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ForestValue - Innovating forest-based bioeconomy

Presenting a pre proposal of a project idea with a work name ”Cellulose Polyelectrolytes in Water Treatment”

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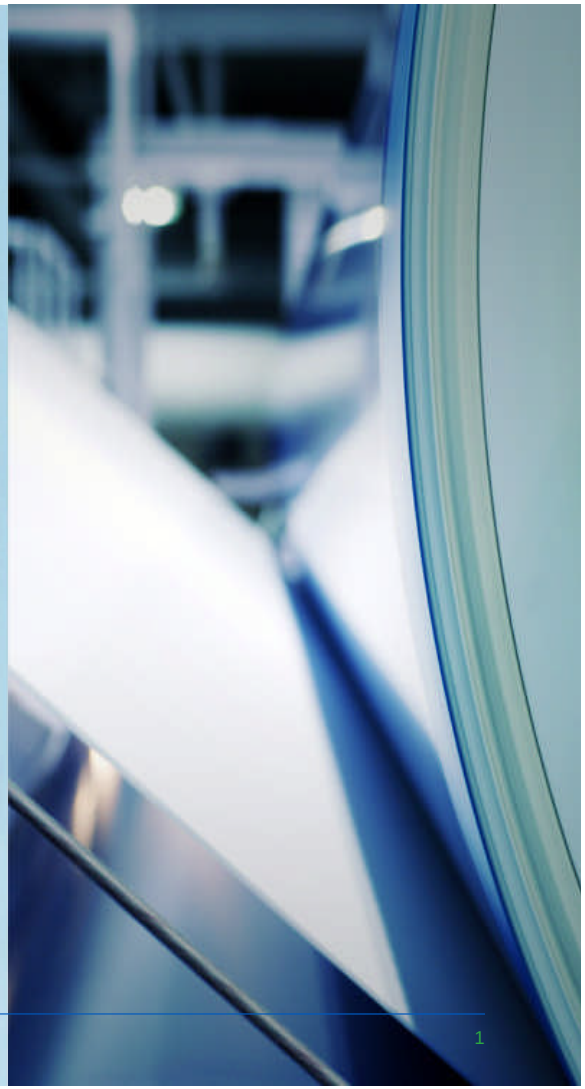

Cellulose Polyelectrolytes in Water Treatment

Kemira Oyj as a company

- A Finnish chemical company with annual net sales about 2,4 billion € and 4800 employees
- Kemira offers sustainable value to customers in water intensive process industries
- Customer segments are Pulp & Paper, Municipal and Industrial water treatment and Oil & Mining

Project idea

Cationically charged high molecular weight polyelectrolytes have important role in modern waste and drinking water treatment. These types of polyelectrolytes are water soluble.

Cationic charge and high molecular weight contribute in flocculation of colloidal particles and thus make overall sedimentation, flotation and filtration type solid-liquid separation processes more efficient. The polymers are needed also when the sludge formed after the separation process is dewatered in centrifuge, belt press or screw press to enable efficiency of the final treatment of sludge such as landfill, composting or incineration.

The mostly used cationic high molecular weight polyelectrolytes are synthetic acrylamide copolymers, so called polyacrylamides. Acrylamide monomer, when copolymerized with a cationically charged vinyl monomer, makes it possible to achieve very high molecular weights, which are several millions or even several tens

Acrylamide and the cationic monomers are made starting from propene and thus they are products in refining chain starting from crude oil or natural gas. of millions g/mol.

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Demand for alternative types of polyelectrolytes is increasing continuously. Sustainabilty of the raw materials of the polyelectrolytes is appreciated, as well as biodegradability of the end product. There are cases where use of fossil based raw materials is wanted to be minimized, and acrylamide as such is wanted to be avoided because of its toxicity.

Naturally occuring polysaccharides give an alternative approach to polyelectrolytes, especially the ones having highest molecular weight. Such polysaccharides are e.g. starches, chitin and cellulose.

Starches are part of food chain and chitin is difficult to collect from the shell waste of sea crustaceans. Wood cellulose is widely utilized industrially today and it is the biggest volume annually renewing biomass. Thus cellulose gives good platform to make cationic polyelectrolytes.

Natural cellulose is not water soluble, but when it has sufficient degree of substitution of a cationic functionality it becomes soluble. Cationization of cellulose using conventional cationization chemicals such as quaternary amine epoxy derivatives is problematic because of inefficient reaction efficiency and difficult handling of the chemical. New, safer methods for cationic derivatization are required.

Though, cellulose has not as high molecular weight as synthetic polyacrylamides, thus its performance needs to be improved by other means. In flocculation required interactions are mostly made by cationic charges, but also other interactions, such as steric and hydrophobic/hydrophilic

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interactions, may help in performance. Thus different interaction mechanisms need to be combined to the same flocculant molecule.

Cellulose chemistry is generally well known up to fiber level and nowadays also rather well to fibril level. But when molecule level knowledge is required it is often inadequate.

In development of new sustainable flocculants deeper molecule level knowledge of cellulose is required. Differences of celluloses in different wood species need to be recognized. Besides industrially widely utilized species such as birch, spruce and pine, also faster growing grades such as eucalyptus, aspen, willow and rowan, as well as recovered cellulose materials from different recycling processes need to be characterized properly at molecular level. New characterization methods are needed in this.

Partners

Industrial partners

- Kemira Oyj

Research partners

- The University of Helsinki, professor Ilkka Kilpeläinen

There is good room also for other industrial and/or research partners in a possible project