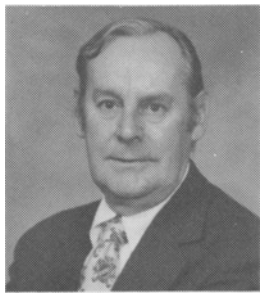
Finished Oil Handling and Storage in the U.S.



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ABSTRACT

Various techniques are practiced in the U.S. to prevent deterioration of vegetable oils following the final stage of processing through deodorization. Because oxidation, free fatty acid development, or adulteration by impurities are the primary concerns, the general practice is to keep oils in closed vessels in an atmosphere that excludes oxygen and moisture and where temperatures are controlled at minimum levels. The technology of sparging and blanketing finished oils with nitrogen during storage and transfer from vessel to vessel is shown. Also, a typical blanketing system for a series of vessels, pressure controllers, and techniques to avoid vacuum conditions is described.

Deodorization of vegetable oils is conducted to distill off residual free fatty acids and to remove by distillation other objectionable materials which contribute to odor and flavor of the finished oil. The effluent from this process is normally filtered through paper to assure removal of solids.

Protection of these finished oils prior to packaging or use in preparation of other foods is important. This presentation reviews generally accepted practices of protecting finished oils in the U.S.

The things most likely to happen to finished oils to affect quality to such a degree that they would have to be reprocessed or used as a subquality product are (a) contamination from atmospheric adulterants; (b) internal contamination by water and soaps, etc; (c) overheating; and (d) exposure to oxygen.

Atmospheric adulteration is avoided in the U.S. by the use of completely closed tanks. Finished oils are stored in all-iron tanks with tank tops, internal heating or cooling coils, and an agitator to help heat transfer and avoid localized overheating. A drawing of a typical tank is shown in Figure 1.

If the finished oil is contaminated with water introduced from leaking steam or water coils, water or steam treatment chemicals can be introduced. Properly maintained coils are obviously necessary. Wet oil also subjects the fat to hydrolysis, especially at elevated temperatures. Additionally, certain metallic soaps are strong pro-oxidants, especially copper, and it is a practice not to use any copper or even copper-bearing materials at any place where it can contact the oil.

Oxidation of the finished oils is considered the most serious effect on fat quality. Pro-oxidants, such as soaps of certain metals, are much more active at elevated temperatures. For this reason, it is not only desirable to keep soaps out but also prevent overheating. In the U.S., finished oil tanks are equipped with heating or cooling coils. Automatic temperature controllers are employed to prevent overheating. Oils coming from the last stage of processing, deodorization, are often at 140-150 F (60-66 C) and are usually stored at temperatures below that.

In addition to these techniques for protection of quality, the exclusion of oxygen during storage of finished oils is highly desirable and practical in the U.S. The normal technique is to exclude oxygen by the use of nitrogen. When oil leaves the deodorizer, it is delivered to a tank under complete nitrogen blanket. Nitrogen is obtained from suppliers who install a liquid nitrogen tank and then vaporize the liquid as needed, or from commercially available nitrogen generators.

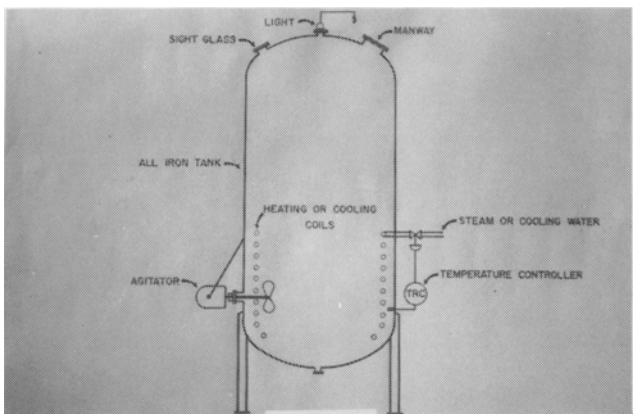

FIG. 1. Typical oil storage tank.

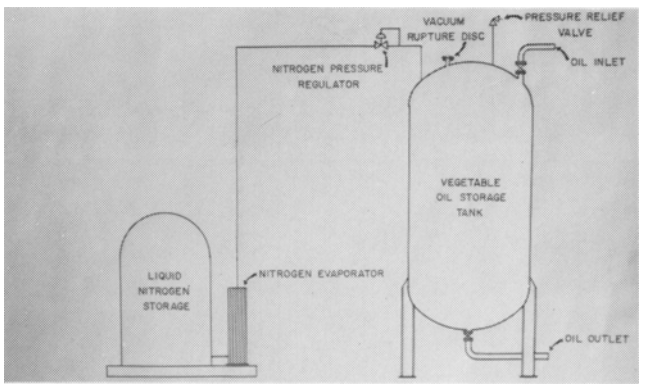

FIG. 2. Simple nitrogen blanketing system.

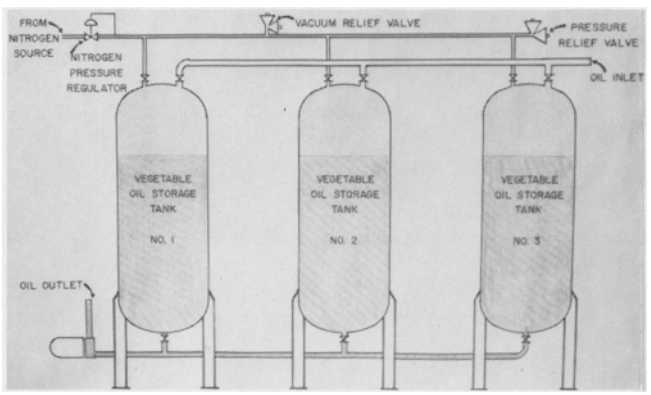

FIG. 3. Multitank nitrogen blanketing system.

A simple system is shown in Figure 2. The finished oil coming from the deodorizer flows directly to a tank under nitrogen protection. The nitrogen blanket is maintained by nitrogen pressure system controlled by a pressure regulator. As the tank fills and the pressure builds, nitrogen is relieved to the atmosphere. As oil is pumped from the tank and the pressure is reduced, the nitrogen regulator opens and replacement nitrogen is introduced into the tank. It is a common practice to put a vacuum relief valve or rupture disc on these tanks to avoid a vacuum condition and collapse of the tank.

A more complex system which could involve many tanks is shown in Figure 3. The system design is similar but is less wasteful of nitrogen since, as a tank is filled, the nitrogen gas can be displaced to another tank. When oil is pumped from tank to tank, the gas is merely exchanged.

A typical system in the U.S. will be kept under a nitrogen pressure of 1-15 psi (1-2 kg/sq cm). This pressure varies as the tanks are loaded or unloaded, and pressure relief valves are set to relieve at pressures above 15 psi (2 kg/sq cm).

Another practice is to "sparge" oils as they leave the deodorizer. The idea is to saturate the oil with nitrogen bubbles while it is completely deaerated. The spargers discharge tiny bubbles directly into the oil stream. This technique is particularly useful when finished oils are loaded into tank cars or tank trucks.

As the nitrogen saturated oil falls into the vessel, the effusing gas sweeps the head space, sweeping most of the oxygen from the vessel.

Finished oils should be used or packaged as soon as possible after deodorization. Scheduling to ensure use of the oldest stock first is important.

A note of caution: Nitrogen blanketed tanks will not support life if entered by maintenance personnel. The tanks must be thoroughly purged and the strictest of safety rules followed to avoid fatal accidents. Safety signs warning of this hazard are normally placed on each tank.