

Phase Diagram of Palm Oil Based Maltosides

Nur Khairunnisa Ahmad Shukri, Dr. Nurul Fadhilah Kamalul Aripin

Faculty of Chemical Engineering, Universiti Teknologi Mara

Abstract—The liquid crystalline phase is studied in Maltoside Palm Oil (MPO) compound using the study of binary phase diagram to obtain the liquid crystalline phase at room temperature, 30 to 60 °C. OPM is used to help finding the phase within each temperature.

Keywords— *liquid crystal, binary phase, isotropic*

INTRODUCTION

Liquid crystals are everywhere seen in our daily life: from laptops to lipsticks to even laundry detergent and high-strength plastics. Liquid crystals are known for decades and its first observation was made by George-Loius Leclerc, Comte de Buffon (1707-88). According to (Palfy-Muharay, 2007), cylindrical phospholipid bilayers of lecithin in water was compared to myelin figures which was the first liquid crystal that lines nerve fiber but this figure was unknown to Leclerc until Rudolf Virchow in 1850 identified it.

Real discovery of liquid crystal (Kelker, 1973) credit to an Australian botanist named Friedrich Reinitzer in 1888 when he extracted cholesterol benzoate from a plant that turned into a cloudy liquid fluid at 145.5°C and completely clear liquid at 178.5°C. Later in 1890, a physicist named Otto Lehmann verified Reinitzer's observation and came out with a "crystalline liquid" term (Lehmann, 1890). In 1990 to 1920, experiments were done to prove and to support the liquid crystal concept and finally determination of liquid crystalline states of order was successful but no applications were made by this time (Hans Kelker, 1989).

In 1960s, a French physicist named Pierre-Gilles de Gennes started working on liquid crystals after he found some interesting connection between liquid crystals and his past subject matter which was superconductors and he was awarded with Nobel Prize in Physics in 1991. Till now, Pierre-Gilles de Gennes's work has been a great influence on the extent research and development of liquid crystals (Nobel Media, 2003)

Liquid crystals are a state of matter stands between an isotropic liquid and crystalline solid (Hari Krishna Bisoyi, 2016). Most of their mechanical properties copy of liquid like unable to support shear, formation, high fluidity and coalescence of droplets. On the other hand, they also possess crystal-like properties such as the property of being anisotropic or ordered in optical, electric and magnetic way (A. A. Kornyshev, 2007). Lehmann (1889) was first to use the liquid crystal term to introduce the state of this matter. Other terms like mesomorphs, mesoforms and paracrystals were also introduced in literature (Michael J. Stephen, 1974).

Liquid crystals can be classified into two major types which are thermotropic liquid crystal and lyotropic liquid crystal (Brown, 1973). These two can be distinguish into different phases depending on parameters mentioned before and under the influence of external factors like temperature (Jiang-Gen An, 2016). Lyotropic liquid crystals are likely to have at least two components which one is formed by surfactant molecules and another one is a solvent. Surfactant molecules contain two parts which the hydrophilic head group and another one is hydrophobic alkyl chain tail(s).

Certain lipids can be mixed with water or aqueous solutions to form lipidic mesophases or basically known as liquid crystalline phases. Structures of high degrees of positional and orientational order are formed through the mixing of two main components of lyotropic and these different arrangements of bilayers or phase types within mesophases are accessible by changing the temperature and the concentration of the surfactant.

The phase diagram of temperature-concentration of two-component consist of surfactant-solvent system or known as binary phase diagram is used to show the best peaks and optimum concentration within it and to observe the phase types like isotropic phases and anisotropic phases and commonly observed phase types are lamellar $L\alpha$, bicontinuous cubic phases and inverse hexagonal H_{II} .

METHODOLOGY

Sample Preparation

30 samples of Maltoside Palm Oil (MPO) is weighed 40mg and put in small glass tube and labelled. Different water concentration for each tube is calculated and pipette is used to transfer the amount of water to each tube before proper sealing. Each tube is centrifuged before heated up in oven with 60°C. The sample is re-centrifuged until homogenous solution is achieved. The observation is recorded using polarized thin film and this observation is taken for room temperature. All the samples are then put in water bath with 30°C for one hour and observation is recorded. Steps for water bath are repeated for 40°C, 50°C and 60°C and

OPM synthesis

The central processor and the microscope is turned on and set up to a startup temperature of 30°C and a target temperature which isotropic phase is found. Small amount of Maltoside Palm Oil (MPO) is placed in sample glass slide before placed in central processor slide lock. When the central processor reached the startup temperature, placed the central processor to the microscope and observation or image shown by microscope is recorded through computer. When the heating is done, thin glass slide is put at the upper of the sample before setting up the central processor back to startup temperature of 30°C for cooling session. When the target temperature for cooling session is achieved, small amount of water is poured at the surrounding of the sample and another observation is recorded for every five minute. This steps are repeated using 40°C, 50°C and 60°C.

RESULTS AND DISCUSSION

Study of binary phase diagram

There are several observations have been made from lab experiment.

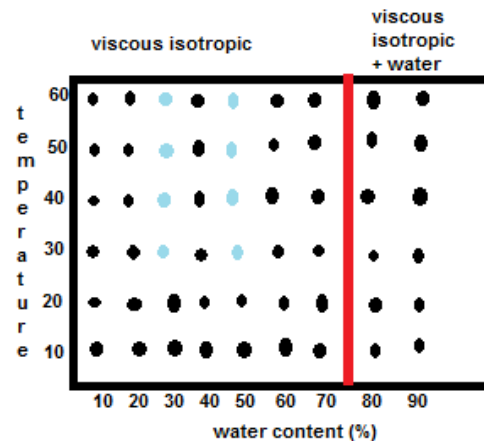


Figure 1: There are two phases involved which the viscous isotropic phase and viscous isotropic with water. The black circle denotes the sample is in isotropic phase with high a viscosity. The blue ones denote the existence of lamellar phase within the isotropic phase.

Binary phase behavior. The phase boundaries of maltoside/water systems were determined by creating samples with a controlled water content that approximately having 5% (w/w) to 90% (w/w). All the samples are well mixed and homogenous after several centrifuge and probably isotropic behavior appeared at all water content ranging from 5-90% (w/w). At high concentration of water starting from 75-90% (w/w), the probably isotropic phase is having the same viscosity but with the addition of water.

CONCLUSION

It can be conclude that a possibility of liquid crystalline phase in the Maltoside Palm Oil (MPO) but the crystalline phase is limited since isotropic phase is conquering the entire water concentration at four different temperatures.

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