CHAPTER I
INTRODUCTION

An important subject of interest in the area of detergency is oily soil washing which is a complicated process having been studied for many years. Numerous studies have evaluated several types of oils in order to understand the mechanism of oil removal and conditions promoting superior oily soil removal in the detergency process (Acosta *et al.*, 2003, Tongcumpou *et al.*, 2003, Tongcumpou *et al.*, 2003, Tongcumpou *et al.*, 2005, Tongcumpou *et al.*, 2006, Chen *et al.*, 2007, Tanthakit *et al.*, 2008, Tanthakit *et al.*, 2009, Phan *et al.*, 2010, Tanthakit *et al.*, 2010, Tehrani-Bagha *et al.*, 2012) .

Palm oil, the most popular vegetable oil worldwide, has a balanced ratio of unsaturated and saturated fatty acids containing 40% oleic acid, 10% linoleic acid, 45% palmitic acid and 5% stearic acid. It is widely used as a cooking oil in households and in the food industry because of its competitive price; moreover, it combined hydrophobic and hydrophilic together makes its phase behavior different from typical petroleum-based hydrocarbons and it more difficult to be solubilized in micelles, which makes them among the most difficult oily soils to remove from fabrics. Thus, it challenges to find the way to get rid of this oily soil (Phan *et al.*, 2010, Tanthakit *et al.*, 2010, agritrade, 2012, Products, 2012, Plc, 2013).

Many years ago, gemini surfactants have gained increasing attention in the formation of microemulsions. Gemini (dimeric) surfactants are a new generation of surfactants composed of two hydrophobic groups (sometimes three) and two hydrophilic groups in the molecule, which are connected by a linkage (spacer). Relative to traditional surfactants groups, Gemini surfactants exhibit greater the C_{20} values, a measure of the efficiency of adsorption of the surfactant at the interface, lower critical micelle concentration (CMC), more effective in reducing the oil/water interfacial tension (IFT), being better wetting and more strongly adsorption to from closely packed monolayers at hydrophobic surfaces. On account of these remarkable properties, gemini surfactants have great potential to be used in industrial detergency, gelation of organic solvent, etc. Accordingly, nowadays, investigation on gemini surfactants is still an attractive subject for advanced international research (Menger *et*

al., 1993, Menger *et al.*, 2000, Chen *et al.*, 2007, Lin *et al.*, 2011, Xu *et al.*, 2011, Lu *et al.*, 2012, Rosen, 2012, Su *et al.*, 2012).

Many studies have been focused on the phase behavior of the system containing anionic or cationic gemini surfactant, microstructure and formation of mixed micelle in anionic and cationic gemini surfactant systems (Dreja *et al.*, 1998, Dreja *et al.*, 1998, Kunieda *et al.*, 2000, Magdassi *et al.*, 2003, Ben Moshe *et al.*, 2004, Chen *et al.*, 2007, Hu *et al.*, 2011, Sheikh *et al.*, 2011). However, to our knowledge, little work has been done on the phase behavior and the detergency containing nonionic gemini surfactant. Therefore, it challenges to use nonionic gemini surfactant for oily soil removal.

Methyl ester sulfonate (MES) and methyl ester ethoxylate (MEE) are a derivative of methyl ester (ME) which is derived from natural fats and oils, renewable resources such as coconut oil and palm oil. According to environmental problems and an increase of petroleum and petrochemical price, MES and MEE are expected to replace linear alkylbenzene sulfonate (LAS) and alcohol ethoxylates respectively, which is the main components in commercial detergents and is produced from petroleum, because a first reason is MES and MEE cost in comparison to other detergent from petroleum feed stocks. A second reason that MES and MEE are friendly environmental surfactants as it is produced from renewable resource. A third reason is the better properties of MES and MEE compared to LAS and alcohol ethoxylates respectively (Cox *et al.*, 1997, Cox, 1998, Cohen *et al.*, 1999, Johansson *et al.*, 2001, Maurad *et al.*, 2006, Cohen *et al.*, 2008, Lim *et al.*, 2009).

The objective of this work was to study basic properties of nonionic gemini surfactants, MES, MEE and their detergency application by using palm oil as a model oily soil in phase studies. In addition, dynamic IFT, extraction method and brightness of fabric were investigated in order to gain a better understanding of the oily soil detergency.