Edible Fat and Oil Processing

Application Note

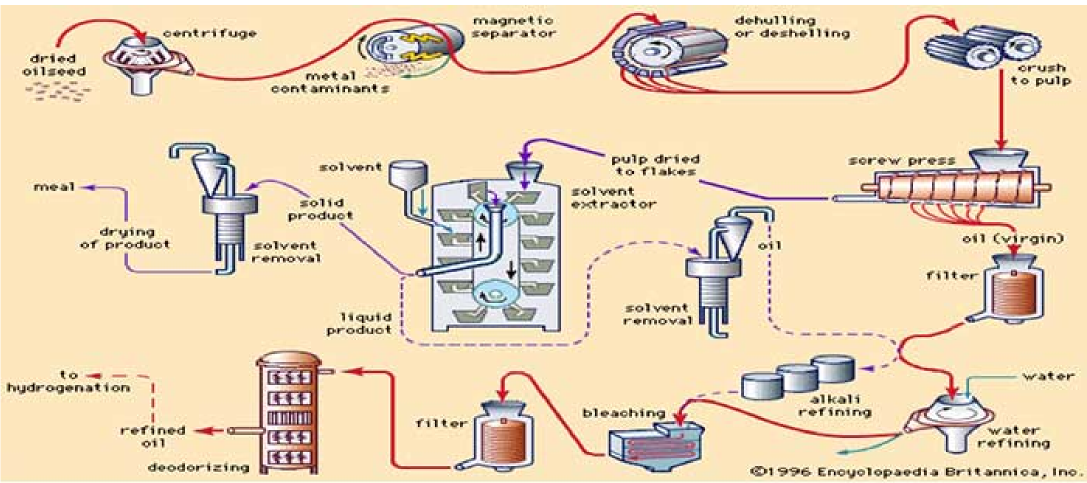
Introduction

There are a number of suppliers of oil and fat products used for edible purposes. These products include, but are not limited to olive oil, peanut oil, soybean oil, sunflower oil, lard, shortening, butter, and margarine. The raw materials for these products include animal by-products, fleshy fruits (palm and olive), and oilseeds. The crude fats and oils from these sources are recovered using a number of methods such as rendering, pressing and extracting with solvents. Some oils, such as virgin olive oil, are ready for consumption after this initial step (pressing), while other requires additional processing. The extent of fat and oil processing depends on the source, quality, and nature of the end use.

Alkali Refining

The growing demand, in the United States especially, for bland-tasting, stable oils and shortenings for the end user has driven the development of extensive processing techniques. The constituents of crude fats and oils that contribute to unwanted flavor and color are free fatty acids, waxes, color pigments, phospholipids (gums), oxidized products, metal ions, and carotenoids. Many of these undesirables can be removed by Alkali refining. Alkali refining is the removal of these unwanted items by a chemical reaction with an alkali (caustic soda). This process is completed by a four step process: Conditioning, Neutralization, Washing, and Drying. The fats are heated between 40o and 85oC and treated with an aqueous solution of sodium hydroxide or sodium carbonate. Conditioning transforms non-hydrate phospholipids into their hydrate form by breaking down metal/phosphatide complexes with a strong acid. In neutralization the removal of free fatty acids and residual gums takes place. Washing is the removal of residual gums by hot water. And drying is the removal of moisture under a vacuum.

Inductive Conductivity can be used to provide a continuous, on-line indication of the aqueous Alkali solution concentration. The aqueous emulsion formed by the impurities is drawn off the bottom of the tank (in batch refining) or centrifuged off (in continuous refining). After alkali refining, the oil is usually washed with water to remove any residual alkali or emulsion. Measuring the ***conductivity*** of this wash water can indicate its quality. Clean water with low dissolved solids will exhibit low conductivity.



Water Refining

Also known as degumming, water refining consists of treating the crude oil with a small amount of water. "Degumming" is where phosphotites in the Oil are hydrated with water and then removed by separating in the Centrifugal Separators. The Degummed Oil is then subject to neutralization with caustic soda where the free fatty acids are converted into residual gums and are separated in hermetic separators. The neutralized oil is then washed and dried.

The "gummy" emulsion of phospholipids created by the treatment with water is then centrifuged off. In the case of corn and soybean oil, this emulsion can be dried to produce a substance known as lecithin, which is used as a emulsifier in many applications. Because of this, the water used in the degumming process needs to be of high quality. Any impurities in the water will end up in the product after the drying process. Once again, conductivity can provide a low maintenance indication of water quality.

Deodorization

Most fats, even after refining, have characteristic flavors and odors, and vegetable fats especially have a relatively strong taste that is foreign to that of butter and are considered undesirable. In order to produce a tasteless, butter-like fat, these oils may undergo deodorization. To do so steam is blown through the heated oil to distill the volatile components responsible for these flavors and odors. Of course, in order to generate steam you will need water, clean water. pH and conductivity measurements of the feed water are mandatory in this process to ensure the protection of the process equipment from corrosion and scaling. Other than water, you need heat to generate the steam. Proper control of excess oxygen in flue gas allows the boiler to be operated efficiently and safely.

Hydrogenation

For many purposes, it is desirable for the oil to be solid, or semi-solid (margarine and shortenings). The process that converts liquid oils to higher-melting solids is called hydrogenation. The process consists of dispersing hydrogen atoms to double bonds of a molecule through heated oil in the presences of a catalyst[1]. Cylinders from a vendor may supply the hydrogen, but some plants produce it on-site. This usually involves the electrolysis[2] of water to form oxygen and hydrogen. It is critical for the water used in the process to be pure. Contacting conductivity can be used to ensure the quality of the water in order to prevent damage to the expensive equipment used to generate the hydrogen. The purity of the hydrogen used in this process is critical, both for the product quality, and the process efficiency. Gas Density can be used to measure the purity of the hydrogen gas leaving the generation system.

Notes

1. A catalyst is a substance which speeds up a reaction, but is chemically unchanged at the end of the reaction.
2. Electrolysis is a method of separating chemically bonded elements and compounds by passing an electric current through them.

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Summary

There are many points in the processing of edible fats and oils that benefit from the use of analytical measurements. Inductive Conductivity, Contacting Conductivity, Gas Density and pH can be utilized to increase the quality of the end product, as well as protecting expensive process

Product Recommendations

Sensors:

For measurements of low conductivity, contacting sensors are recommended such as the Yokogawa SC4A and the SC42 series. For cleaning and rinse processes, inductive conductivity offers the best solutions with a minimum of maintenance.

For pH measurements the FU24 All-in-One pH/ORP sensor is the best solution. By incorporating the successful Yokogawa patented Bellow system integrated in the FU24 electrode, the built-in bellows ensures immediate interior pressure equalization to the outside pressure, making the sensor virtually insensitive to external pressure variations and potential plugging.

Holders:

All of Yokogawa sensors can be installed online, retractable, or flow-thru, depending on which installation the customer requirements. Material construction for Yokogawa sensors and holder may vary, but typically is 316SS.

Analyzers:

The Yokogawa model FLXA402 analyzers should be used for applications where 115 VAC equipment is required, The Yokogawa Model FLXA202/21 analyzer should be used for application where 24 VDC loop powered equipment is required.

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AN 10B01K20-01E
[Ed:02, Dec. 2020]