

SUSTAINABILITY

Environmental benefits of primary fiber vs secondary fiber: it's not black and white

Life Cycle Assessment. A rigorous scientific study, commissioned by Kimberly-Clark but carried out by independent LCA experts, has analyzed the relative environmental impact of primary versus secondary fiber in K-C operations producing tissue products. The result: each has benefits and drawbacks, with no clear winner for K-C marketed tissue products. As the Roman poet, Phaedrus (15 B.C. - 50 A.D.) famously said: "Things are not always as they seem; the first appearance deceives many".

Hugh O'Brian

When considering recycled paper, the gut feeling or immediate, initial reaction most people have is that secondary fiber must be better for the environment in total impact. Certainly, recycling can help reduce pressure on the world's forests, which is something we can all feel good about. I have a personal attachment to this question since I worked for several years as a process engineer in a paper mill near Los Angeles, California, that made newsprint from 100% recycled newspapers. We quite rightly made a big deal out of the fact that "Old news is Good news". After all, the wood fiber was being used for a second, third or perhaps even fourth time, which must be a better use of the world's resources. But a recent independent, peer-reviewed Life Cycle Assessment (LCA) study which was conducted by the respected Environmental Resources Management (ERM) group based in Oxford, UK, and commissioned by Kimberly-Clark, comes up with a surprising conclusion. It shows that for the tissue products that K-C is making, neither primary fiber (which is often called virgin fiber as it is being used for the first time) nor secondary (or recycled) fiber show a clear overall environmental preference as produced by K-C. We recently sat down with David Spitzley, K-C's Product Sustainability Manager based in Neenah, Wisconsin, USA, to discuss the findings. Spitzley, who has a background in Sustainability and Environmental Issues research from both the University of Michigan and the renowned Battelle Institute in Ohio, joined K-C in mid-2006 with his first major task being to coordinate this study.

LOTS OF QUESTIONS LED TO SOLID STUDY. "K-C was getting lots of questions about the use of primary and secondary fiber from various stakeholder groups such as customers, NGOs, investors and employees", recalls Spitzley. "After discussions within the company, our CEO Tom Falk gave his full support to the proposal to have an independent outside firm conduct a thorough, objective study. As we went along, we also decided to have it peer reviewed, which means that the independent findings were then critically reviewed by experts in the field of Life Cycle Assessment to add to the level of credibility."

The LCA, which was done over the course of nearly 11/2 years, looked at the performance of each tissue product across the following environmental impact categories.

Impacts related to air pollution:

- Acidification, acid rain;
- Global warming, climate change;
- Human toxicity, human health;
- Ozone layer depletion;
- Photochemical oxidation, smog.

Impacts related to water pollution and water consumption:

- Eutrophication, nutrient pollution and O₂ depletion;
- Water consumption.

Impacts on resource availability and waste:

- Depletion of non-renewable resources;
- Solid waste.

K-C, along with numerous companies that supply pulp fiber to K-C, made available a wide range of real mill operational data to ERM, which then carried out the LCA according to well-established ISO-standards which dictate the actions and steps which must be followed. Thus it was ERM making the analysis and coming up with conclusions,

which were then peer reviewed by an international panel of three recognized experts in the field of LCA.

NEITHER 1° NOR 2° FIBER CLEARLY BETTER. The key finding is that neither primary nor secondary fiber is environmentally preferable for the 14 K-C tissue products from seven categories (such as bath tissue rolls, folded washroom towel, kitchen towel, commercial wipers, etc.) that were studied in North America and Europe. While this result in itself is somewhat surprising, Spitzley is very cautious about making generalizations, saying that in some mills for some products secondary fiber may be better, while in other sites primary has the advantage. The conclusion, says Spitzley, is that it is not black and white as far as environmental preference; there is a lot of grey area.

“It is really impossible to say that for a certain tissue product, primary or secondary fiber is always better, environmentally. It depends on many factors, such as whether the mill is integrated or not, energy and water supply, technology used in the mill, age of the machinery and many other things.”

“I also want to add,” continues Spitzley, “that this study covers K-C tissue products made in North America & Europe and should not be assumed to be valid for other paper grades or other plant locations. LCA conclusions can’t be extrapolated like that.”

2° FIBER HAS TO COME FROM SOMEWHERE. Secondary fiber has to originally be primary fiber, of course. A method called sensitivity analysis was used to try to account for the fact that secondary fiber might reasonably be expected to carry a portion of the environmental impacts of its initial manufacture and use. To see how significant this “inherited burden” might be on the overall calculation, the researchers then formulated three scenarios for each product category:

- Scenario A: high usage of virgin fibers.
- Scenario B: the highest usage of recycled fibers and where a portion of the environmental impacts “inherited” from the recycled fibers’ previous life is included.
- Scenario BB: the same product as scenario B but where the recycled fiber comes free of “inherited” environmental burden.

Graph 1 shows a visual outline of the relative impacts for nine environmental impact categories that were studied. These specific results refer to North American facial tissue but Spitzley says they are fairly typical of the seven product categories that were examined.

LOWER FOSSIL FUEL USE MEANS LOWER GREENHOUSE GASES. A summary of the impact categories is shown in Table 1, with the nine original categories regrouped for simplification into five areas: Fossil Fuel Combustion (encompassing natural resource depletion, acidification, global warming potential, smog and ozone layer depletion); Human Toxicity; Water Quality; Water Use and Solid Waste.

The key factor which works in favor of primary fiber is energy or, more specifically, the source of energy. This is because much of the energy used at pulp mills making primary fiber is based on renewable biomass, mainly lignin and wood waste, coming in to the mills with the wood. It is hard to get a precise figure and it varies from mill to mill but it is thought that anywhere from 50 to 100% of the energy requirements of a pulp mill is covered by wood biomass. Thus this energy, being green energy generated from biomass, has a much lower carbon footprint compared to the non-renewable fossil fuel based energy that often runs secondary fiber mills. This has to be seen as the “surprise” factor that works strongly to the advantage of primary fiber.

Paradoxically, this heavy use of renewable biomass as a source of energy, also contributes to the strongest factor which goes against primary fiber. This concerns air emissions. The wood biomass that is burned to create energy in pulp mills is based on lignin, a complex aromatic hydrocarbon which does not burn as cleanly as good old fossil fuels. Thus when lignin is combusted there is potential for mixed aromatic compounds to be formed which could be harmful to humans. The quantities of these compounds produced are well below allowable and sometimes even measurable limits but still the potential works against primary fiber in the LCA. Since energy used in secondary fiber is generally based on fossil fuels, there is much lower potential for these types of air emissions to occur in secondary fiber processing.

In the area of water quality, which reflects environmental impacts related to eutrophication (the process whereby water bodies receive excess nutrients which stimulate excessive plant growth and leads to reduced dissolved oxygen), primary fibers were also favored. This is mainly due to water quality degradation which may occur via disposal of sludge containing inks, fillers and other materials from deinking, as well as, again, the use of fossil fuels which generate water pollution in production and burning.

In the last two areas, water use and solid waste, there is generally no significant preference for either primary or secondary fiber. It is pretty even between the two fiber sources.

TOTAL IMPACT OF TISSUE IS SMALL. Another consequential finding that the study reached, when looking so deeply at all the inputs and outputs of the tissue making process, is that the magnitude of the impact of tissue products on the environment is pretty modest compared with other activities such as driving a car. “In the global scheme of things”, explains Spitzley, “tissue products have a pretty low impact when you compare them to other household and commercial activities.”

In conclusion, looking at the study from his background in Sustainability and Environmental Issues, Spitzley says that “this truly is a very well done, scientifically sound LCA study. ERM did a very thorough, objective job and acted as a sparring partner to challenge us. The fact that it is based on real world data, gathered from real production sites making real products, rather than being based on modeling or simulation, gives us a high level of confidence in the results.”

To be frank, it is somewhat surprising that the conclusion that primary and secondary fibers are fairly equal could be reached. But upon examining the study, and taking into account the total impact from all inputs or raw materials and outputs of emissions, waste streams and finished product, the study makes a very good, logical argument for the benefits and drawbacks to each fiber source.

Coming back to Phaedrus, the Roman poet, perhaps things aren't always as they seem, but that doesn't necessarily mean that deception is involved. Sometimes our expectations lead us to believe something that is not truly based on facts. Hopefully this study has helped bring some more factual information to the discussion of primary and secondary fiber for tissue products. •

For more complete information, see these resources:

Full Report:

<http://www.kimberly-clark.com/pdfs/FinalReportLCATissuePaper.pdf>

Executive Summary:

<http://www.kimberly-clark.com/pdfs/LifeCycleAssessment.pdf>