Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Tiemo Arndt
Tel: 03529 / 551-643
Fax: oder 03529 / 551-889
E-Mail: tiemo.arndt@ptspaper.de

Research area: Process aims

Paper and paperboard production // Stock preparation

Key words:

Refining, cavitation, fluid dynamics

TITLE:

Replacement of the mechanical pulp refining process in stock preparation by the hydrodynamic modification of chemical pulp fibres

Background/Problem area

The refining process is an energy-inefficient process in the stock preparation line of a paper mill. During refining only a minor share of the fibres is directly treated by the bars or grooves, fibre treatment is uneven, and the strength potential of the pulp is not used completely. Alternative technologies have been investigated for several years based on ultrasound and high frequency mechanical forces. The main mechanism of these technologies is based on cavitation. It has been demonstrated that the strength properties can be increased, but the technologies cannot compete with traditional refining technology because of economic constrains. However, cavitation can be much easier created and has a lower energy demand generated in two or three phase fluidics by means of hydrodynamic effects.

Objectives/Research results

The aim of the research project is to replace the traditional industrial refining process by using hydrodynamic forces, whereby a reduction in energy consumption can be achieved. From the scientific point of view, the objective is to understand the mechanism of hydrodynamic cavitation forces on pulp fibre. In addition, the observed effects on structural and morphological changes on the fibre level will be investigated. Besides this, a method is to be developed to evaluate the cavitation process and to find indicators to measure the excess of the observed cavitation effects. Based on these results, the objective is to develop a system which can be introduced into a stock preparation line of a paper mill. To evaluate cost competitiveness, the capacity, energy, maintenance, and process control of the mill will be considered.

Since the start of the project, suitable experimental equipment has been developed based on a nozzle construction where power consumption, static pressure pattern, and flow velocity can be measured. Initial tests showed that pulp suspensions with solids content up to 2% can be transferred through the nozzle. Starting at a certain volumetric flow, cavitation could even be observed within the pulp suspensions culminating in an enhancement in the water retention value and tensile properties. It was seen that recycled fibres react more sensitive on the cavitation forces than chemical pulp fibres.

The cavitation effects depend strongly on the water temperature and content of entrained gas. By optimizing the treatment process the number of cycles in the cavitation nozzles could be reduced without loss in strength properties. It was demonstrated that scaling up the process from laboratory scale to pilot-scale can be easily done. Effects from laboratory scale experiments could be verified on a machine used for waste water treatment. It was also seen that the deinking of recycled fibres is improved after a treatment in cavitation nozzle. The ink detachment was enhanced and the area of dirt particles were reduced depending on the cavitation intensity and solid content.

Application/Economic benefits

The results can be used to develop new aggregates and machines by supplying the mechanical engineering industry to help paper mills reduce the energy consumption of chemical pulps and recycled fibres in stock preparation. But implementing this technology into a paper mill has to be adapted with respect to the composition of the raw materials and production capacity. That requires the highly flexible construction of the systems which can be especially supported by small- and medium-sized companies. Because cavitation is a complex state of fluids, companies with special know-how in modelling simulation will also benefit from the development.

However, the principal user of this technique will be paper mills as they will have the opportunity to reduce the energy consumption in the pulp refining operation. It is expected that the savings in refining energy will originate not from the reduction in specific refining energy, but also from the total refining energy consumption and less maintenance costs. Especially for paper mills with deinking stock preparation lines the results can be used to reduce the energy demand in flotation and thickening processes, and less chemical costs in pulp bleaching.

Period of time: 01.01.2011 – 30.06.2013

Remarks

The research project IGF 16817 BR was funded by the Federal Ministry for Economy and Technology (BMWi).