Colgate emery process

Colgate-Emery process, or modifications of it, is the most efficient and inexpensive method for large scale production of saturated fatty acids from fats and oils, and for the production of unsaturated fatty acids generally below IV levels of 120 (fish-derived) or 140 (soya, etc). The high temperature and pressure used permit short reaction time.

In continuous, counter-current splitting the fatty oil is deaerated under a vacuum to prevent darkening by oxidation during processing. It is charged at a controlled rate to the bottom of the splitting tower through a sparge ring, which breaks the fat into droplets. The oil in the bottom contacting section rises because of its lower density and extracts the small amount of fatty material dissolved in the aqueous glycerine phase. At the same time deaerated, demineralized water is fed to the top contacting section, where it extracts the glycerine dissolved in the fatty phase. After leaving the contacting sections, the two streams enter the reaction zone. Here they are brought to reaction temperature by the direct injection of high pressure steam, and then the final phase of splitting occurs. The fatty acids are discharged from the top of the splitter to a evaporation chamber, where the entrained water is separated or flashed off. The glycerine-water solution is then discharged (to evaporation chamber. The sweet water is concentrate to 30% glycerine concentration before pre-treatment section) from the bottom of an automatic interface controller to a settling tank. Full counter-current flow of oil and water produces a high degree of splitting without the need of a catalyst. However, a catalyst may be used to increase reaction rate further.

Method

Colgate-Emery Process

GREEN CHEMISTRY AND SUSTAINABILITY

Principle 3: The substances used and produced are non-toxic

Principle 5: No harmful solvent and auxiliary are used

Principle 7: The raw material is renewable source which come from plant

Principle 10: The products are all bio-degradable.

Catalyst

No catalyst

Conversion

Process temperature

250-260 °C

Process pressure

5MPa

Composition of final product

90% Fatty acids

10% Glycerine

Process time needed

2-3 hour at 250 °C and 5MPa

Hazardous Reactant/By product or product

Glycerine

May cause eye and skin irritation.

Ingestion of large amounts may cause gastrointestinal irritation

Inhalation of a mist of this material may cause respiratory tract irritation

May cause headache

Energy consumption

Energy Intensive

Type of reaction

Endothermic

Raw material cost

Safety factor

High pressure process

No harmful chemical is used

Flexibility of operation

Unreacted vegetable oil is recycled to prevent waste of raw material.

Variability of feedstock such as: corn oil, palm oil, palm kernel oil, etc

Catalyst may be added to enhance the process

Process Description

The splitting tower is the most important part of this hydrolysis process. The Refined Bleached Deodorized Palm Oil (RBD PO) is preheated and feed into the column bottom by means of a sparge ring, around 1 m with a high-pressure pump. Water is introduced near the top at a ratio of 40-50% of the weight of the oil. The high splitting temperature (250-260 °C) ensures adequate dissolution of the water phase into the oil so that mechanical means for bringing the two phases into contact are not required. The oil rises through the hot glycerol-water collecting section at the bottom of the column and passes through the oil-water interface into the continuous phase, the oil layer in which hydrolysis takes place. Direct injection of high pressure steam at certain points quickly raises the temperature to 260 °C and enhances the splitting of oil. The continuous, countercurrent high pressure process splits fats in 98- 99% efficiency in only 2- 3 hours with little or no discoloration of the fatty acids and an efficient use of steam. The fatty acids are discharged from the top of the splitter to an evaporator, where the entrained water is separated or flashed off. The glycerine-water solution is then discharged from the bottom of an automatic interface controller to a settling tank. The vapour from evaporator is compressed, cooled and then collected at the feed water tank.

After evaporator, the crude fatty acids are undergoing a series of distillation to separate different fatty acids according to their boiling point. Because of the inherent sensitivity of fatty acids toward heat, the distillation methods employed should be conducted at as low a temperature as practically and economically feasible while maintaining the shortest residence time of the

fatty acid in the distillation unit. The separation sequence of fatty acids of palm oil is pre C-14, palmitic acid, mixture of oleic acid and linoleic acid, stearic acid and residue.

The sweet water is let to settle down to separate into upper phase of unreacted fat and fatty acid and settle sweet water. It is settles for approximately 24 h at 80-90 °C and a pH of 4-5. Phosphoric acid is sometimes used to help break any emulsion, but this is not always required. The fats and fatty acids are decanted from the top of the sweet water and returned to the splitter feed for recycle. The settled sweet water is then sent to the evaporators for concentration. This alternative method requires two tanks, one for settling and one for collecting the sweet water. The tanks are alternated every 24 h to run continuously.

The pre-treated sweet water will pass through 3 evaporators in series. This is accomplished by joining two or more evaporators in series using the heat from the live steam. The water vapour obtained from each evaporator is condensed to process water before being reused in the splitting column. Through these 3 evaporators in series, crude glycerine of about 88% can be obtained. The crude glycerine is then store in a tank.

Reaction System

Fat Splitting Column

Refined Bleached Deodorised Palm Oil (RBD PO) is feed from the bottom of the column and the water is feed from the top of the column. The high temperature (250 °C) and high pressure (50MPa) enhance the solubility of water in oil phase where hydrolysis of oil occurs. The empty volume of the

tower is used as the reaction compartment. The crude fat passes as a coherent phase from the bottom to the top through the tower, whereas the heavier splitting water travels downward as a dispersed phase through the mixture of fat and fatty acid. The mixture of fatty acid and entrained water is obtained at the top while the sweet water which contain 10 to 18% of glycerine. Approximately 2 hours of reaction time is needed to reach degrees of splitting up to 99%.

Separation System

Evaporator

The fatty acids are discharged from the top of the splitting column to a evaporator, where the entrained water is separated or flashed off. The water content is removed to prevent oxidation and degradation fatty acids. The water vapour are then condensed and collected at the feed water tank.

Distillation Column

Due to the different carbon chain length and level of saturation of fatty acids, fatty acids can be separated according to their own boiling point. Due to the sensitivity of fatty acids toward heat, Distillation is carried out under high vacuum and lower temperatures and with the shortest residence time allowable. Typically, the distillation unit will work at a vacuum of 1. 2kPa or less and temperature according to the feed composition and boiling point. After this series of distillation columns, 99% of palmitic acid, mixture of oleic acid and linoleic acid at 99% and 99 % stearic acid are achieved. The light cut or pre C14 fatty acids contain volatile impurities as well as odor and color bodies. The residue which consists of the higher boiling components, usually

of lower quality can either be withdrawn separately or recycled directly for redistillation.