

## Quality Development of Recycled Fibers to Expand their Papermaking Potential: Fractionation Approach

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Recycled cellulosic fibers, in spite of their economic value and socio-environmental significance, often have inferior properties compared to those of virgin fibers. Thus, one of the most challenging aspects of fiber recycling processes is understanding how to increase fiber bonding-ability and finally suitability of recycled fibers for making papers with market-acceptable properties. To overcome the problems of strength and quality decrease in recycled papers, research and industry sections have been exploring various options, including: refining, chemical additives, blending with virgin fibers, and fiber fractionation. Once pulp has been fractionated, the resulting long and short fiber pulps can be used in a way to improve different paper or board properties. Thereby, the use of fractionation has the potential to open the way for selective refining of fractionated pulps, improvement of targeted paper properties, and better suitability for forming machine designs to manufacture multi-ply papers and boards.

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Nowadays, in some countries the paper industry cannot survive without recycled fibers. The paper industry is the main consumer of recovered paper as a secondary cellulosic raw material. In different countries, for the different sources of recycled papers and collection strategies, the quality and composition of recycled fibers are different. For an instance, North America has certain sources of recycled fibers whose quality are close to those of virgin pulp. But Asian countries such as Iran, China, and Singapore utilize mainly low quality recycled fibers which have been used several times. Most of recovered papers have been applied for low-quality grade papers and paperboards. This would include newspapers, toilet roll, corrugating board, and test liner, for example, in Europe and Asia. The utilization of recycled fibers for newspapers has been restricted in the last decade because of the demand for decreasing of paper grammage. Other paper grades manufacture blends of recycled and virgin fibers. Examples are testliner produced in North America or Northern Europe. The proportion of recycled fibers in the paper machine furnish can vary from about 5% for fine papers to 100%, depending on the paper or board grade or geographic region. The utilization of recycled fibers for making higher paper grades such as printing and writing papers is still at low level.

The recycled fibers become less flexible, bulkier, and shorter often contain more fines than virgin fibers and do not conform as well. The main factors hindering the recyclability of paper and board products are the inferior and unstable quality of raw material. The quality of the recycled pulp depends on how many times the secondary

fibers have been recycled. Recovery of recycled fibers potential is possible by refining, chemical additives, blending with virgin pulps and fiber fractionation. Each method has its own advantages and disadvantages, and the correct choice for a mill will depend on each mill's particular circumstances. For example, although refining action is widely used to develop desired paper properties, it can easily be counterproductive if it is not practiced properly. Fractionation is very promising process for upgrading recycled pulp and develop its papermaking potential. The fractionation of recycled pulp has a potential to upgrade the supplying the fibers to enable the production of higher paper grades, providing better formulation. By fractionation long fibers can be refined and recombined with short fibers to prepare a new stock. The long fibers can be also used to improve paper strength and fracture resistance, and the short fibers can be used to improve the optical and surface properties of papers. The quality of each fraction can be enhanced by applying separate processing specific to each fiber type. The upgrade fractions can then be blended together to design a pulp that suited for desired paper properties such as strength and smoothness.

Upgrading strength property of recycled pulp by fiber fractionation is a promising practice in board grades manufacture. However, optimum use of this process is still under drastic re-evaluation. Many pilot plant trials are under way in the research labs or paper mills to attain proper procedure for fractionating the recycled pulp.

Fiber fractionation can give a lot of benefits. The possible benefits that can be achieved from fiber fractionation are shown in the following list:

- Greater strength development capability for linerboard and corrugating medium
- Reduced energy requirements in a refining system
- Reduce virgin fiber requirement
- Linerboard surface property enhancement
- Multi-ply paper or board production
- Increased production in the system
- Greater quality control flexibility in the raw material and the end products
- Reduced equipment capital expense
- Increased cleaning efficiencies throughout the system

The use of fractionation opens the way for selective refining of fractionated pulps. The long fiber fractions have much higher freeness and strength, which reduces the need for more expensive virgin fiber furnish. The short fiber fractions are used with gentle refining action of very low intensity. If the short-fiber pulp fraction has very low freeness, it may be used without refining, resulting in a possible overall decrease in refining energy and intensity. Moreover, since paper machine multi-ply forming is often used to produce paper or board grades using lower cost fibers in the middle of the multi-ply papers or boards, fiber fractionation can be by far the soundest approach to use.