Some Solvent Extraction Experiences

By David Wesson

During a period of fifty years, the question of solvent extraction of cottonseed has frequently come to the writer's attention. At first blush this appeared simple and better than the present crushing methods, which call for the use of heavy machinery, much power, steam and labor, to say nothing about the loss of between fifty and sixty pounds of crude oil per ton of seed in the cake; to say nothing about the conversion of valuable protein into cattle food or fertilizer.

From a chemical standpoint the proposition looks easy. There is no question but the oil can be removed from the cottonseed meats by solvents which can afterwards be removed from the oil and meal and good products will result.

Probably my first experience with cottonseed was in the early days of the American Cotton Oil Trust, when samples of crude and refined oil were sent to me for examination and report. This was in 1889. A carload of separated meats had been sent to the Evans Process Works, located somewhere in nothern Indiana. This plant was in successful operation on linseed and the American Cotton Oil Trust wanted to try out the experiment on cottonseed. The oil, as shown by the sample sent me, contained about one per cent of benzine, was very poor in color and totally unfit for edible purposes. Doubtless the meats were injured by exposure to the air during transportation, and possibly the crude oil was overheated in the extraction process. I never saw the figures showing efficiency of the work done nor samples of the meal which was said to be fit only for fertilizer. The only practical result of the experiment was the condemnation of solvent extraction as a means of producing cottonseed oil.

Judging from the grease samples received from time to time, solvent extraction plants were used in the fertilizer business for extracting bones and garbage. About 1900 a plant was set up by Worth, of Wilmington, to operate on cottonseed. A sample of crude oil from the plant showed that it had been badly scorched and was unfit for refining purposes. The process proved a failure.

Somewhere between 1905 and 1910 several tons of cracked cake were sent to a garbage extracting plant in Bridgeport, Conn., where close count was kept on the results of an experiment. The oil was fully extracted from the cracked cake and a very dark meal free from solvent odor was obtained. This was fed to cattle without any adverse criticism from the cows. The oil was disposed of to a steel spring manufacturer for tempering purposes. Enough money was received for this oil to pay for the experiment. At this particular time, oil was worth real money.

During the World's War an extraction plant worked successfully on cracked cake. The very dark oil obtained was quite marketable at a high price, while the high protein meal made from the residue, brought a good price for fertilizer. The plant had been designed for extracting garbage and was unsuitable for extracting cottonseed meats for food purposes.

On account of improper separation of the hulls and allowing the oil to oxidize in the meats with the formation of fatty acids, a pretty general opinion has prevailed that cottonseed meats can not be treated by solvent extraction.

Toward the close of the World's War, some experiments made in the writer's laboratory showed it was possible by solvent extraction, to obtain a crude oil which could be refined and bleached to a better color than that obtained in the press room from the same seed. On account of the high protein value of the residue it occurred to the writer that all attempts to use cottonseed meal as a flour were incorrect, that the extracted cottonseed meats were really a meat substitute instead of a flour substitute. Only the addition of water and refined cottonseed oil or vegetable shortening were needed to obtain the same composition as meat. Researches made in various laboratories had already shown the high biologic value of the cottonseed protein. To carry out this idea, on a practical basis, a ton of cottonseed meats was packed in hackney drums. Enough benzol was added to expel the air from the interstices, and the meats were shipped from South Carolina to New Jersey, where they were tried in a semi-commercial solvent extraction plant, handling batches of 500 pounds each. The resultant oil was refined with a very reasonable loss, and bleached to a better color than that obtained from some of the same seed worked in the regular way in the mill. The meal on account of the remaining hulls had a slight hully flavor, as the result of grinding. This meal was mixed with vegetable shortening and water, as indicated above, and after preparation in different ways, was used as a dietetic experiment on a good many people; many of them the writer's friends, who pronounced the products excellent, and they still remain his friends.

In an attempt to put the process into large scale production, various plants and processes were studied and looked into. Various difficulties were encountered. First, cottonseed meats absorb large amounts of solvent and form a pasty mass which does not separate readily. This means large amounts of solvent have to be removed from the meal after extraction and this requires an excessive amount of steam and the application of sufficient heat to injure the protein. Another difficulty encountered was that of handling sufficiently large quantities of cottonseed in any practical extraction plant available. All sorts of claims, of course, were made by the manufacturers of different plants. One which seemed to be quite promising was a continuous apparatus, apparently requiring little labor and not much power. The inventor of this process, in a well written prospectus, made the claim based on the relative percentage of protein in the meats and that in the meal, that more protein was obtained per ton of seed by solvent extraction than was possible by press work.

In conclusion, as the result of the writer's experience and observations, the fact seems to be well established regarding the use of volatile solvents for extracting cottonseed, that with a properly arranged and constructed plant, solvent extraction should in the not too distant future, be not only a possibility but should come into practical use, and it is only a question of time before someone will work out the proper apparatus which will make the present method of pressing seem obsolete.

May 4, 1933.