

New Catalysts in Technology of Hydrogenation of Cotton Oil

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catalysts on the basis of nickel, copper and promrtored additives. The stationary floatable catalysts, containing one and two promrtored additives are analysed. Componential structure of the analysed stationary floatable catalysts is resulted in Tables 1 and 2.

Introduction

Improvement of quality of fats can be carried out by change of triglyceride structure of oils and fats in the various ways of their modification. Now the basic methods of modification of oils and fats are technology hydrogenation, hydro inter-esterification and inter-esterification [1]. In industrial practice most accepted way of catalyst modifications of vegetable oils and fats is the technology of hydrogenation with use of various types of catalysts [2]. Despite large number of the catalysts offered in technology of catalyst modification of cotton oil till this moment there are no concrete recommendations for choice the most effective catalyst allowing considerably to raise quality and to provide food safety of finished food fats. Therefore widely scale researches in the field of development of new technologies and hydrogenation catalysts which main advantage is quality maintenance and food safety catalyst modified fats proceed [3].

Purpose of work

The work is directed on improvement of quality and maintenance of food safety of fat-oil, received by hydrogenation of cotton oil, by selection of scientifically valid highly effective technologies and catalyst systems, allowing to lower the maintenance a trance-isomerized fat acids and to regulate necessary arrangement of fat acids in triacylglycerides of food fats.

Research course

Object of research were the refined deodorized cotton oil, powdery and stationary floatable catalyst systems on the basis of nickel, copper and various proctored additives, possessing high hydrogenating properties. Researches on catalyst modifications of cotton oil and studying of the basic kinetic laws of process in flowing conditions in the presence of stationary floatable catalysts is used plant of a high pressure with reactors of columned type [4]. For the analysis and an estimation of quality, the physical and chemical characteristic, food safety of raw materials, intermediate materials, hydrogenated fat-oil and products on their basis are used modern physical, chemical and physical-chemical methods and mathematical processing of the received experimental data [5,6].

Results and Discussion

In researches on catalyst modifications of cotton oil are used various catalyst systems of new modification. Also were analysed stationary floatable and powdery (Nisosel-8 containing nickel and copper salts)

The catalyst, No	Alloys	Parity of components
Initial		
1	Nickel-copper-aluminum	25:25:50*
2	Nickel-copper-aluminum	37.5:12.5:50**
Promrtived		
3**	Palladium	0.1
4**	Rhodium	0.5
5**	Ruthenium	0.15
6*	Rhenium	1.5
7*	Germanium	1.5
8*	Tin	1.5
9*	Vanadium	1.5
Note (*, **): promotor is entered instead of an aluminum part		

Table 1: Componential structure of new types of nickel-copper-aluminum floatable stationary catalysts.

The catalyst, No	The additive	The maintenance, %
10	Palladium	0.5
11	Ruthenium	0.5
12	Rhenium	2
13	Germanium	1.5
14	Tin	1.5
15	Vanadium	2

Table 2: Componential structure of new types of nickel-copper-rhodium (0.5%) - aluminum alloys, promrtored additives.

The catalyst, No	Additives	The maintenance, %
16	Rhenium+Germanium	2.0-2.0
17	Rhenium+Vanadium	2.0-2.0

18	Rhenium+Tin	2.0-1.0
19	Germanium+Tin	2.0-1.0
20	Germanium+Vanadium	2.0-2.0
21	Rhodium+Vanadium	0.5-1.0

Table 3: Componental structure of new types of nickel-copper-aluminum of alloys, with the combined combination of two proctored additives.

As the most effective powdery catalyst it is used catalyst "Nysosel-800" made by firm Engelhard in Holland [7]. In researches are studied nickel-copper-aluminium (25.0:25.0:46.0-48.5) alloys with the joint combination of two promrtored additives (Table 3). Catalyst hydrogenation of cotton oil were carried out in identical technological modes (Table 4) at which the basic properties of stationary floatable catalysts are established. The basic physical and chemical characteristics of catalyst "Nysosel-800" are resulted in Tables 5 and 6.

Parameters of conditions of hydrogenation	Unit of measure	Value
Temperature	°C	200
Pressure	kPa	300
Volume velocity of feed of raw materials	h ⁻¹	1
Volume velocity of feed of hydrogen	h ⁻¹	60
Catalyst volume	ml	1000
The average size of particles of the catalyst	mm	6

Table 4: Conditions of an estimation of hydrogenating properties of new types of floatable stationary catalysts.

Component	Percentage parity
Nickel 7440-02-0	15
Aluminate of nickel 12004-35-2	10
Sulphide of nickel 12035-72-2	2
Hydrogenated vegetable oil 68334-28-1	not established

Table 5: Componental structure of catalyst "Nysosel-800".

Research of influence of temperature for velocity of saturation of cotton oil at presence of non-promotor and promotor nickel-copper-aluminum catalysts carried out at following conditions: pressure 300

Modification conditions		Fatty-acid structure					Factor of selectivity, %	The maintenance of trance-acids, %
Pressure, kPa	Velocity of feed of oil, h ⁻¹	14:0	16:0	18:0	18:1	18:2		
100	1.6	0.6	22.0	6.9	53.9	16.6	91.2	17
300	1.6	0.6	21.7	8.0	51.4	18.3		
300	1.1	1.0	22.4	6.0	63.6	7.0		

kPa, velocity of feed of hydrogen of 60 ml h⁻¹, volume velocity of feed of oil 1.2 h⁻¹. Results of research are presented at Table 7.

Physical condition	Firm, granules
Color	The black
Smell	Has no
Melting temperature	Nearby 60°C
Disintegration temperature	Above 300°C
Volume density	700-800 kg/m
Solubility	not dissolved
Self-ignition temperature	350°C

Table 6: Physical and chemical properties of catalyst "Nysosel-800".

	The catalyst, No			
	2	5	20	21
Temperature, °C	Δ I.h. % I ₂			
120	19	25	27	28
140	27	32	40	42
160	33	38	42	43
180	38	40	45	46
200	44	46	53	54
220	47	49	57	59

Table 7: Dependence of velocity of saturation of cotton oil on temperature on stationary catalysts.

As we see from Table 7, with rise in temperature velocity of saturation increases, thus intensive growth of velocity is observed at 200°C, even at 120-180°C. Apparent activation energy is approximately equal to 15 kJ/mol. At more heat this size decrease even more sharply that specifies in limitation of process by hydrogen diffusion [8]. Pressure of hydrogen has the greatest influence of fat-oil qualitative measures in the course of continuous hydrogenation. In these conditions the greatest influence on selectivity of process renders a combination of the raised temperatures to enough high volume velocity on oil. In this connection, particular interest has data, received at continuous operation of hydrogenation plants (Tables 8-10).

100	1.1	1.7	22.2	8.2	50.3	18	89.3	14
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Table 8: Reception of fat-oil for confectionery products on recycled and experimental (120) catalyst N 21, promoted vanadium.

Iodic number, % I ₂	The maintenance of conjugate diene, %	Acid number, mg KOH/g	Temperature of melting, °C	Hardness, g/cm
81.5	0.81	0.25	36.6	400
75.8	0.82	0.26	37.0	500
66.7	0.94	0.29	37.6	480
67.6	0.80	0.31	36.3	360

Table 9: Technical and chemical characteristic of fat-oil, received on catalyst N 21.

Modification conditions			I.n % J ₂	The maintenance of trans-acids, %	Acid number, mg KOH/g	Temperature of melting, °C	Hardness, g/cm
Temperature, °C	Pressure, kPa	Velocity of feed of oil, h ⁻¹					
200	300	1.8	74.1	11	0.2	34.5	420
200	300	1.5	72.1	14	0.21	36.1	500
200	100	1	64.2	18	0.27	37.2	540
180	100	1	63.7	19	0.29	37.1	600
180	100	1.2	66.4	21	0.35	38.3	620

Table 10: The characteristic of fat-oil, received by continuous catalyst modification of cotton oil on recycled and trained during 800 h catalyst N 21 (selectivity of process of 94-99%).

Conclusions

It is established that the optimal catalyst systems for production of firm food fat-oil of high-quality and food safety are powdery and developed stationary floatable catalysts on the basis of nickel, copper and promotor additives. Such catalyst systems have allowed to lower quantity of trans-isomerized fat acids in fat-oil to 5-7% and to provide maintenance constancy of linoleic acids. The most comprehensible technological modes of manufacture of the high-quality hydrogenated fats were temperature 180°C, pressure 100 kPa and volume velocity of feed of oil 1.2-1.5 h⁻¹. Such conditions have allowed lowering the quantitative maintenance of trans-isomerized mono-nonsaturated fat acids in food fat-oil.

References

- Arutyuyan NS (1999) Technology of fat processing. In: Arutyuyan NS. Pishpromizdat; 1999. p. 452.
- Tovbin IM, Melamud NL, Sergeyev AG (1981) Hydrogenation of fats. In: Light and Food Industry; 1981. p. 246.
- Akramov OA (2008) Modification of cotton oil with efficient of the catalyst. In: Abstract thesis of candidate of technical sciences. TashCTI: Tashkent. 2008. p. 26.
- Majidova NK (2010) Improving of quality and ensuring of food safety of hydrogenated fat obtained by hydrogenation of cotton oil. In: N.K. Majidova. Abstract thesis of candidate of technical sciences. TashCTI; 2010. p. 26.
- Manual of methods of research, technical-chemical control and production accounting of fat-and-oil industry. 4: 1967-1989.
- Adler YP, Markova YV, Granovskiy YV (1976) Planning of experiment in the search for optimal conditions. In: Nauka; 1976.
- Majidova NK, Akramov OA, Xujanov IX, Majidov KH (2007) Improving of technology of catalytic modification of cotton oil. Collected papers of the Republican Scientific and Technical Conference, Tashkent, 279-281.
- Majidov KH (1987) Research and perfection of technology of hydrogenated cotton oil on modified alloyed stationary catalysts. In: Majidov KH. Abstract thesis of doctor of technical sciences; 1987. p. 48.