

Paper From Alternative Fibres

The Facts

The paper and paper packaging industry depend on an efficient, abundant and economically viable source of cellulose fibre to manufacture the huge variety of paper products we use today, like; newspapers, magazines, tissue, and paper packaging. Most commonly fibre is sourced from trees, a natural renewable and sustainable source but, cellulose can also come from other agricultural sources.

What are 'alternative fibres'?

The key ingredient in papermaking is cellulose, which is derived from the vegetable fibres found in trees and other plants. Wood fibre (including recycled fibre) is by far the most common source used in modern papermaking, due to its cost-effective availability, relatively high proportion of cellulose and reliable technical characteristics. Alternative fibres come from grasses, seed hairs and other parts of plants (such as bast fibres and leaves) and have historically been used too, albeit in relatively low volumes.

History

Paper was traditionally made from clothing rags, and sometimes plant material such as straw, until the mid-19th century. Developments in pulping and bleaching technology, as well as economic drivers, pushed the development of other fibres, including esparto grass and wood fibre. Since the 1940's, papermaking in Europe and North America developed around the use of fibre from trees, because of its renewable and recyclable nature, technical properties, relatively low cost and all-year-round availability. While some producers in Asia (particularly China and India) continued to use agricultural waste such as straw, the volumes produced by the small and polluting mills in China greatly reduced in recent years, driven by government mandated closure of obsolete capacity. So, today it can be estimated that 97% of fibre globally is sourced either directly from trees or paper for recycling. However, there continues to be some small-scale exploration of whether alternative fibres can be used to complement wood.¹

Types of alternative fibre

In principle, almost any plant fibre can be used to make paper, but characteristics vary and few are commercially viable.

- Straw was once widely used but has traditionally suffered from drawbacks, such as slow drainage during papermaking and greater pollution potential, coupled with higher cost and lower quality compared to wood pulp.

- Cotton and linen remain excellent papermaking fibres, with very high cellulose content. This gives superior strength and a luxurious feel but comes at a higher cost.
- Bamboo has similar technical characteristics to wood pulp and is used commercially in some parts of the world, particularly Asia, albeit in relatively small quantities.
- Bagasse, the fibrous residue after extraction of sugar from sugar cane, behaves similarly to straw but is more difficult to process.
- Sugar beet, meanwhile, has some potential, particularly because of a low lignin content (the 'glue' that binds fibre together, causing impurities in paper) but is unproven at scale.
- It is important to note that it is rare for any alternative fibre to be used exclusively in a paper grade. For technical and economic reasons, the ratio of alternative fibre to wood pulp is relatively low, typically only up to 20%.

Benefits of fibre from trees

Wood fibre is proven to provide various benefits. It has a relatively low cost and is available in sufficiently large volumes with year-round availability. It imparts key technical attributes, such as strength and printability, and offers a wide choice of properties depending on the tree species and pulping technique. Because it is so prevalent its behaviour is well understood and reliable, meaning that the industry has become optimised for its efficient use.

Importantly, wood fibre also has known sustainability characteristics. There are robust traceability systems in place to verify that it comes from well-managed forests, which can support biodiversity and help to tackle climate change. In production, by-products of wood fibre pulping are commonly used to generate energy. And, after use, wood fibre is easily recyclable, thus extending its value and contributing to a circular economy.

Sustainably managed forests, from which pulp wood commonly originate, provide buffers for protected areas and help to protect vulnerable forests from illegal logging, encroachment or conversion to farmland.

Between 2005 and 2020, European forests grew by 58,390km²- an area larger than Switzerland and the equivalent of 1,500 football pitches every day.²

Potential benefits of alternative fibres

There are in principle appealing reasons to consider using alternative fibres in papermaking. It may have greater local availability in non-forest areas and, annual growth and harvesting may represent a comparatively high yield of fibre per hectare when viewed over the short term. To some degree this could reduce the transport impacts of importing wood pulp and help to reduce pressure on forest resources.

Importantly, there is potential to make use of what could become agricultural waste, particularly in countries where this may otherwise be burnt.

From a production perspective, the lower cellulose content of some alternative fibres could mean less processing is required and so reduced energy consumption and pollution potential. Others may provide useful attributes such as strength, bulk or pleasing haptics.

Limited Evidence

Despite the historic use of alternative fibre in papermaking, current initiatives are largely at the development stage. There may yet be a place for alternative fibre in the pulp mix, especially in areas that have limited forest resources.

However, claims of reduced carbon emissions and better yield per hectare are yet to be proven at commercial scale. There also remains uncertainty about economic viability, technical characteristics and environmental issues such as water pollution and recyclability.

Recycling

One key sustainability factor that must be considered for all types of fibre is its suitability for recycling.

In Europe 72% of all paper was recycled in 2019³ (85% for paper and cardboard packaging). Paper is recycled, on average, 3.5 times a year in Europe.³ Most European countries have efficient collection schemes to collect and recycle paper, others are developing them.

The European paper and paper packaging industry recommends that alternatives to cellulosic wood fibres, such as from agricultural residues, have been prepared for use in papermaking and can be recycled.

The paper industry recognizes the need to investigate the impact of these fibres when they are returned to a conventional papermaking process.

Considerations for buyers and specifiers

It should be recognised that alternative fibre papers are actually in most cases a combination of wood (or from paper for recycling) along with alternative fibres. At present, a higher proportion of alternative fibre content (more than 20%) may mean a reduction in quality, though this could be acceptable for some applications.

With regards to sustainability, it is important to consider whether there is reliable evidence to support any claims being made, and if that evidence is comparable to alternative mainstream papers with the same characteristics.

Misleading marketing

As organisations market their products, too often they make selective and misleading environmental statements overstating the benefits. A very common example for paper made from alternative fibres is that this saves trees and reduces deforestation. The reality however, is that forests from which paper is made are growing in size. Furthermore, rather than focusing on one selective element the full life cycle should be considered.

In Europe making such misleading statements contravenes European advertising rules and regulations.

Case Study: Grass Paper

German company Creapaper uses grass from European meadows, the same as might be used for animal feed. The grass is mechanically processed, meaning that any lignin content is not removed. In small-scale tests, paper has been produced with up to 50% grass fibre, the remainder being conventional wood or recycled paper pulp. Proposed products are aimed mostly at the packaging sector.

The company claims a reduction in CO₂ emissions by up to 75%, compared to conventional pulp delivered to a paper mill in Germany. The published lifecycle assessment (LCA) compares 50% grass fibre pulp (with 25% wood fibre and 25% wastepaper) against a composite wood input including fibre from South America. It assumes that the wood pulp is chemically processed (to remove the lignin for greater quality), has a lesser yield per tonne of fibre, and will be used at a non-integrated mill.

The reported benefits are selective relating predominantly to transport and assume that the alternative fibre is sourced locally to the mill, within a 50km radius.

SOURCES

1. UN FAO Forest Products Statistics 2018
2. FAO data, 2020
3. CEPI Key Statistics 2019