ARCRESPO

TOWARDS EFFICIENT AND SUSTAINABLE ARCTIC OIL-SPILL RESPONSE

Oil dispersing and emulsion–stabilizing nanoparticles from cellulose

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INTRODUCTION

In the ARCRESPO -project, dispersing and herding agents from natural bioresources for Arctic oil-spill response are developed. Processing of materials is based on utilizing green chemistry and is targeting into sustainable and efficient use of natural resources, cellulose and chitosan. The project partner in ARCRESPO is Lappeenranta University of Technology.

Increased oil transportation and oil drilling in Arctic areas increase also the risks of oil-spills. One of the most potential method for oil-spill response in icy and windy environment is the use of oil dispersants. However, the commercial dispersants are reported to be toxic to ecosystem and are believed to lead to long-term effects on human health as well. For these reasons, some Arctic countries have restricted or even banned the use of commercial dispersants.

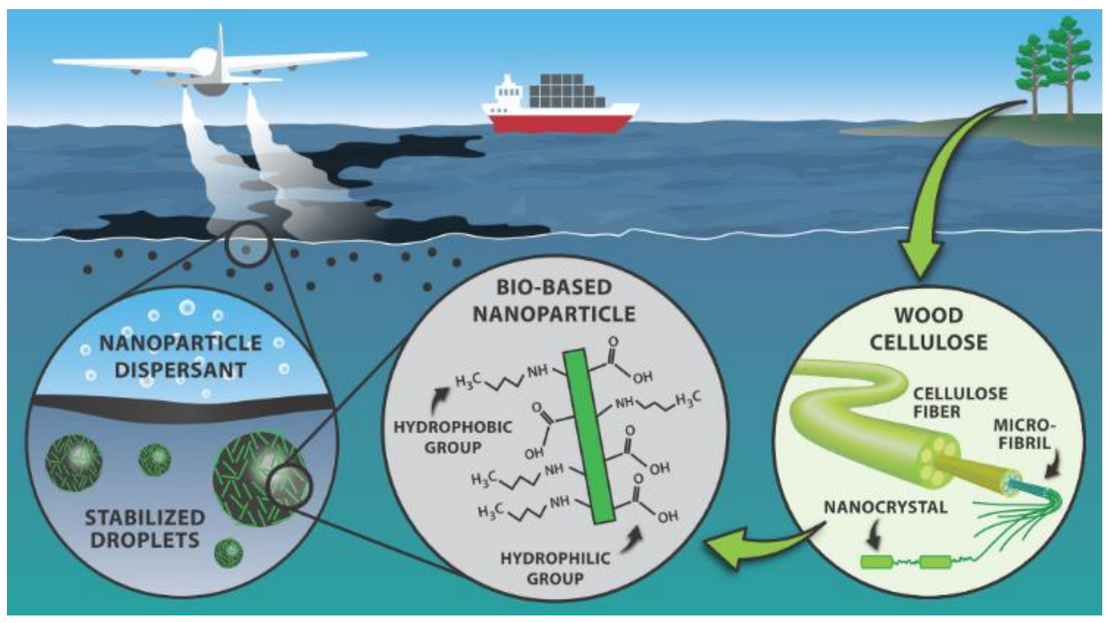

Figure 1 Fabrication route for cellulosic nanoparticle dispersant towards enhanced oil response.

APPROACH

Dispersants break the oil slick into small droplets to ensure the natural microbial degradation of oil. Naturally mainly hydrophilic cellulose raw material was first chemically modified to increase hydrophobicity and then was nanofibrillated to obtain nanocellulose particles to be used in oil-in-water (o/w) emulsions as stabilizing agent. (Fig 1.)

Within the Arcrespo -project, green, nontoxic surfactants from renewable biopolymers, cellulose and chitosan, will be fabricated using sustainable chemical modifications.

MAIN RESULTS

Nanoparticles in o/w emulsions prevent the oil droplet from coalescing by absorbing irreversibly at the oil water interface. This phenomena enables the oil droplet size to remain favourable in biodegradation process. In our research, obtained cellulose nanoparticles from different origin and produced with different chemical routes, showed efficient stabilizing characteristics against creaming effect as well as droplet coalescence that are the most probable routes for de-stabilization of o/w emulsions.

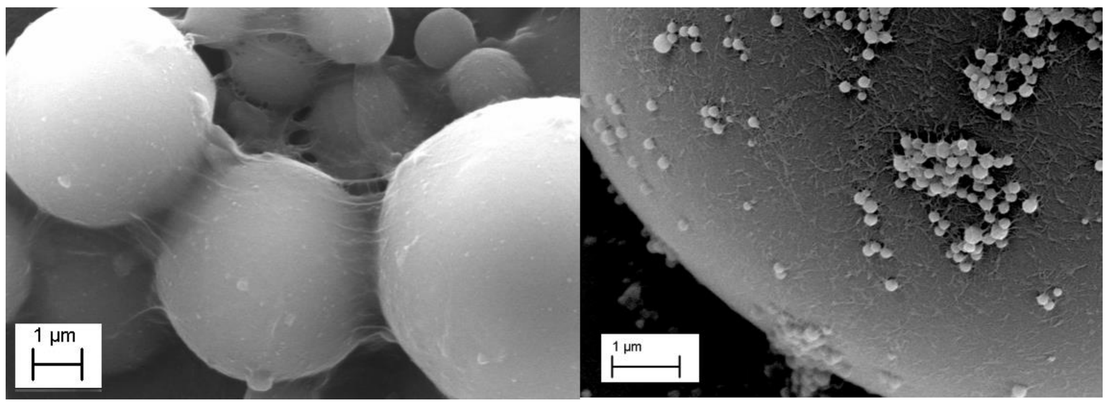

Figure 2 Different nanoparticles attached in the surface of styrene. On the left, cellulose nanofibers (CNFs) and on the right cellulose nanocrystals (CNCs)

We studied the mechanisms, how CNCs and CNFs stabilize oil by using styrene as a model compound (Fig 2), and found out that CNCs form a monolayer while CNFs from a network of fibrils that bind droplets and prevent coalescence.

Cellulose nanoparticles—including CNCs and CNFs made from renewable cellulosic substrates—have been considered to be promising green and sustainable alternatives for o/w emulsion stabilization and therefore provide an alternative technique for chemical oil-spill response.

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