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Research area: Process aims

Paper and paperboard production // Stock preparation

Key words:

Deinking, ink fragmentation, cavitation, paper strength

TITLE:

Hydrodynamic surface treatment of recycled fibers in a cavitation nozzle for a better DIP-stock preparation

Background/Problem area

The average utilisation rate of recycled fibers for production of printing papers stagnate since 2009 at a level of 48 %. A limiting factor for higher use of recycled fibers are increased amount of difficult deinkable printing inks (toner, uv cured inks, uv varnishes) in recovered papers, especially from magazines and catalogues.

The big and shear resistant ink particles are difficult to remove from the cellulose fibers surface (low ink detachment) and therefore not separable in deinking flotation. At current state there is no suitable technological solution available to solve this problem.

For using deinked fibers in high quality printing papers a high technological input is necessary (1-2 disperger stages, pre- and post-flotation, several bleaching steps) in order to reach a sufficent brightness and low amount of optical inhomogenities. A considerable disadvantage of conventional disperger treatment of recycled fibers is the fibers darkening by redeposition of ink partikels. This must be compensated later by bleaching. Generally the dispersing stage in stock preparation is the most energy consuming process step.

There is an urgently need for alternative technological solutions for improved deinking process with regard to efficieny and costs. In literature and in some orientational pretrials by PTS the possible improvement of ink elimination in flotation by using a pretreatment by hydrodynamic cavitation was demonstrated.

Objectives/Research results

Aim of this project is the improvement of the deinking process regarding efficiency and costs. In that way the utilisation rate of recycled fibers for production of printed paper shall be increased.

The recycled fibers shall be treated with hydrodynamic generated pressure pulses in a cavitation nozzle before the ink particles will be removed in a flotation cell. The research objective is the evaluation of required process conditions and the reachable effects by cavitation.

Therefore several partial effects shall be combined in only one technological process step: Improved ink detachment, better ink fragmentation, avoidance of fiber darkening and restoring of fiber bonding ability.

Firstly basic research shall be done by using a cavitation nozzle in lab size (8 mm diameter) for evaluation of basic parameters for cavitation intensity. Subsequently the influence of cavitation treatment to ink detachment and fragmentation will be investigated at selected printing inks and at standard deinking furnish. In the second part of the project the influence of cavitation treatment to the flotation process shall be examined followed by test trials in a bigger nozzle for evaluation of the effects during upscaling.

The results showed a strongly increased ink fragmentation in DIP stock when raising the flow velocity in the used cavitation nozzle from 18 to 38 m/s. Below 18 m/s no significant ink fragmentation was observed. The maximal ink fragmentation (= reduction of ink particles > 50 µm) was 60 - 65 %. This reduction rate is comparable to current dispergers in deinking plants. The needed number of up to 100 passages through the lab scale cavitation nozzle is a limiting technical factor at the actual state of work. The total energy consumption is expected to be lower than in current dispersers in paper mills.

An increase of 20 % in Tensile strength was reached by fibers treatment with cavitation impulses. Simultanously no significant reduction in dynamic Tear strength was determined which is a very positive aspect in comparision to DIP refining. The strength increase was performed with significantly lower passages through the nozzle than the ink fragmentation. So the specific energy consumption is expected to be lower for cavitation treatment in relation to pulp refining.

Application/Economic benefits

The potential application of cavitation treatment will be at all paper producers which are using complete or partially recycled fibers containing printing inks: newsprint, SC and LWC-paper, tissue, white covered liner paper mills.

The cavitation treatment can contribute to reduction of energy consumption in stock preparation (when replacement of disperger is possible) and to process design simplification (if the post flotation can be cutted down). An improved ink detachment allows the reduction of fiber loss in the flotation cells. Also an increase in tensile paper strength can be realized by hydrodynamic cavitation.

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Remarks

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