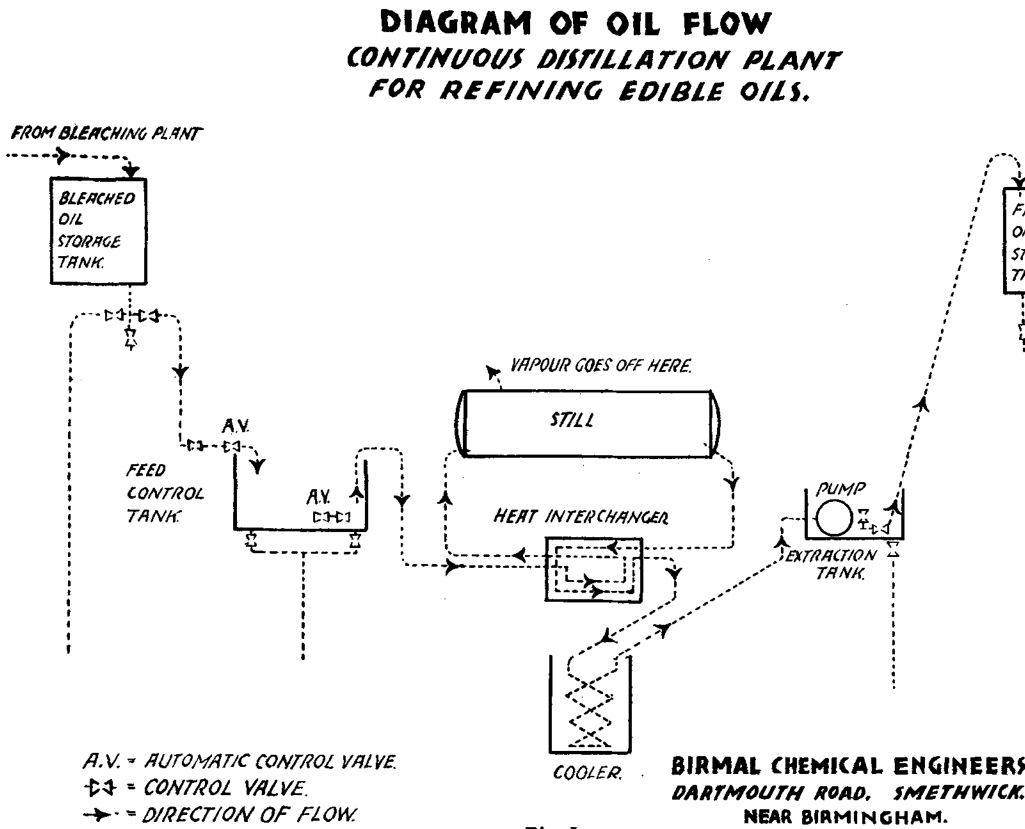


Fig. I

A Method for Refining and Deodorizing Oils

By V. CONQUEST
Armour & Company

THE discovery of the fact that natural fats and oils are composed of at least two components, one of which is a fatty acid, is generally credited to Chevreul in 1813. The years immediately following this discovery were remarkable for the large amount of research conducted to find means of producing a high quality of refined oils. A glance through the older literature on the subject of refining of oils shows that countless methods were devised by technologists and a great number of them were patented. Many of these older methods were entirely unsuited for the production of high quality edible oils and many were too costly.

Some of the earlier methods depended upon the use of sulphuric acid, either alone or in combination with various other reagents. Typical of this class we might mention Cogan's, Twistleton-Hall's, Puscher's, Thenard's, and Brunner's process.[1] Some of the other methods which were tried depended upon the use of ammonium hydroxide; lime water; zinc chloride; or tannin.[1] At one time an electrolytic method was tried in which the oil was mixed with a salt solution. Various mechanical devices were developed for mixing fats and oils with the refining agent and also for separating emulsions and foots formed during the process.

For edible purposes it has been found necessary to further process refined oils to give them a suitable flavor. Deodorizing methods also passed through their period of development, be-

[1]Andés, Louis E., "Vegetable Fats and Oils," Third Edition, Chapters X, XI, Scott, Greenwood.

ginning with the use of heat and saturated steam at atmospheric pressure and leading up to the processes as we know them at the present time in which a combination of superheated steam, high temperatures, and high vacuum is used.

The desire to conduct operations of all sorts in a continuous process is one of the developments of the modern industrial age. Continuous refining of oils has received its share of development work while much work has been done to devise a continuous method for deodorizing. Practically all of the methods tried for making refining and deodorizing continuous were unworkable either due to technical difficulties or to costly operation. In comparatively recent years, oil technologists have devoted themselves to combining the operation of removing free fatty acids from natural fats and oils and simultaneously deodorizing them. Increased knowledge of physical and chemical properties of fats and oils and contemporaneous development of engineering equipment aided in the successful development of the continuous process for refining and deodorizing oils.

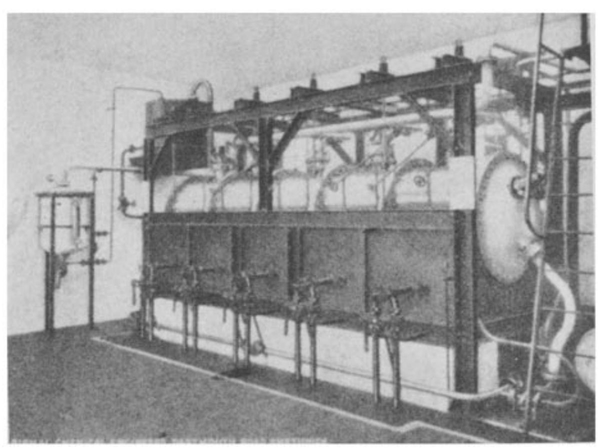
One of these continuous methods for refining and deodorizing has been in operation for several years on a limited variety of oils, chiefly olive oil. This plant is of vertical construction with superheated steam running countercurrent to the oil in process.

The equipment and process which is about to be described has been in successful operation for about eight years. It is the result of the combined efforts of chemical and engineering research. This process renders obsolete all the caustic refining tanks formerly used and the expense of chemicals, and eliminates loss of oil as soap and as free oil mixed with soap stock.

The equipment consists essentially of a horizontal cylinder directly heated from below by series of gas or oil burners. The success of the use of direct heat is due largely to the fact that a suitable aluminum alloy has been developed which prevents localized overheating and distributes the heat evenly to the oil in process. The horizontal cylinder is divided into at least five sections, each of which acts as an individual deodorizer. Here again engineering ingenuity has devised the aluminum alloy with a sufficiently low coefficient of expansion so that no trouble with loosening or leaking is experienced at the connecting joints. Each of the sections is connected to a common header which in turn leads to the vacuum equipment through a pair of distillate receivers and emulsion separators used alternately as needed. Each of the sections of the deodorizer is fitted with outlets for introducing steam into the oil. No special superheating equipment is required, but the exhaust gases from the flue are utilized to give the incoming steam a small amount of superheat.

The oil to be treated by this process is first bleached. The bleaching process is determined by the quality of the oil and may consist in the ordinary treatment with fuller's earth or may demand a treatment with highly activated earth and carbon or the use of small amounts of sulphuric acid. Oils that have been hydrogenated ordinarily are light enough in color so that additional bleaching is unnecessary. The oil is fed continuously to a feed control tank which is so arranged that a constant predetermined flow of oil is maintained to the equipment. The feed control tank is equipped with an automatic device which controls the rate of feed and indicates improper functioning. From the feed control tank the oil passes through a heat interchanger where it absorbs part of the heat from the finished oil and then it is lead to the still or deodorizer.

Upon passing from the still or deodorizer the oil flows through the heat interchanger, then



A typical unit illustrating the continuous distillation type of plant

through a water cooled coil, and then it is pumped to the finished oil storage. The still or deodorizer operator makes periodic examinations of the finished oil for free fatty acid content and flavor, and adjusts the operation of the still or deodorizer to produce oil of the desired quality. Ordinarily the finished product contains under .05 of 1 per cent free fatty acids and a suitable flavor for the purpose intended. Line pressure steam, which may be as low as twenty pounds gauge, passes through the superheater in the waste gas flue and then into the header which supplies the individual sections of the still or deodorizer with the required amount of steam. The mixture of steam and volatilized free fatty acids passes through the vapor pipes into a condenser and thence into the distillate receiver. In the distillate receiver most of the water separates and may be drawn off from under the fatty acid layer.

The usual fatty acids recovered are very white and are suitable for soap making without further treatment. However, with certain highly colored oils, and in cases where refractory emulsions are formed, a lead-lined acid treatment tank is provided to make the necessary treatment. A wet vacuum pump provides the vacuum, the exhaust of which passes through a separator for further collection of small amounts of entrained fatty acids.

If production demands, this unit may be operated continuously for periods of several months without shutting down for cleaning up. There are very few movable parts so that repairs are very infrequent. A few figures on the cost of operating this equipment will be of interest.

1. *Capacity.* Palm kernel, cocoanut, 2,800 lbs. to 3,360 lbs. per hour.

   Peanut, corn, and other soft oils, 2,000 lbs. to 2,500 lbs. per hour.

   Deodorizing only; 2,800 lbs. per hour.
2. *Steam.* 400 lbs. per hour or at the rate of 2,800 lbs. per hour, 320 lbs. of steam a ton.
3. *Gas.* 160 lbs. of coke per hour.

   130 lbs. of coke per ton of oil, or 10,000

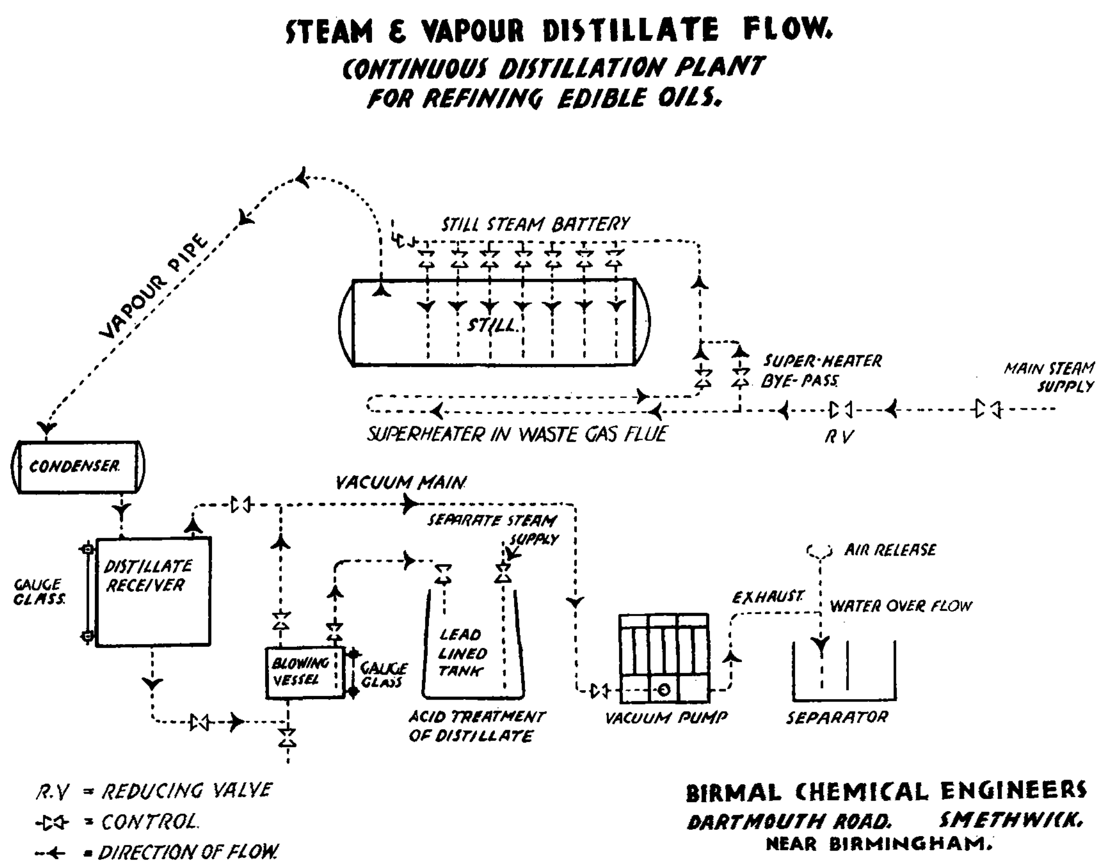


Fig. 11

cu. ft. of gas per hour, or at the rate of 2,800 lbs. per hour, 9,000 cu. ft. per ton.

4. *Power.* 8 k.w. per 2,250 lbs. or 11 k.w. per hour at 2,800 lbs. of oil.

   When two or more units are operating, the power consumption is reduced to 6.5 k.w. per ton of oil.

5. *Water.* 3,000 to 4,000 gallons per hour. 2,400 to 3,200 gallons per 2,240 lbs.

6. *Labor.* Two men can attend as many as four units without any difficulty since the whole operation is practically automatic. The operators must be able to judge the flavor of the oil produced, take temperature readings regularly, and make free fatty acid determinations.

7. *Yield.* In refining, only the actual weight of the free fatty acid removed is lost. The distillate contains 95 per cent free fatty acid. The process eliminates black oil since the distilled fatty acid is water-white. There is no caustic used, consequently no loss of oil in foots.

The oils which are very satisfactorily refined and deodorized by this plant are: palm kernel, cocoanut, soya bean, olive, palm, peanut, and tea seed. The success attained in refining and deodorizing cottonseed oil, corn oil, and tallows has been variable. Difficulties encountered in treating these oils have been due to inability to bleach the oils sufficiently before subjecting to the process, and inability to completely remove albuminous and other colloidal materials which interfere with the production of a highly satisfactory oil. As a continuous deodorizer, however, this plant will satisfactorily handle oils from practically any source.

Summary

Equipment and process for the continuous and simultaneous refining and deodorizing of oils has been described. Ease of operation and low operating cost indicate that this method should find more and more use in the preparation of edible oils and fats.

More work is necessary before the process can be applied in its entirety to certain fats, but these difficulties are technical rather than basic.

As a continuous deodorizer, the equipment described furnishes the best known method in use and brings fat and oil technologists a workable method which has been long desired.

Permission to describe this method was courteously granted by Mr. W. B. Allbright, Sr., of the Allbright-Nell Company, the American agent for the equipment.

Smalley Foundation Committee Reports

A. W. PUTLAND, *Chairman*

THE tables attached to this report summarize the results of the cooperative analytical program of the Smalley Foundation for the past year. The program was concluded, as usual, with thirty samples. There were 80 collaborators participating, as compared to 99 for the season 1930-1931, and 96 for the season 1929-1930.

In Table No. 1 we show the standing of the 50 collaborators who reported oil determinations on all samples. In the two preceding years 45 reported oil determination on all the samples.

Table No. 2 shows the standing of the 62 collaborators who reported ammonia results on all samples. This number compares with 71 and 75, respectively, for the two preceding seasons.

Table No. 3 gives the average for both oil and ammonia for the 50 collaborators who reported on both oil and ammonia on all samples. In the two preceding seasons 45 collaborators reported oil and ammonia on all samples.

The winning collaborators are as follows:

The Battle Cup for the highest efficiency in the determination of both oil and ammonia on all samples is awarded to Analyst No. 18, Mr. I. N. Pless, Royal Stafolife Mills, Memphis, Tenn., whose average is 99.896 per cent. The average efficiency is slightly higher than that of last year obtained by Dr. W. F. Hand with an average efficiency of 99.889 per cent. The