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INTERESTERIFICATION: PROCESS CONDITIONS

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1. Introduction

From the three main oil modification technologies (fractionation, hydrogenation and interesterification), interesterification is by far the easiest process to understand and to control. The interesterification process is used to modify the physical properties of the oil or fat blend by rearranging the fatty acid groups within and between the different triglycerides. It is applied directly to naturally derived oils or fats, or to hydrogenated or fractionated oils. Interesterification can be induced by chemical or enzymatic catalysts. The effect can be either a random distribution of the fatty acids, corresponding to the law of probability, or a directed distribution, e.g. by segregation of the newly formed high melting esters from the reaction mixture through controlled crystallisation during interesterification.

2. Chemical process

The random chemical process is the most general applied. The best known catalysts are alkali metals such as sodium, potassium and their alloys and alkoxides such as sodium methylate or sodium ethoxide. In order to allow the catalytic reaction to proceed, the oil or oil blend needs to satisfy certain quality standards, depending on the catalyst used. When alkaline catalysts are used, care should be taken with water, free fatty acids and peroxides, as they destroy the catalytic activity (table 1). Fatty acid neutralisation and drying is therefore necessary prior to the addition of the catalyst. Drying under vacuum at high temperatures and oil prebleaching also reduce the peroxides, which reinforces the catalytic activity.

Table 1. Inactivation of catalysts by poisons

Poison		Catalyst inactivated (kg/ton oil)		
Type	**Level**	Na	CH_3ONa	NaOH
Water	0.01 %	0.13	0.3	–
fatty acid	0.05 %	0.04	0.1	0.07
peroxide	1.0	0.023	0.054	0.04
Total catalyst inactivated		0.193	0.454	0.11

The interesterification reaction can be terminated by adding water to the solution (wet catalyst deactivation), or an acid (dry catalyst deactivation), or by adding a silicate (eg.trysil).

3. Industrial interesterification technology

Interesterification is usually conducted in batch. More modern plants run in a semicontinuous way (figure 1).

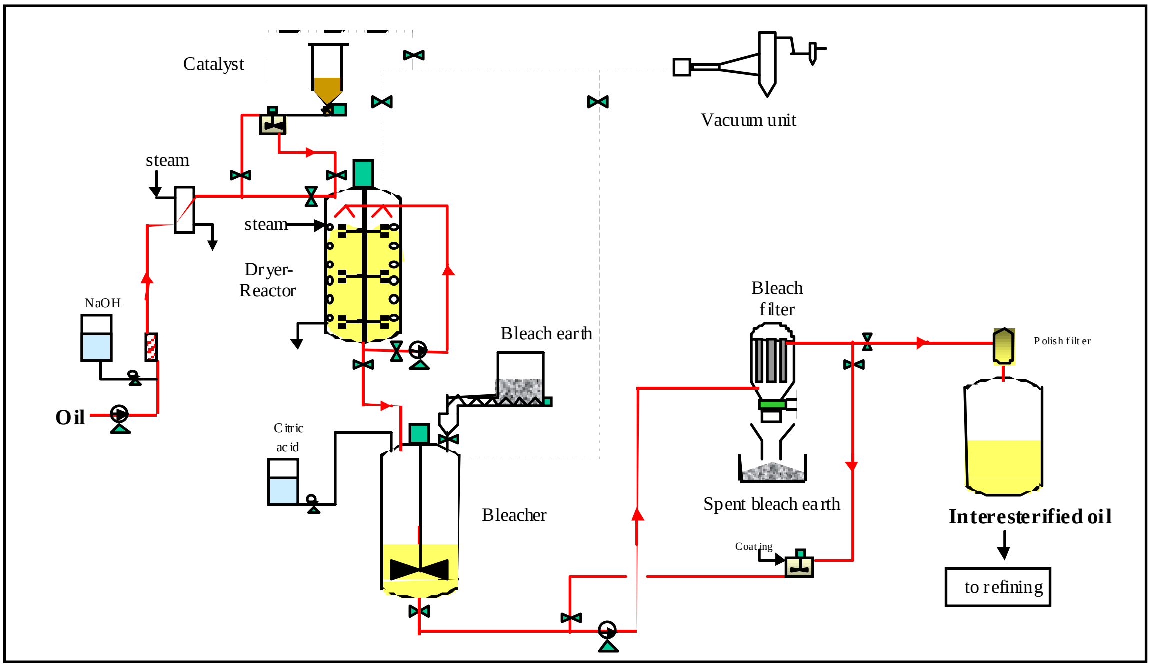

Figure 1. Simplified flowsheet of a semicontinuous chemcial interesterification process

In recent years, some important modifications have been introduced to improve the operation and performance of interesterification plants. Especially the dosing of the catalyst as well the overall control of the different successive stages, neutralising, drying, reaction, termination and postbleaching, have led to a serious reduction in utility consumptions and above all oil losses. Nowadays, all plants are designed for full automatic operation with a minimum of manual intervention. This ensures higher production efficiency as well as safer operation. Random interesterification is relatively simple, and is therefore quite easy to automate.

4. Industrial reaction conditions

Typical industrial values for a random interesterification with sodium methylate catalyst, are as follows (table 2). The catalyst consumption is largely determined by the quality of the feedstock material. Therefore, neutralised and bleached oils are preferred, although perfectly degummed & neutralised oils also provide a good source for interesterification.

5. Operating costs for interesterification

The operating costs are largely determined by the oil losses which are directly related to the catalyst consumption. About 40% of the operating costs is due to oil losses directly or indirectly caused by the catalytic side reactions. It is therefore of utmost importance to reduce the catalyst consumption to a minimum. Today, in modern plants and when using high quality oil blends, preferentially neutralised and bleached, catalyst consumption can be as low as 0.03-0.05%. As an example, a lowering of the catalyst consumption from 1 kg per ton of oil blend to 0.5 kg, reduces the overall operating cost with about 40% (from eg. 38 to 23 us$/ton).

Table 2. Feedstock quality and reaction conditions for interesterification

Feedstock		
Oil / fat mixture semi – refined (neutralised / bleached)		
-Water :	< 0.02 %	prefer. < 0.01 %
-FFA :	< 0.1 %	prefer. < 0.05 %
-Peroxide value:	< 3	perfer. < 1
-Phoshatides:	< 0.01 %	(P max. 5 ppm)
Conditions :		
-Catalyst	0.05 → 0.1 % of Na – methylate	
-Temperature	90 → 150 ° C	
-Pressure	< 50 mbar absolute	
-Reaction time	15 → 60 min	

6. Conclusion

In order to properly respond to the continuously changing oil quality standards as well as to the ongoing diversification of fatty matters in both food and non-food products, existing processes are continuously improved, and new technologies emerge. New opportunities are created specially in oil modification processes. The combined use of interesterification and fractionation, for example, is becoming a serious alternative to partial hydrogenation. With respect to interesterification, the question of the extent to which the enzymatic process will replace the chemical one still remains open. At present, the production costs as well as capital investment still favour the chemical processes, in particular for the production of commodity oils and fats. Today, new chemical catalysts, with a high selectivity, are under investigation. This, together with the fact that chemical processing plants are becoming more efficient and less polluting, speaks in favour of the chemical route.