of the vacuum, various important refinements and secret details have made the so-called Wesson process maintain its pre-eminent position. In about 1908, the process of hydrogenation appeared, and what has happened since is so familiar to my readers and so recent, that it can hardly be considered historical.

Nutrition and Mayonnaise

(*From p. 23*)

The appetizing refinements in the preparation, serving and appearance of food to which many have become accustomed have developed a need for them, and they determine to a large extent the desire for food and the feeling of satisfaction that results from a meal that is relished. Has not the succulent green lettuce and bright red sliced tomato salad with its billowy puff of mayonnaise contributed to the value and pleasure of a meal and thereby established for mayonnaise a position both useful and delectable?

Mayonnaise is one of our most concentrated foods, in that it consists largely of vegetable oils and protein that are almost completely assimilated. It furnishes vitamins and minerals. What is more important is that mayonnaise encourages the consumption of those essentials in which it as well as other foods we eat may be deficient. That mayonnaise has established for itself an important position in the American dietary is shown by the size and prominence of your Association, and it will maintain and improve that position if your organization will keep abreast of the developments in our energetic nation.