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Research area: Product aims

Paper, paperboard and board // technical speciality papers

Key words:

Additives, PCC, MFC, strength

TITLE:

Production of nanocomposites of cellulose and precipitated CaCO3 for the strength control of paper

Background/Problem area

The strength enhancement potential of PCC nanocellulose composites is undisputed. The procedures used, however, hardly allow for industrial use. This is due to the following factors:

MFC availability still does not exist despite the announced commissioning of as many as 15 pilot-scale plants worldwide. The technologies of homogenisation using high-pressure homogenizers or grinders are not designed for large capacities or are no longer economically attractive due to chemical pre-treatment.

The production of PCC compounds analogous to SUBRAMANIAN can only occur at solids contents of 4-5%, since the homogenizers will otherwise clog. Hence, the homogeneous precipitation of CaCO3 in the aqueous phase predominates in the reaction, and thus the high specific surface area of the MFC is only insufficiently exploited.

Economically speaking, the share of more than 50% nano/microfibrillated cellulose in the SUBRAMANIAN compounds is much too high to actually be implemented.

Studies have demonstrated that only 20-40% of the PCC was able to be taken up irreversibly. This is at least more than what was possible with GCC compounds in the extruder, although it does show that controlling precipitation onto the fibrillar structures is difficult. The precipitation and the reaction preferably occur in the aqueous phase at a stock consistency of 3-5%.

Objectives/Research results

Based on the current state of scientific research, the idea behind this project is the fact that the alkaline conditions that occur in the chemical precipitation of CaCO3 can be utilised to improve MFC production in an extruder and, at the same time, to precipitate PCC onto the highly specific surface area of fibre wall nanostructures.

The strength values of paper are to be enhanced and the raw material costs in production are to be cut due to the use of these novel PCC cellulose nanocomposites. Such novel filler composites are suitable for producing innovative products. For this it is necessary, however, that the production of such PCC cellulose nanocomposites can take place under industrially utilizable conditions.

The objective of this project is therefore to develop a novel process for precipitating CaCO3 onto nanostructures of the cellulosic fibre wall in the high consistency range in an extruder.

There is a pressing need for an application in papermaking and the development of the properties of PCC cellulose nanocomposites in respect of:

the retention and filler distribution in paper

the impact on paper strength and

the impact on the surfaces and structural properties that ensure processing in printing and packaging operations.

Initial trials were devoted to studying a basis for comparison involving different pulps, preparing the pulps by adding lime milk and studying the influence of pH on mechanical degradation in the extruder. The following parameters were varied in the extruder: screw geometry, mixing ratio of pulp to lime milk, throughput, speed, dwell time. The degradation behaviour and properties of the pulps differ significantly at varying reaction conditions in the extruder. After evaluation of this basis for comparison, it was determined which pulps and which settings are required to produce MFC in the extruder. Trials are now underway using these prepared pulps and subjecting them to a flow of CO2.

Application/Economic benefits

With the development of an innovative procedure for precipitating CaCO3 onto nanostructures on the cellulosic fibre wall in the high consistency range in an extruder, it should be possible to cut costs in the production of filler-containing graphic and packaging paper.

Period of time: 01.11.2014 – 31.12.2016

Remarks

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