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Hydrophically modified chitosan as an Emulsifier for Oil-Spill Treatment

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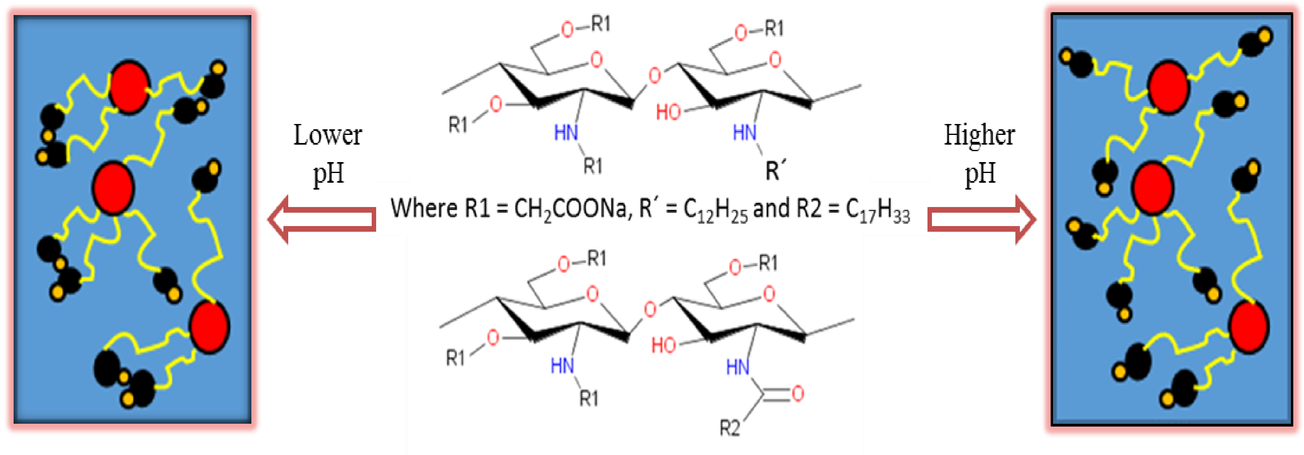
Introduction

This project is based on development of green and sustainable nanoparticles from biodegradable and non-toxic biopolymers such as chitosan and cellulose. Chitosan, a polysaccharide with surface active moieties consists of hydroxyl and amino groups, which can introduce carboxylic groups and hydrocarbon long chain onto its surface very easily. Such hydrophobically modified chitosan being amphiphilic, emulsified oils (dodecane and marine diesel) present on the water surface, which can be readily skimmed off. Emulsion behavior of these derivatives were pH dependent.



Materials and Methods

Chitosan is carboxymethylated in alkaline conditions with chloroacetic acid at 50 °C. This carboxymethylated chitosan was hydrophobically modified as h-CMChi by dodecanal (via imine linkage) and $NaCNBH_3$, and NaO-CMCS by oleoyl chloride (via amide linkage). Dodecane and Marine diesel were used as an oil phase for h-CMChi and NaO-CMCS, respectively.

Results

In our previous studies it was concluded that the emulsification ability of h-CMChi is pH dependent. The hydrophobic modification of CMChi hinder the de-emulsification in varying pH, as some dodecane was trapped inside the aggregated h-CMChi. This attributes the particle-particle interactions among h-CMChi, which transform the gel-like emulsion to free flowing emulsion (Fig. 1) from lower to higher pH **[1]**.

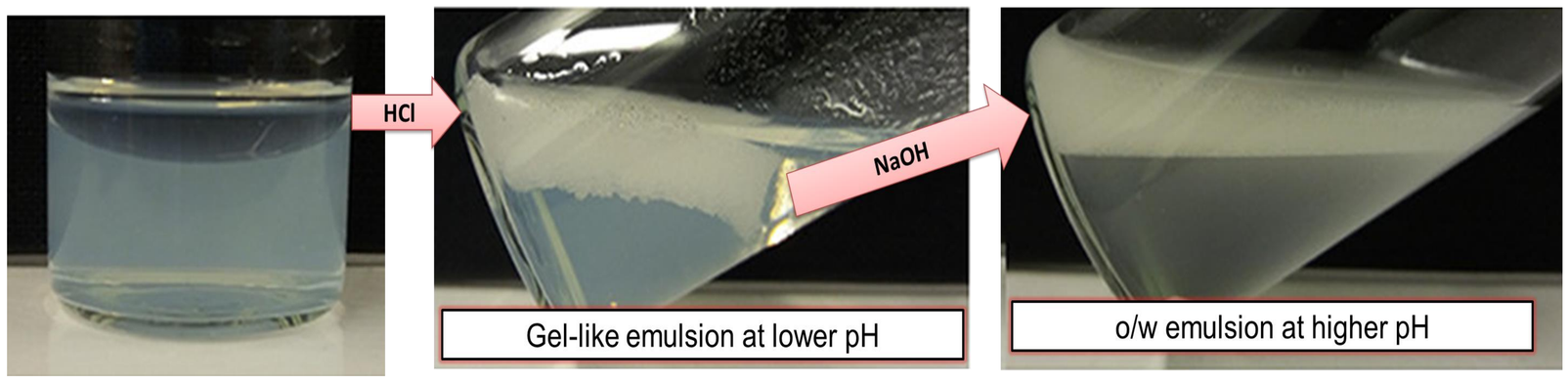


Figure 1. Emulsification behavior of dodecane using h-CMChi by changing pH.

NaO-CMCS forms creamy emulsion with similar pH dependent behavior as h-CMChi. However, below pH 5, the coalescence rate found to be enhanced due to the positive charged surface of NaO-CMCS. Moreover, water salinity makes the emulsion denser by building up of bridging flocculation. This emulsified oil can be easily skimmed off (Fig. 2). The addition of Ca^{+2} solution, destabilized the emulsion by cross-linking with carboxylic groups of NaO-CMCS **[2]**.

The addition of hydrophobic moiety on the carboxymethylated chitosan enhanced the emulsion stability. Despite of similar emulsion ability of h-CMChi and NaO-CMCS, the type of oil phase changes the appearance of the emulsion. Such emulsified oil can be easily skimmed off. Therefore, h-CMChi and NaO-CMCS can acts as an emulsifier for oil-spill treatment.

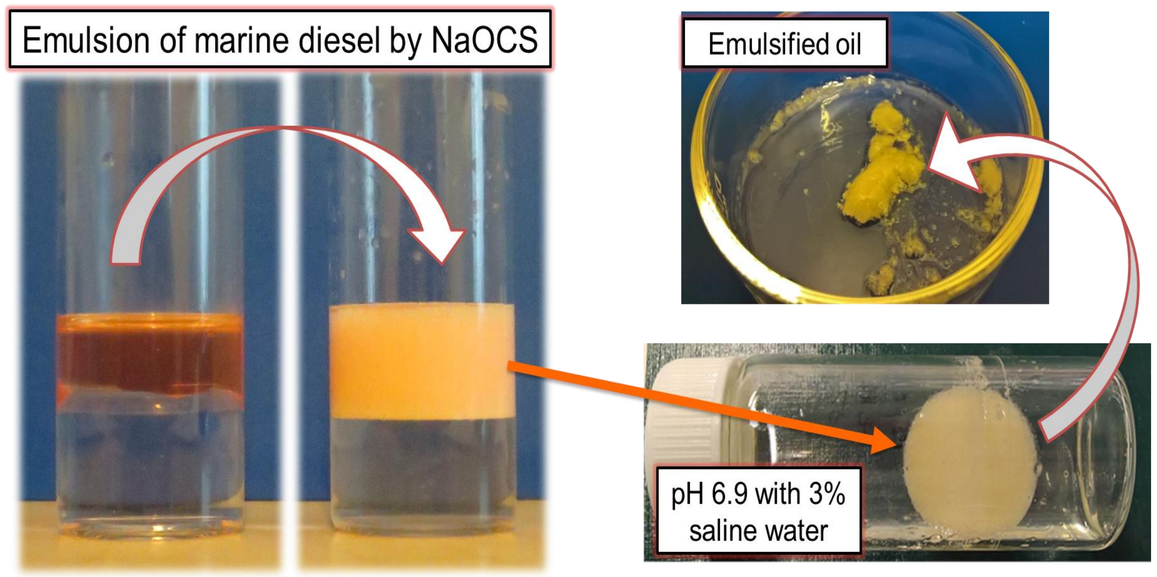


Figure 2. Emulsification of marine diesel with 3% saline water using NaOCS.

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