

## Breakup emulsions aiming recovery of microbial biodiesel

Beatriz G. Colnaghi (IC), Carolina S. F. Picone (PQ), Rosiane L. Cunha (PQ).

### Abstract

This project aimed to develop a new physical separation method for oil-in-water emulsions based on the application of heat treatment in order to increase the economic feasibility of microbial biofuel production in large scale.

*Key words: Biodiesel, Demulsification, Heat Treatment.*

### Introduction

Biodiesel has been used in replacement of traditional petroleum diesel as a renewable energy source (FERRARI et al. 2004).

Microbial production stands out among biofuel production technologies. However, large-scale production of this kind of fuel has a narrow economic margin due to difficulties in recovering the product since a kinetically stable emulsion is formed inside the reactor (HEERES et al., 2014).

Such an emulsion could be stabilized by biosurfactants or bioemulsifiers produced by microorganisms or by the presence of active surface particles (cells) which would act as a barrier to droplets coalescence (HEERES et al., 2014). In addition, fermentation conditions as culture media could be contributing to enhanced stabilization of emulsions.

Understanding emulsion stabilization mechanisms could help developing methods to make easier phase separation and seeking higher yield of oil recovery. Therefore, this project aimed to identify the stabilization mechanisms of model emulsions similar to those observed in biofuels production and to develop new oil separation techniques.

### Results and Discussion

Emulsions were prepared by mechanical stirring with 30% (w/w) of hexadecane and 70% (w/w) of aqueous phase, which was composed of 10% of yeast in phosphate buffer pH 5.2.

In order to determine the effect of the aqueous phase complexity on the kinetics of emulsions phase separation, different concentrations of glucose (0%, 5%, 10% and 20%) were added into aqueous phase of emulsions. Each emulsion phase was characterized by optical microscopy, droplets size distribution, rheology and tensiometry.

After emulsions stabilization, there were observed three phases: an upper consisting of an emulsion rich in oil, yeast and water; an intermediate phase composed by water and yeast; and a bottom phase composed by settled yeast. The upper or

top layer phase was heat-treated at different temperatures (70°C or 90°C/30 min.).

Higher temperatures resulted in greater destabilization and an increase in coalescence rate, related to a decrease in the phase viscosity. However, it was not possible to obtain a complete oil separation.

Increasing glucose concentration to the aqueous phase also resulted in a positive influence on emulsion destabilization, showing a higher volume fraction of coalesced drops. Without glucose, yeast is under stress condition and can produce compounds with surface properties that contributes to emulsion stability and to yeast location at the interface. When glucose was added, the yeast tended to remain at the aqueous phase instead of the interface. Since it is not stressed, yeast surface properties decreased resulting in higher phase separation.

It was also observed that with the addition of glucose to the emulsions, there was production of gas bubbles, which may had contributed to the emulsion destabilization and phase separation.

### Conclusions

Heat treatment affected directly the emulsion stability, since higher temperature favored destabilization and formation of coalesced drops. However it was not possible to obtain complete oil separation and recovery. Addition of 20% glucose to the aqueous phase resulted in a complete oil separation. The obtained results allowed to increase the understanding of demulsification behavior and phase separation to make biofuel production more economically viable.

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