CATIONIC STARCH AS A FLOCCULANT IN FOOD INDUSTRY

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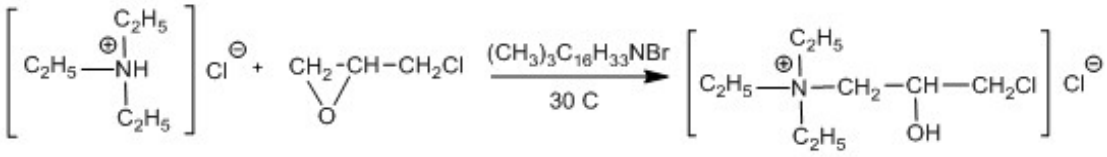
Effective treatment for municipal and commercial wastewater creates a serious ecological problem. It is generally known the utilization of synthetic flocculants such as hydrolysed polyacrylamide derivatives (PAM), poly(acrylamide-*co*-acrilic acid), or cation-active flocculants, that is cationic PAM.

However, synthetic cationic polymers are expensive; moreover, being carbon-chain polymers they hardly decompose in the environment. PAM depolymerization causes acrylamide formation which is a neurotoxin and carcinogen. The important properties of flocculants are their non-toxicity and biodegradation. The utilization of non-toxic, biodegradable, and environmentally friendly flocculants in the food industry and agriculture makes it possible to bring into use sewage sludge of the food industry as fertilizer in farmland and avoid secondary environmental pollution.

In this work, cationic starch (CS) was utilized as a flocculant for whey components precipitation while cottage cheese production.

A cationizing reagent (CR), *i.e.*3-chloro-2-hydroxypropyltriethyl ammonium chloride was synthesized by a one-pot method according to Scheme 1.

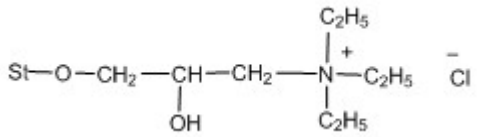


Scheme 1. The formation of the cationizing reagent CR.

A reactor while chilling and stirring was charged with triethylamine (TEA), water, and 35% HCl for 20-30 minutes. Next, epichlorohydrin (ECH) was added at molar ratio TEA to ECH equal to 1.0:1.1 as well as a catalyst - cetyltrimethylammonium bromide. The mixture was thermostated at 40^0C at a pH of 8.0-8.5 for 6-7 hours. Afterwards, the residual water and volatile compounds were removed *in vacuo*.

Further, the CR was used for cationizing of corn starch which was accomplished by a semi-dry method in the presence of NaOH. The obtained CS was purified through precipitation from 2-propanol.

The synthesized CS (Scheme 2) with the degree of substitution of the hydrogen atoms in -OH groups within a starch unit equal to 0.21 was used subsequently for the precipitation of whey components. The rate of clarification by CS action was estimated by turbidimetry as the rate of whey clarification during a 10-minutes initial period.



Scheme 2. Cationic starch.

It was shown that the rate of whey clarification relies upon CS concentration and the pH level of the whey. The dependence of the clarification rate against time has an extremum; besides the highest rate is observed at CS concentrations equal to 43.7-58.0 mg/l and the whey pH below the isoelectric point of whey proteins, *i.e.* the pH of 7.4. At the pH of 7.4 (the pH above isoelectric points of proteins) turbidity increases with stable colloid formation.

The obtained CS is offered as the perspective, inexpensive, biodegradable, and non-toxic flocculant for precipitation of matter as cottage cheese making.