Extraction Experiences in Foreign Lands

By BRUNO HASSEL

THE exceedingly favorable economic conditions which prevailed in the U. S. until recent years have undoubtedly exerted anything but a favorable influence upon economical management in the Oil and Fat Industries. In Europe, on the other hand, and particularly in Germany, the distress caused by the war and post war period has compelled men to devise working methods which, in addition to a full yield, will insure the highest possible quality. Since the great losses and high operating costs of hydraulic pressing plants for oil and fat production could no longer be met, it became necessary to perfect as far as this was possible the extraction process. The tests and experiences extending over many years have brought some very favorable results.

The economic conditions in this country, once the war period and attending conditions over, have become normal again; i.e., supply and demand pretty well balance each other, and the shortage in goods has gradually been followed by large production and stocks of goods. There is no question but that consequent competition has become very keen and that many producers are compelled to keep their production costs at the lowest level. For these reasons the oil and fat producing industry has in an increasing measure paid attention to the extraction system, even though in this country manufacturers are rather sceptical in this respect; for the reason that those extraction systems used here were largely rather defective and frequently led to explosions and conflagrations, and also because the products obtained were not of desirable quality.

As already mentioned, the necessity caused by the war and post-war period has compelled us, particularly in Germany, to bring the extraction system to a certain stage of perfection. The results obtained thereby may be designated as being very good, and have proven the absolute superiority of the extraction over the pressing system. Nobody will expect, of course, that a complete change is to take place from today to tomorrow; but this much is certain, that the Extraction System is slowly

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but surely making its way and will gradually displace the pressing system. Prejudice and established customs which always have been an obstacle in the way of progress, because based upon non-experience or one-sided experience only, are also in the way of the development and recognition of the Extraction System in the U. S. These remarks are to contribute to the elimination of both of these factors, for my statements are based upon experiences which I have acquired in many countries.

(2) Nature of the raw materials and of the products obtained.

(3) Cost of installation and of operation.

So far as oil yield is concerned, I only need to call attention to the fact that pressed oil cake always contains 8-10 per cent oil, even though the most modern presses be used. This percentage of oil, however, is in most cases much greater. The extracted materials, however, are degreased to plus or minus 1 per cent. The following figures speak for themselves:

	Press System	Extraction System
Oil yield of the seed	34%	39.4%
Oil yield as relates to oil content	85%	98.5%
Oil loss as related to oil content	15%	1.5%

The oil industry introduced the Extraction System in 1856, and since about 1885 the large plants have used it. Developments were insignificant, however, until 1914, as the systems existing were not adequate. Only after the construction of the first efficient rotating extraction apparatus in 1912 did a great change take place, and aided by the requirements caused by the World War, the extraction problem has been solved technically, principally in Germany.

Extraction by means of solvents makes it possible to work all materials containing oil, fat, resin, wax and paraffin; whereas the use of the pressing system is depending upon the nature of the raw materials, and is therefore limited. In order to make a comparison between production of oil by the press and the extraction system, the following points must be taken into consideration:

(1) Yield in oil.

Rapeseed, with a 40 per cent oil content, has been taken as example: The lower the oil content of the seed, the higher is the percentage of loss. With soya beans, for instance, the loss runs to 45 per cent.

The pressing system requires a far more intensive pre-cleaning and trituration of the oil seed. Some important raw materials such as wool, fuller's earth containing oil, used catalyzers, bones and also damaged oil seeds could not be worked by this system. Oils extracted with benzine are purer and of a much better keeping quality than warm pressed oils. They contain less slime, albumin and coloring matter, are mostly free from resins, therefore lighter and cleaner; also their content of fatty acids is lower, so that their refining is less costly and more easily managed.

The residues from extracted material, which are principally placed on the market as feed stuff, are

more tasty and easier to digest than pressed cake. As feed stuff, they are not inferior to press cake, since the animal organism does not digest more than 20-25 per cent of the oil contained in the press cake; but they do, in view of the lower oil content of the extraction flour, contain more protein, which is much more important in the feeding of animals. Experiences extending over many years in Europe, have proven that extraction flour is much superior to press cake as a feed stuff, and the generally very conservative farmer has also recognized this advantage and now prefers to buy extracted feed stuffs; i.e., such with low oil content. Due to its relatively high oil content, press cake soon gets rancid, since through oxidation fatty acids will form, through which the cake acquires a bad taste, and being acid has an unfavorable influence upon the animal organism. Extracted feed flour can not become rancid, since it contains practically no oil, can be stored for long periods, and is always fresh and tasty. Also, it is in shape to serve as feed, whereas press cake has first to be broken up and ground.

There is also an economy in the cost of the extraction plants, since in the pressing system a greater number of heavy and costly presses, costly power stations, large heat transmission and transport equipment are required, which necessitate considerably more labor, space and heavier foundations than is the case with an extraction plant of the same capacity. In the latter the consumption of steam, power and cooling water, in addition to the labor required and the losses in solvents, are the principal operating costs. How small they are as compared with those in a pressing plant may be seen from the fact that a modern extraction plant of 40-50 tons capacity in 24 hours requires only three operators per shift. The operating costs in a modern extraction plant, for 1000 kilos raw material, consist of 1000-1200 kilos steam consumption, 10-12 cubic meters cooling water consumption, 8-10 H.P. hours power consumption and 8-10 kilos loss of solvents.

Experience has shown us in Europe that oils and fats extracted with benzine are the purest and bring highest prices. Other solvents, such as di- and trichlorethylene have not been able to maintain themselves, since they dissolve practically all matters containing slime, colors, albumin and resin and yield dark oils and fats, containing many impurities. In spite of the absence of danger of fire and explosion in these solvents, benzine has for the reasons named been given preference almost exclusively as a solvent, all the more so since it has been possible to devise a recuperating system which precludes almost completely all danger of fire and explosion. I wish to mention also that in the use of modern extraction methods all oil and residue are completely free from any smell or taste of the solvent employed.

In recent years a great many extraction systems have appeared on the market and it is difficult to draw a line as to the efficiency and economical operation of every one of them. As I have frequently had occasion to test the various systems as to their efficiency and economy, I am probably in a position to give a well rounded out opinion. There are but few specialists in this line who have had the opportunity to

become familiar in a practical way with the various types of extraction plants and the extraction of the very great variety of raw materials. Each will judge on the basis of the experience which he has had with the system he is operating and which he knows how to handle. It is evident from this that there is often a certain prejudice against those systems with which one is not familiar, and one is apt to judge them exactly as those with which one has had bad experiences. No one knows better than I do that the oil producer is perfectly right in having a certain amount of distrust, as many extraction plants are put in which in no way justify the expectations that were promised for them. The few firms who furnish good, modern extraction plants, and which meet all requirements, are hard put to it, since they naturally can not furnish as cheaply as those firms which in spite of great promises turn out a deficient product. And those who know something about the extraction business can only shake their heads when they see what is still being offered today to the oil and fat industry, by certain manufacturers, in the way of antiquated and defective extraction apparatus.

The modern horizontal or vertical extraction plant, with or without agitating device, whose application is limited to the extraction of oil seed, is by far surpassed by the rotary extraction plant. For a number of reasons this system has proven to be the best over a number of years of practical application. The rotary plant in its construction is well thought out, comprehensive, simple and of easy operation. Its advantages as compared with the others consist in smaller steam, cooling water and solvent consumption, though power consumed is about the same. These advantages are due to the fact that in horizontal or vertical apparatus great quantities of direct steam are required to separate the solvent from the residue, whereas in the rotary apparatus the solvent is separated under vacuum while being heated externally. Direct steam is only required for a few minutes in order to eliminate the last traces of the solvent from the residue. This permits the extracted feed flour to come out of the apparatus thoroughly dried, as required by the trade, of light color and with a high protein content; whereas the flour which leaves other apparatus contains at least 25-30 per cent water and has to be dried in special apparatus. Being in contact so long with direct steam, and on account of this subsequent drying process, the protein content is reduced and the color and taste are impaired, so that the flour is inferior to that produced in rotary apparatus. Every specialist in this line knows that material with more than 10 per cent water content is difficult to extract, as it quickly becomes pasty and the oil can not be eliminated completely. Such materials must therefore be submitted to a drying process, and in connection with horizontal or vertical extraction apparatus there is required for this a separate drying plant; whereas the rotary plant is so constructed that drying, extraction and subsequent drying are all attended to in the plant in one operation. The use of vacuum and jacket steam and the continuous movement of the material prevent all overheating, and the feed flour obtained is of proper color and a good taste. Another advantage is that the solvent mixture can be

drawn from the extractor under vacuum; whereas in the vertical plants special pumps are required for this purpose. The emptying of the rotary extractor is automatic and requires a few minutes; whereas the agitating apparatus in the other plants eliminates only a part of the residue and the rest must be scraped out by hand. Due to this and the presence of benzine vapors an occasional spark has led to many an explosion. If through any circumstance or other, trouble is caused with a certain batch of material, the solvent can in that event be eliminated completely from the rotary apparatus under all conditions, before it is opened or emptied, but this is more or less impossible in other systems.

As already stated, the field of operation in the horizontal or vertical extraction plants with or without agitating apparatus is very limited, whereas the rotary apparatus handles, in addition to oil seeds, all other materials, such as fish, oil-containing Fuller's earth, slaughter-house and meat refuse, bones, wool, leather refuse, paraffin refuse, etc. It is especially suitable for wet materials, as there is no need to install costly drying plants.

In this enumeration of facts I believe there has been demonstrated the superiority of the rotary extraction system over the other systems. There are, of course, various types of rotary systems.

The purpose of my dissertation is in the first place to demonstrate the superiority of the extraction over the pressing system; since before long the question will become vital in the United States for the entire industry producing oils and fats as to how to increase production and lower production costs. Every expert is agreed that this can only be done through the extraction system. Another purpose I have had in view is to facilitate for you the choice between the various systems, based on my experience and practical operation extending over many years. In my own experience I have always come back to one type of system, as by its use I was always able to secure the best results.

I have therefore considered it my duty to call your attention to this system by pointing out its great superiority over all other systems, since it unites in itself all the advantages which we expect of a modern extraction plant: reduced consumption of steam, water, power and solvents; increased output of high grade products, free from all smell or taste of the solvent mediums; and is a well thought out, comprehensive construction with limited personnel requirement and elimination of all danger of fire or explosion.
