Farmet Physical Refining – Advanced Green Technology for Vegetable Oil Processing

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Technology of vegetable oil production is divided into oilseed processing by mechanical methods – either colt or hot pressing – and oil extraction by chemical solvent. The product of these processes is non-refined vegetable oil and meal or cake.

The production process of obtaining vegetable oil from oilseeds can be further divided into several steps. The first step is oilseed preparation; it comprises – depending on the downstream technology and sort of oilseed – processes like cleaning, dehulling (removing of seed husk), sometimes crushing and hydrothermal treatment. This step is highly important for the subsequent processes as well as for the quality of the final product.

After the pre-treatment, oilseeds are processed by pressing or extraction. The received cake or meal finds its use in production of compound feed for cattle, as a valuable protein source. The vegetable oil continues for subsequent processing. In accordance with the normative requirements, vegetable food-grade oil has to pass through further cleaning – filtration and refining processes, where undesirable substances that originate in oilseeds (such as waxes) are removed.

The basic goal of refining is to remove substances like free fatty acids (FFAs), phospholipids, waxes, volatile substances and pigments from oil, or at least to maximally reduce their content in the oil. On the contrary, antioxidants, like tocopherols and sterols should be preserved as much as possible. That has to be achieved at as-low-as-possible losses in oil. In the result of the refining process, oil gets transparent, does not form sediments and has neutral aroma and taste. Since vitamins partially degrade in the process and most of substances originally contained in the oil are removed, the physiological value of refined oils decreases.

Vegetable oil refining can be done generally by two processes – **either by chemical or by physical refining**. The full cycle of the commonplace chemical refining comprises several stages of oil processing – filtration, hydration, neutralization, bleaching and deodorizing. During the neutralization, large amounts of sodium hydroxide are used for removal of FFAs, and soapstock (which can be further used for soap production) is formed by its reaction with FFAs.

Winterization is used mainly for sunflower oil for removal of waxes and wax-like substances, which get in oil from sunflower hulls. Waxes are undesirable, since they crystallize when storing oil in cool places and form whitish sludge, so they need to be removed by winterizing to get oil with standard, transparent colour. In the result, the technology of chemical refining has numerous shortcomings; the principal one is the complexity of the process, high operational costs for chemical agents, necessity to further process the byproduct (soapstock) to soap on additional equipment and high energy demand of the technology.

On the basis of carried-out research, Farmet has developed a new technology of vegetable oil processing. Farmet physical refining is environmentally friendly and resource-saving technology, which uses chemical agents just in minimal quantity and oil receives lower thermal load due to use of deep vacuum.

In contrast from the chemical refining, the physical oil refining offered by Farmet comprises four production sections (PS): 1 – degumming, 2 – bleaching, 3 – winterization, 4 – deacidification.

In the first production section, phospholipids, or gums, are removed. The main task of this section is to remove hydratable and partially also non-hydratable phospholipids (ppm P). Phospholipids are natural substance coming from oilseeds and they can be disposed to the pressing cake if the processing takes place in a pressing plant. In the cake, phospholipids are valuable feed component. Alternatively, they can be used for further processing to lecithin.

In the second section, oil bleaching takes place. Pigments, carotenes and residual non-hydratable phospholipids get removed from oil by their adsorption on bleaching earth. The byproduct is the spent earth, which is removed from oil by filtration. It can be also dosed into cake, composted or used in biogas plants.

The third section of the technology – winterization – serves to remove waxes and wax-like substances from oil. It is used mainly for oil sorts with high content of waxes, which is typical i.e. for sunflower oil. For removal of waxes, the company is offering the Dewaxing technology, which can be supplied and an independent self-contained module. Winterization is not used for soy or canola oil.

The fourth, and final, section of the technology is oil deacidification, which is carried out under vacuum and which ensures distillation of free fatty acids (FFA condensate being the byproduct) and volatile substances. In order to reach high stability and quality of oil, it is vital to secure deep vacuum at this stage, such as below 2 mbar. The byproduct – FFA condensate – can be further used in chemical industry for various purposes.

Tab. 1 – Example of consumption of auxiliary substances per 1000 kg of vegetable oil

Substance	Degumming	Bleaching	Winterization	Deacidification	**Total**
Technological water, kg	35	10	-	0	**45**
Citric or phosphoric acid, kg	1,5	-	-	-	**1,5**
Natrium hydroxide, kg	0,87	-	-	-	**0,87**
Bleaching earth, kg	-	10	-	-	**10**
Filtration cellulose, kg	-	-	5	-	**5**

The technology of physical refining utilizes a number of auxiliary agents and materials. Tab. 1 shows consumption of auxiliary agents for refining of 1000 kg of oil. This balance is however just informative one, since the actual consumption depends on parameters entering oil as well as on process setting.

Quality of vegetable oils is generally characterized by parameters like taste, colour, aroma, transparency, sediments, density, refractive index, acid, peroxide and iodine values, soap number, presence of unsaponifiable matters, etc.

Tab. 2 shows maximal values of the principal parameter before and after physical refining of oil.

Tab. 2 – Parameters of vegetable oil before/after physical refining

Parameters of vegetable oil	**Before refining**	**After refining**
Content of phospholipids, ppmP	1200	8,0
Content of water, %	0,8	0,05
Solids, %	0,4	0,05
Acid value, mg KOH/g fat	6,0	0,2
Peroxide value, mmol/kg fat	5,0	approx. 0
Content of waxes, ppm	1000	50
Oil temperature, °C	10-70	15 °C above ambient

According to the results of the company´s research, the technology of physical refining has numerous advantages.

For example, lye is used just in minimal quantities within the physical refining, as it does not serve for removing of FFAs (which is the case at chemical refining).Vegetable oil processing by physical refining is characterized by low losses, since no soapstock gets formed within the process.

Due to the complex solution of oil cooling with a heat recovery system, substantial amount of waste heat is re-used for preheating in the subsequent sections, which in turn minimizes the energy demand.

Company Farmet offer the following models of technological equipment for vegetable oil refining: **RF5, RF10, RF20 and RF33**, with production capacity of 15, 30, 60 and 100 tons of oil per 24 hrs, respectively. For vegetable oil produced on small-capacity equipment by cold pressing, the company offers refining equipment with capacity of 100 or 250 kg of oil per hour; technology with output from 300 kg per hour up is available for oils produced by hot pressing.

The process of physical refining is fully automatized. Process control and regulation is ensured through the **FIC** control system, which optimizes the technological parameters of physical refining of vegetable oils.

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