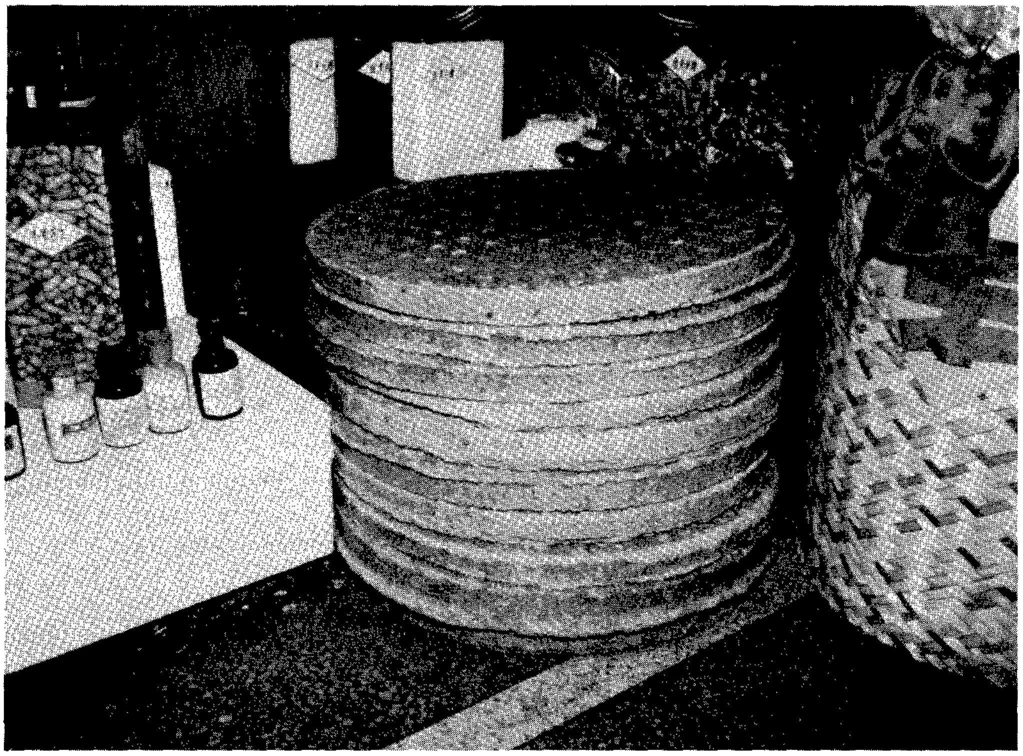
Fats and oils in the People's Republic of China



Oilseed meal cakes from presses at the People's Republic of China are stacked to await further processing.

When several fats and oils researchers from the People's Republic of China attended the 1980 ISF/AOCS World Congress in New York, it was the first time in many years that speakers from mainland China had participated in AOCS meetings.

China is the origin of soybeans—and thus much of the current fats and oils industry can trace its roots to mainland China. But, it has been many years since AOCS members have had a chance to hear reports at our national meetings on what was happening in fats and oils research on the mainland.

With the cooperation of Dr. Stephen S. Chang, program chairman for the ISF/AOCS meeting, *JAOCS* has received four papers by Chinese speakers. We think *JAOCS* readers who were unable to attend the meeting will find the reports interesting.

The papers provide a glimpse at how China is modernizing its solvent extraction industry, how soybeans are used for human food, how researchers are seeking improved cottonseed extraction to produce better quality oil and meal, and the status of the soap and detergent industry.

The Technical Developments of the Oil Solvent Extraction Industry in China

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ABSTRACT

The development of the oil solvent extraction industry in China is described. The first continuous oil solvent extraction plant (modeled on a Rotocel extractor) was built in 1955. Since then, other types of extractors have been installed and processes such as the desolventizing of extracted meal, the evaporation of miscella and the recovery of solvent vapor have been adopted. This essay documents improvements in technology and machinery and discusses future developments in the industry.

Oil solvent extraction is a new industry in China. Before 1954, there was only one batch solvent extraction plant. In that plant, the evaporation of miscella and the stripping of residual solvent in oil were all done as batch processes and production efficiency was low. In 1954-55, we learned of the simple construction and high utility of the Rotocel extractor. We were prompted to attempt our own design. Our first model was 3.2 meters in diameter and had 22 cells. Tests showed, however, that the dimension of every cell was so small that the extracted meal could not be properly discharged. The problem was solved by decreasing the number of cells from 22 to 11. The speed of the rotor was 1 rev/120 min.

In 1956, we constructed the first continuous extraction plant in Northeast China. The capacity was 40 tons of soybean daily. Although this plant operated satisfactorily, there were 2 disadvantages: (a) since the arrangement of the soybean flakes entering cells was very regular and compact, the penetration of solvent or miscella was poor. This reduced extraction efficiency and increased the amount of residual oil as well as the solvent remaining in the meal; (b) the moisture of soybeans from the northeast region is high, sometimes reaching 16-20%, so that if the soya flakes are not sufficiently dried, the discharge will become clogged, resulting in the need to discharge the meal manually and leading to unnecessarily large losses of solvent.

Those 2 problems were solved when we adopted the following steps: (a) a miscella screw conveyor was used to bring soya flakes entering the extractor into contact with the miscella, forming a "slurry," and the flakes in cells were arranged irregularly, thus improving miscella or solvent percolation; (b) by improving the drying conditions of the soya flakes, the moisture content was reduced to 12% or less, and the extracted meal could be discharged quickly.

In the drying of meal, we used a horizontal, tubular dryer. At first, the diameter of the main solvent vapor pipe was small, and screw blades were used to convey the dried meals. However, this method often choked the dryer, necessitating several improvements such as the enlarging of the main pipe and the use of paddles instead of screw blades. In addition, the quality and quantity of the direct steam was regulated. As a result, there was no more solvent flavor in the dried meal and no more choking of the dryer.

The rising film evaporator ran very well (the oil concentration of miscella could reach 90-95%) but failed in stripping. Formerly, we had used 2 batch kettles, but this produced a crude oil full of solvent flavor. After consideration, we designed a continuous, packed, stripping column to take the place of the 2 batch kettles. The many ceramic rings in the column enlarged the contact areas between the concentrated miscella and the direct steam, with the concentrated miscella flowing from top to bottom, and the direct steam flowing oppositely, so that the transference of heat and mass took place simultaneously. This efficient method ensured high quality in the crude oil.

In the recovery of the solvent vapor from vent gas, we let the vent gas run into a bubble-cap column, but its resistance was so high that a great deal of solvent was wasted daily. To resolve this, we designed 2 adsorbers of activated carbon which, although they reduced solvent loss, resulted in more steam consumption.

As our vegetable oil industry developed, the number of continuous solvent extraction plants increased. In 1958, we imported a De Smet extraction plant from Belgium which could process 85 tons of cottonseed/day. We accepted the direct extraction method for cottonseed without prepressing, but we were not satisfied with the results (the extracted meal still contained 2-3% oil). We changed to the prepress-solvent extraction method and residual oil content of the cottonseed meal fell below 1%.

During the years 1960-1970, our oil solvent extraction industry advanced considerably. The extractors were now batch extractors, Rotocel extractors, De Smet extractors and loop-type extractors, while the horizontal, tubular dryer, the vertical stack dryer and DT came into use as meal driers. Recently, we designed a deep meal layer dryer, and have also become interested in the DTDC equipment. In miscella evaporation, we still use first- and second-rising film evaporators, but there are many stripping columns, such as packed, chamber, disc and steam ejecting types. In vent gas, we have adopted the absorb method, adsorb method, refrigerating method and others.

After 1976, opportunities for contact with our foreign cooperatives increased and many more technical symposia with foreign specialists were held. We are now aware of new technologies and new experiences in the oil solvent extraction industry. We have improved the structure of our extractors, to reduce the oil content of extracted meal and increase the oil concentration of miscella. With the use of a flaking roll, strengthened by hydraulic power, soya flakes can be flaked thinner and more compactly than before and the flake bed height in the extractor can be increased. Thus, at the same solvent ratio condition, much more solvent or miscella penetrates into each material area, increasing extraction efficiency, and, in this way, the oil content of the meal is reduced. In the Rotocel feed-apparatus, we have used the choking screw conveyer to prevent the solvent vapor of the extractor from escaping to the prepressing or preparation shop. In the drying of meal, new desolventizer-toasters have been installed to destroy urease in the meal and increase the nourishment of soya meal. Recently, we tested the flash desolventizer and desolventizer-deodorizer. In the stripping of concentrated miscella, we have found the disc type to be more adequate in the larger plants because of its better heat transfer and mass transfer reactions, and its reduced steam consumption. The cottonseed oil miscella-refining method has been used extensively, but in the separation of miscella from soapstock, we use the stationary disc-type separator instead of high-speed centrifuges. The rapeseed oil miscella-refining is being tested. We use paraffin oil of edible grade to absorb the solvent vapor from vent gas and our experience indicates that this method is better than the others, since paraffin oil is an ideal absorbing agent.

Formerly, energy-saving had not been one of our considerations, but it has become an important problem. We have increased the exchangers (in every production shop) and, by using the solvent vapor from DT as a heating source and using the prepress-solvent method extensively, we have greatly reduced the electric consumption of expellers.

The technical economic data (or consumption data) of our solvent extraction plants (based on material/ton entering the extractor) are: electrical power, 13-20 KwH; steam, 600-800 kg; water, 11-15 ton; and solvent, 5 kg.

It must be pointed out that the solvent loss in our plant is higher, not only because of the technological or equipment factors, but because our solvent is petroleum ether, which has a wide boiling range.

Our oil plants are located near the seed-collecting regions and, in general, their daily capacity is ca. 30-70 tons. Our smallest plant is 10 tons/day, and the largest, 350 tons.

The extraction equipment was originally manufactured and built by the oil plants themselves, but last year, after a meeting on oil equipment standardization, it was decided that solvent extraction equipment should be manufactured by special mechanical factories in the future. Quality can thus be ensured.

Although there is still a wide gap between industrialized countries and the People's Republic of China, our solvent extraction plants today process more than 20% of the total amount of oilseeds grown. As our modernization advances, vegetable oilseeds will see a remarkable rise in production, and we can surely believe that our oil solvent extraction industry will develop rapidly.