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Research area: Product aims
Raw materials // Arable crops

Key words:
Additives, pectin, CMC, strength

Title: New fibre-pectin compounds for the strength enhancement of paper and as an additive coupler

Background/Problem area

A competitive edge can be created by making a cost-effective, renewable and sustainable additive available which is based on sugar beet pectin and which combines the properties of different additives designed to increase paper strength. Such a competitive edge is a benefit in particular to all suppliers and processing industries participating in the added value chain, most of which are small- and medium-sized enterprises.

If beet pectin can be successfully isolated such that it both increases the dry strength of paper and at the same time is available as an additive coupler, it will make results, efficiencies and prices possible that are virtually impossible to achieve by combining classical dry strength agents such as starch and CMC.

Objectives/Research results

The objective of this project is to obtain pectins from plant cell walls that have been extracted from the residues left over from sugar production in such a way that they can be used in combination with cellulosic paper fibres to enhance paper strength and to function as an additive coupler (fibre-pectin compounds).

The anticipated result will be the cost-effective isolation of technical pectins with defined properties by obtaining them from sugar beet residues using a suitable extraction method that involves integrating a modification step in the extraction process.

It is important to find a way of economically isolating pectins of technical quality from the residues left over from the processing of sugar beets and to make them available for large-scale use in papermaking. In addition, the cellulosic residues that accumulate are at the same time to be rendered suitable for use in papermaking.

Initial tests using commercial pectins (apple, citrus and sugar beet pectins) and sugar beet pectin extracted at the Institute of Plant and Wood Chemistry IHPC (acid, basic and neutral extraction) showed no significant strength gains after the addition of 1.5 % pectin and various retention aids. Attachment by means of Ca^{2+} ions - similar to CMC - was equally unsuccessful.

For this reason, fibres were coated with cationic starch (polyelectrolyte coating) to overcome the repulsive forces between anionic fibres and pectin. After this, pectin leaves and retention aid were added. The starch coating alone resulted in a strength increase of 10 Nm/g. The addition of pectin increased the tensile index by another 3 -15 %.
The pectins were characterized in terms of molar mass and esterification degree. Tensile indices were found to increase with increasing degrees of esterification. In particular the pectins prepared by IHPC were found to have high salt contents, meaning that the dosing quantity of 1,5 % pectin was incorrect. It was therefore corrected in relation to the salt content. However, the increased pectin additions produced no further strength gains.
Further pectins were produced at IHPC by integrating modification steps (amidation). The amidation of pectins led to the greatest strength gains achieved so far – approx. 37 %.

Application/Economic benefits

The following economic benefits are expected: Cost-effective isolation of technical pectins extracted from sugar beet residues by integrating a modification step into the extraction process. Utilisation of the left-over sugar beet cellulose (from the sugar beet parenchyma) in papermaking, perhaps in combination with the pectin as a fibre component. A more effective method of strength enhancement in papermaking that can stand up to a comparison with established additives and cost advantages (compared to CMC-starch combinations). Cost advantages are to be developed as a product coupled to sugar. Preparation of an effective, sustainably available, strength-enhancing additive which is uncoupled from the petroleum price. Ensuring the continued existence of functioning added value chains to guarantee the continued existence of sites and jobs: Complete, added-value, material utilisation of the sugar beet, bridging the gap between the sugar beet farmer and the papermaker, improving the competitiveness of grades of manufactured paper by savings of expensive fibre raw materials and energy, realising high filler contents and increasing the use of recycled pulps. Ensuring the continued existence of papermaking sites by offering competitive grades of paper, contributing to guaranteeing demand in the added value chains of suppliers in the fields of mechanical engineering, the chemical industry and paper converting, especially in the printing trade.

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Remarks

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