

Industrial Utilization and Prospect of Sunflower-seed oil in China

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Abstract: This Paper mainly discusses the industrial utilization of sunflower-seed oil, especially in paint, pharmaceutical and chemical industry. It also discusses sunflower-seed oil's utilization in man-made high molecular plastifier, producing chemical raw material with dimeric acid and making dynamic fuel for diesel engine in detail.

Section 1. Preface

The utilization of oil in industry, especially in chemical industry, is very wide. It's main products include adhesive, paint, detergent, plastifier, chemical agents for farm, engineering heat plastic, fiber softener, artificial lubricant and so on. To make full use of oil resources, develop oil industry can raise the economic value of oil-bearing crops, provide mankind with demanded raw materials and products.

China has a vast territory. Its different topographies, soil and weather conditions suit the growth of various oil-bearing crops and wild oil-bearing crops. In the north-east china, especially in Jilin

Province, the output of sunflower-seed is very large, with rich sunflower-seed oil resource, there are a great many extracting oil factories in north-eastern region. In recent years, many experts in various countries have done a great works in the industrial utilization of sunflower-seed oil, especially in chemical industry. It is developing rapily all over the world. China's industrial utilization of sunflower-seed oil has begun, and is taken seriously in oil processing, chemical and pharmaceutical industry. This paper will present its current situation and developing prospect.

Section 2. The current situation of sunflower-seed oil's industrial utilization.

The industrial utilization of sunflower-seed oil is very important in developing oil resources, expanding oil application, making new oil products and increasing oil economic value. Sunflower-seed oil mainly contains glycerine esters of oleic acid and linoleic acid, but little glycerine esters of other organic acids. It has light color, low viscosity which are good in industrial utilization. At present, the industrial utilization of sunflower-seed oil in China is mainly as below:

1. producing fatty acid with sunflower-seed oil.

To get fatty acid with sunflower-seed oil takes the same technology like other oil. Two steps are adopted as below:

A, Hydrolysis, main methods include:

- a, Saponification acidolysis method.
- b, acidation hydrolysis method
- c, High temperature non-catalysis method.
- d, Continuing extraction method.

B, Separation of mixing acids.

Main methods to separate fatty acid are as following:

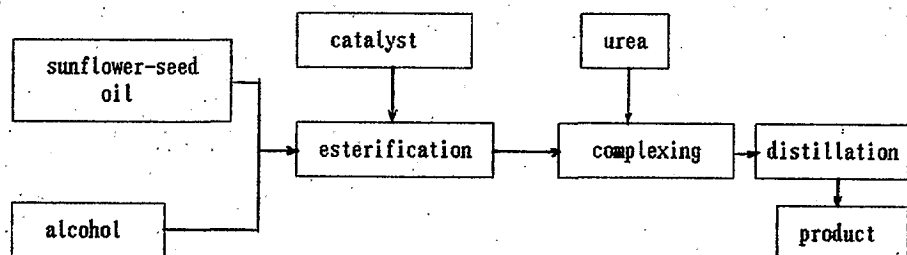
- a, press method.
- b, Surface activator separation method.
- c, rectification method.
- d, Solvent separation method.
- e, urea separation method.
- f, acidic soap separation method.

Main products after separating include stearic acid, palmitic acid, oleic acid, linoleic acid, glycerine and so on. Chang Ling Oil Chemical Factory of Ji Lin Province got into operation in October, 1990 with annual output of 10,000 tons of fatty acid. This factory adopts the technology of GINAZZA CO, Italy, using local sunflower-seed oil as main raw material. Its main production process includes oil high-pressure hydrolysis, fatty acid distillation, adding hydrogen etc. It can also produce 1,000 tons of glycerine as side-product annually.

2. Producing ethyl linoleate with sunflower-seed oil.

There are plenty of linoleic acid in sunflower-seed oil, and ethyl

linoleate has the function of lowering cholesterol and blood ester, so ethyl linoleate can be used to prevent and cure atherosclerosis. With this function, it is mainly used in pharmaceutical industry. production technology to get ethyl linoleate is as below:



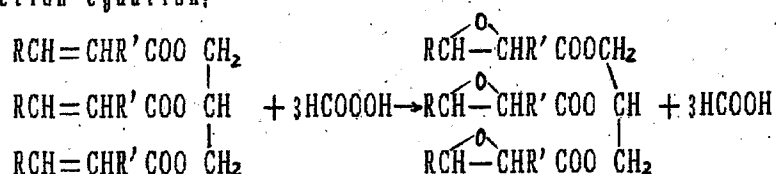
This product is produced in No.4 Pharmaceutical Factory of Wu Han, Hu Bei Province and Shang Hai No.3 Agent Factory.

3. Producing epoxy sunflower-seed oil with epoxidation method.

Epoxy sunflower-seed oil, which similar to epoxy soya-bean oil, is used as PVC's plastifier and stabilizer. With excellent stability to heat and light, perfect solvent to PVC, little volatility and none-poison, it can be used in all kinds of PVC products. The epoxy value of epoxy sunflower-seed oil is little higher than that of epoxy soyabean oil, simple production technology for reference is like this: under the temperature of $50\sim 60^{\circ}\text{C}$, take benzene as

medium, (or using surface activator method) add sunflower-seed oil, formic acid, catalyst. Then with dripping 40% H_2O_2 , epoxidation reaction takes place. Then keep still, Separate waste water. Finally after water washing, solvent recovery, dewatering, distillation, the product is ok.

Reaction equation,



This technology was developed in Beijing No. 3 Chemical Factory.

4. Ozene decomposes fatty acid in sunflower-seed oil to produce azelaic acid.

There are plenty of oleic acid and linoleic acid in fatty acid, after ozonation and heat decomposition, we can get azelaic acid, It is a substitute of sebacic acid and also a kind of productive raw material for plastifier, polyestr resin and artificial fiber.

In inert gas, the product composition of ozonation and heat decomposition is as following: (w%)

azelaic acid 22.9; octyl azelaate 30.1;

Pelargonic acid 17.5; pelargonic aldehyde 9.6;

Pelargonic di-aldehydic acid 5.6; Palmitic acid 5.0;

Caproic acid 4.5; Caproaldehyde 2.5; myristic acid 0.5; others 1.8;

When the heat decomposition occurs in oxygen medium, all aldehydes are oxygenized into corresponding acids:

azelaic acid and ester 35.5; palmitic acid 46; stearic acid 3.5; pelargonic acid 8.5; caproic acid 3.0; others 3.5;

This technology is not spread and utilized in industry mainly because of these factors, such as production efficiency, technological conditions, Separation conditions, economic benefits and so on.

5. The utilization of sunflower-seed oil in paint.

There is plenty of unsaturated fatty acid in sunflower-seed oil, after mixing with various kinds of bakelite and alkyd resin, it can be used in the production of paint. It is also practical to oxygenize the oil in order to produce peroxy-chains. After this kind of treatment, the oil can be used in paint so that the paint has a quick-dry paint-film, good quality, proper stick. At present, many paint factories in Inner Mongolia and Jilin Province use

Sunflower-seed oil in paint production.

Section 3 New method of utilization of sunflower-seed oil

1. Linoleic acid in sunflower-seed oil can be used to produce dimeric acid which is a kind of raw material in low molecular weight polyamide production.

Taking linoleic acid as raw material to produce dimeric acid, there

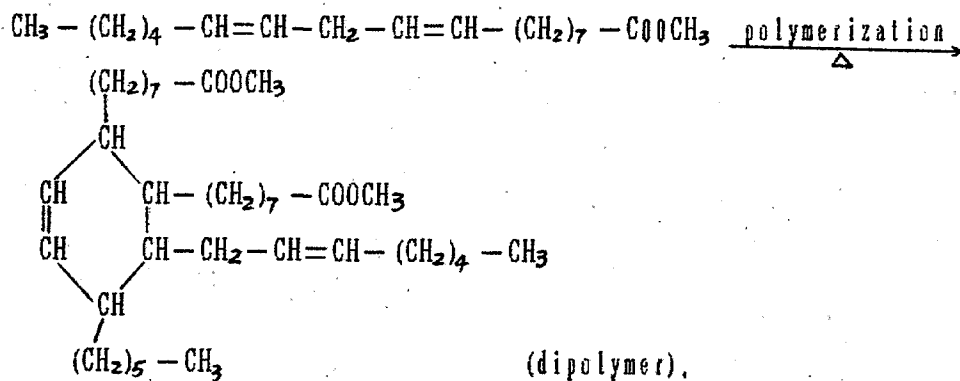
will be many routes, in general goes to the following two kinds:

a. normal pressure method.

Adding catalyst at the temperature of 300°C, protected by nitrogen, the reaction will last for more than 10 hours, then produce dimeric acid by reducing pressure distillation.

b. adding pressure method. adding catalyst at the temperature of 250°C and pressure of 0.78~1.18 mpa, protected by nitrogen, the reaction will last for several hours. Then produce dimeric acid by reducing pressure distillation.

reaction equation:

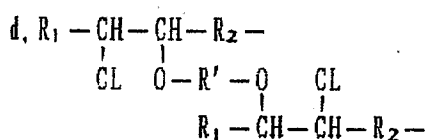
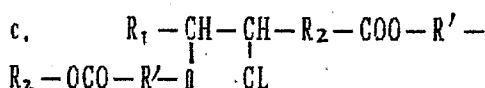
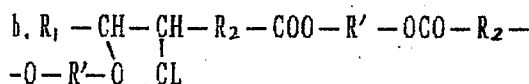
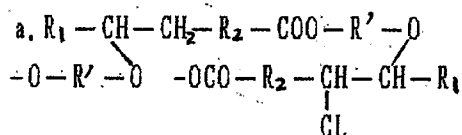


When the condensation reaction occurs between dimeric acid and low molecular weight polyamide, we will get low molecular weight polyamide resin which has a light color, bright and clear. It can be used as solidifier, and provides the adhesive with very high adhesive intensity and good tenacity. As the ingredient of print ink, it is widely used in polythene and polypropylene film print. And

perfectly solves the problem of plastic print. The excellent practical property of low molecular weight polyamide has attracted the attention of the whole world, and so using sunflower-seed oil to produce dimeric acid has a very high industrial value.

2. Producing high molecular weight plastifier for PVC with unsatisfied fatty acid in sunflower-seed oil.

Add 2 valences alcohol or epoxy ethane or epoxy propane to mixing fatty acids obtained by hydrolysis of sunflower-seed oil, then at normal temperature, add chlorine gas to chloridize. The chloridization reaction takes place at the twin-link with appearing of chlorine hydride, which will act as a catalyst to stimulate the esterifying reaction between mixing fatty acids and 2 valences alcohol. Because the unsatisfied fatty acid contains twin-link and carboxy groups, the product of this reaction will be complicated high-molecular compounds.



After these reactions, the water which produced by these reactions will be removed by reducing pressure and heating. The hydroxyl groups which remain at the large molecules, will be esterified with glacial acetic acid to complete the reaction. In the mixing fatty acids, there are a little satisfied acids, which will have the function to close the end of reaction, so that the molecules are not too large and the molecular weight get controlled.

In order to reduce the side reactions, HCL will be removed immediately from the system by adding Na_2CO_3 or N_2 . generally the average molecular weight will be controlled at 1600. comparing this kind of high molecular plastifier for PVC with DOP, we can find that it has many better qualities than DOP and evident characts of high molecular plastifier.

Currently the output of PVC products is very large, so the agent for PVC will be of a very good sale. And this product will promote the industrial utilization and economic value of sunflower-seed oil.

3. Using sunflower-seed oil in diesel engine fuel.

Petroleum is a main energy resource for all over the world, and at present crude oil gradually has this tendency of heavy-mass while light-mass fuel productivity is lower than before. After the global recovering of petroleum, it will be short in time. It will be very important to develop substitute fuel, especially the substitute of vegetable oil by which we can change solar energy into dynamic energy. This will be a kind of perfect energy resource for mankind.

So the research and utilization of vegetable oil in dynamic fuel will a significant program in the future.

Sunflower-seed oil has low viscosity and light color, but as dynamic fuel for diesel engine, it still has quite high flow point and viscosity. Not only will it be difficult for the oil to flow in oil-pipes, but will solidify in cold weather. If we add various kinds of agents, we can solve the above-mentioned problems and use the oil in diesel engine.

a. adding alcohol to sunflower-seed oil to lower its viscosity and improve fluidity at low temperature.

b. the sixteen alkane value of sunflower-seed oil is quite low, so it is difficult for the oil as diesel engine fuel to be ignited. we can add ether to improve its ignition properly.

c. After adding these agents, the oil's fluidity and ignition property get better, but its volatility increase. So we will add turpentine oil to control its volatility and increase stability. In cold region, a little amount is added or nothing at all.

d. in the fuel for diesel engine, sunflower-seed oil accounts for 50-70% of total amount, various agents 30-50%.

The proportion among various agents; alcohol accounts for 30-50% of all agent amount; ether 20-40%; turpentine oil 10-20%.

Controlling the proportion scientifically, We can get substitute dynamic fuel for diesel engine which mainly consists of

sunflower-seed oil.

Section 4. Discussion

China has achieved some effects in the industrial utilization of sunflower-seed oil, but it is far from enough. oleic acid and linoleic acid in sunflower-seed oil are important raw material for pharmaceutical and chemical industry, and have a huge potential. If we can make full use of it, the economic value will be tremendous.

In recent years, some industrial countries are developing fine chemical products; especially these products come from vegetable oils. China has a rich sunflower-seed oil resource. If we use it rationally and pay more attention to it, there will be a wide prospect in it.

Documents for conference

1. 辽宁化工 91.4
2. 特开昭 44-25701
3. 特开昭 58-222189