# Prospects for the modification of oils and fats

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***Annotation.*** *Research was carried out on the technology of production of modified fats by reducing the amount of trans fatty acids in the process of transesterification. The effect of catalysts on the transesterification process was evaluated.*

***Keywords****: transesterification*, *catalyst, transesterified fats, cottonseed oil, soybean oil.*

When assessing the prospects for the development of fat modification technology for the period up to 2020, one should take into account a number of trends that have manifested themselves to one degree or another in recent years.

Analysts estimate that the total demand for food security in 2015 was $4.8 billion. By the end of 2021, this figure will reach 8.04 billion. It is projected to increase by an average of 7.8 percent from 2016 to 2021. By 2030, global demand for food is expected to grow by 35%. Based on these requirements, important issues are raised, such as expanding the range of food products, improving production processes and ensuring the safety of consumer goods. In particular, the production of petroleum products, which are considered the most important branches of the food industry, also requires compliance with the above requirements. This requires an analysis of the state of oil production in the world, an assessment of the future supply and demand for vegetable oils, and an increase in the quality and variety of oils. In turn, the solution of these problems is not only harmful to the human body, but also useful in the production of various types of products, such as consumer oils, trans fats, margarine, mayonnaise, shortening oils. For this reason, scientific research is needed to improve the quality of vegetable oils, including cottonseed, soybean, sunflower oils, as well as for the production of interesterified oils, which are considered raw materials for margarine products based on them.

The technology for the production of vegetable oils and fats is implemented in several stages. One of these steps is the process of modifying these oils. The modification process consists of fractionation, hydrogenation and re-esterification of oils. In the production of hydrogenated fats, trans-isomerized fatty acids are formed. The emerging fundamental changes in the technology of hydrogenation of dietary fats are caused by a likely relationship between the level of consumption of highly isomerized fats and the possibility of developing cardiovascular and some other diseases. To reduce the amount of trans-isomerized fatty acids in fats, the hydrogenation process can be modified by re-esterification.

Modern innovative processes in the technology of fat modification aim to provide the food industry with an assortment of physiologically complete modified fats with the required consumer properties [1,2].

The content of trans-isomers in hydrogenated fats is determined by the degree of reduction in unsaturation of raw materials; temperature, pressure and hydrodynamic conditions of the process; selectivity and isomerizing ability of the catalyst and other well-studied technological factors. The regulation of technological parameters of the process within a fairly wide range is possible on modern imported hydrogenation plants of periodic operation (there are no Russian analogues of such equipment).

Technological innovations carried out abroad at these plants are reduced to the use of more active, low-temperature nickel catalysts; selective and non-selective partial hydrogenation at temperatures not exceeding $140^0$C; deep hydrogenation of vegetable oils and their fractions.

Considering that a decrease in the process temperature leads to a decrease in the hydrogenation rate, reactors with improved mixing devices have been developed abroad, the hydrogenation rate in which is 2–3 times higher than in existing devices, which is achieved

due to a radical improvement in the hydrodynamic conditions of hydrogen dispersion in the liquid phase.

Fats subjected to partial hydrogenation at low temperatures do not contain trans-isomers, or contain their small amounts. But at the same time, fats differ in phase heterogeneity, stratify during storage. In margarine products, they can be used in mixtures with palm oil, as well as after interesterification with other vegetable oils or fractionation [3,4].

Fully saturated hydrogenated fats are highly melting and non-plastic. Without additional processing, they can be used in shortenings for baking, in the fat bases of liquid margarines and as a structure-forming component of the fat bases of margarines, which also contain lauric oils, milk fat and their fractions.

A promising field of application of high-melting fully saturated fats is static interesterification in mixtures with liquid vegetable oils in order to obtain fat bases for dietary margarine products that do not contain trans-isomers [5].

It can be assumed that in the longer term the following technological developments will be introduced:

• low-temperature highly selective hydrogenation of vegetable oils in liquefied propane and carbon dioxide, as well as in other solvents;

• continuous hydrogenation using stationary catalysts based on nickel and noble metals;

• use in the hydrogenation process of mixtures of hydrogen with gases inert for this catalyst;

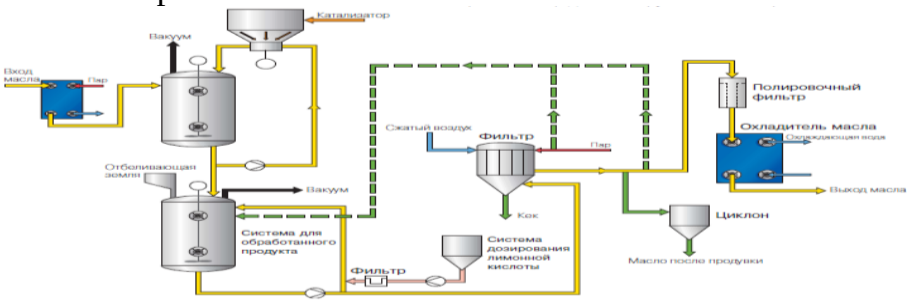
• combination of hydrogenation and transesterification on heterogeneous or homogeneous catalysts.

Innovative technologies provide suppression or a sharp decrease in the accumulation of positional and geometric isomers of unsaturated fatty acids in hydrogenated fats and suggest the subsequent processing of these fats by methods of interesterification and fractionation.

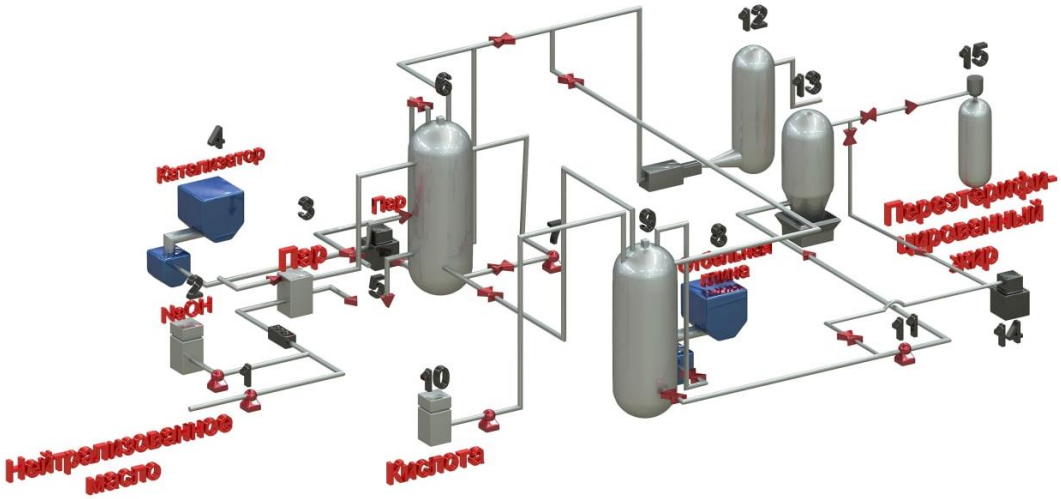
Currently, the process of interesterification of oils and fats is carried out slowly. As a result of the implementation of re-esterification methods on modern equipment, it is possible to obtain safe transesterification fats with high nutritional value and produce different types of fats according to different recipes. In this case, it is possible to reduce the amount of trans-isomerized fats in hydrogenated fats from 40% to 2%.

As a result of the use of transesterification fats as raw materials in the production of margarine, the shelf life of margarine products specified in regulatory requirements, regardless of temperature, improves their quality. The interesterification process mainly uses Alfa Laval equipment and devices, which are considered the world's leading manufacturers. Using these devices, we can get the following opportunities: to create new types of oils, to achieve high profitability.

For example, equipment based on the flow chart in Figures 1 and 2 can be used for the re-esterification process.




***Rice. 1 Technological scheme of the process of interesterification of oils and fats.***




***Rice. 2 Diagram of the transesterification process (catalyst deactivated by acid)***

The process of interesterification of fats is carried out in several stages. Vegetable oils used in the interesterification process in fat processing plants, direct catalysts are used in the processing of animal fats. Catalyst types are selected based on the physicochemical properties of the oils and fats in the recipe. In particular, various catalysts are used, such as sodium methoxide salt, sodium ethylate salt, calcium oxide, etc. Sodium methoxide salt is used in Uzbekistan for the production of interesterified oils, mainly from vegetable oils and animal fats. The sodium methoxide salt is a white powder that reacts in the open air to form a strong splash due to the same property that the catalyst is initially mixed with oil in a sealed vessel and turns into a liquid. The catalyst based on sodium methoxide is consumed in the amount of 1.2-1.4 kg per 1 ton of oil and after the periesterification process it is re-purified.

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