

# Detoxing Future Pulp Production

## Why it's time to revisit the pulp bleaching debate



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*This discussion document by an independent consultant is intended to foster dialogue regarding a key issue of concern or an opportunity for advancing the goals of the Environmental Paper Network's Global Paper Vision. The information contained in this document is the sole responsibility of the author(s) and does not necessarily indicate a consensus viewpoint or formal position of the members of the EPN.*

The Global Paper Vision seeks 'the successful transition to pulp and paper that is made... with water that is as clean after paper production as before, producing zero waste and zero emissions.' Under the goal of clean production, the vision calls for 'Elimination of the use of chlorine and chlorine compounds for bleaching.' However, progress by the pulp and paper industry towards this goal is slow. This paper aims to promote discussion about why and how this progress might be accelerated.

### INTRODUCTION: THE CHLORINE PAPER TRAIL – A SNAPSHOT SYNOPSIS

The pulp and paper industry accounts for more than [40% of industrial wood](#) traded globally. As demand for paper-based products continues to grow, closer scrutiny needs to be applied to the environmental impacts of the chemicals used in their production, in particular the bleaching of wood pulp.

Elemental chlorine as a bleaching agent has been largely phased out of [Kraft pulping](#) since the 1990s due to concerns over the [dioxin by-products](#) released, but its use still persists in some pulpmills. It has been widely superseded by Elemental Chlorine Free (ECF) technology, which now [accounts for over 90%](#) of global bleached Kraft pulp production. However ECF tends to rely on chlorine dioxide as the main bleaching agent – this still risks releasing harmful substances into waterways.

The most environmentally-safe technology available to pulpmills is Total Chlorine Free (TCF), which uses no chlorine compounds. Instead the bleaching process is supplemented with oxygen, ozone and/or hydrogen peroxide. Despite its green credentials, uptake of TCF [remains limited](#) especially outside of Europe.

For the majority of mills, ECF continues to be the technology of choice partly due to claims that it is comparable to, if not better than, TCF in terms of quality and environmental performance. This position paper questions those claims and sets out a compelling case for wider adoption of TCF to help drive new toxic-free standards for the industry.

### 1: THE CASE FOR DETOX – SWITCHING TO TOTAL CHLORINE FREE

The detox agenda relating to industrial water and air pollution is a very relevant one right now. Companies are facing increasing scrutiny over the hazardous nature of their factory discharges and emissions, and are being urged to go beyond standard compliance requirements. Demands to clean up 'dirty' operations are unlikely to diminish given this push for hazardous chemicals elimination and greater supply chain transparency.

The bleaching process represents one of the most important environmental pollutant stages in the pulp and paper industry especially as many mills are sited near sensitive eco-systems, such as rivers or lakes. TCF offers the best assurance of zero toxicity in this respect, as it eliminates all risk of directly discharging dioxins and other hazardous chlorinated compounds such as AOX (Adsorbable Organic Halides) into waterways as effluent. Once released into the environment, these bioaccumulative substances may enter the food chain where they can cause a number of [adverse health effects](#).

While ECF does significantly reduce the potential to form dioxins, it does not completely eliminate this risk. The use of ECF still generates AOX emissions, and it should be pointed out that the environmental performance of ECF mills can vary markedly in this respect. [Research](#) suggests that only the most modern, well managed ECF mills using best available technology are capable of achieving the lowest AOX emission levels. Older and less well designed ECF mills,

which dominate the industry landscape, are likely to be poorer performers, with their toxicity factor ranking some way behind TCF technology.

Further up the production process, TCF also delivers a number of benefits over ECF relating to occupational health and safety. There is no risk of worker exposure to sodium chlorate (used by ECF mills to produce chlorine dioxide) either during the handling or transport process. Sodium chlorate can cause nausea, vomiting, diarrhea and abdominal pain. It may also damage the kidneys and affect the liver. It is worth noting that the production of chlorine dioxide itself has also been found in some cases to produce residue dioxins, according to [research](#) by the Swedish Forest Industries.

It must be stressed that chlorine dioxide is a flammable gas and as such presents an explosion risk. Various [reports](#) have suggested that any accidental leaks or spillages of the gas or its by-products from mill processes could prove hazardous – not just to the mill workers, but also to those living in nearby communities. Thus ECF mills must take extensive measures to mitigate these risks by safeguarding the enclosure of chlorine and chlorinated compounds, and reducing their toxicity profile where possible.

There are also end-of-life concerns. The ECF bleaching process effectively leaves a chlorine [‘footprint’](#) in the paper, which stays throughout the entire lifecycle. This means when ECF paper is recovered and recycled, the chlorine compounds embedded within it still pose a risk to paper reprocessors and to the environment, e.g. when burning paper crumple at recycling mills, or handling de-inking effluent.

Taking the above factors into account, TCF has several advantages in reducing environmental risk as a readily available technology. Production of the oxygen-based bleaching chemicals used in TCF mills such as ozone and hydrogen peroxide requires less toxic inputs, and because TCF produces no chlorinated substances, the treatment and monitoring systems deployed on-site – such as those used during the filtration and washing stage – are likely to be less complex.

TCF can also contribute to improved resource efficiency within mills as it offers good potential for lowering water usage – by a factor of 2 – compared to the ECF bleaching process which generally requires more water circulation. The argument here in favour of TCF is that due to the accumulation of chlorine compounds in filter systems it is more challenging for ECF mills to create closed loop pulping systems that recycle wastewater from the bleaching process. A TCF mill operator in Sweden has reported that its total wastewater effluent volumes are half that of typical ECF discharges<sup>1</sup>.

Given the water-intensive nature of paper production, TCF should be strongly promoted for its ability to minimise fresh water usage. Reducing fresh water use at mills results in a number of operational benefits. These include:

- Reduced effluent discharge
- Less overall chemical and energy use
- Lower fuel costs
- Reduced water treatment costs

## **2: THE SCALE-UP CHALLENGE – IDENTIFYING THE BARRIERS**

Despite the cleantech merits of TCF, it remains an understated technology. Its [market share](#) peaked in 1998, and has since stagnated, except in more environmentally aware regions such as Scandinavia where the technology has been more widely adopted. The main barrier preventing greater uptake of TCF is the upfront cost of conversion, a capital investment which has been heavily resisted by most mills so far.

The case for TCF has also been undermined over time by a series of exaggerated claims arguing that the technology requires a higher degree of management capacity, that oxygen-based bleaching agents result in inferior pulp quality, higher wood consumption and that higher energy inputs are required to power the process. This position paper sets out its own arguments to dispute these claims (see separate box, **Pulp Fiction? The Myth Buster**).

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<sup>1</sup>SCA and Södra presentations. (Copies available on request).

A great deal of literature has been published and circulated in support of ECF over TCF, but questions need to be raised over how much of this research has been independently peer reviewed, rather than subsidised or influenced by ECF lobby groups. The most important academic paper to come out in favour of TCF, known as [The Stockholm Study](#), has been independently peer reviewed.

The prevailing view within the industry is that ECF is comparable to TCF in terms of toxicity risk factor and environmental performance. This view needs to be challenged if non-TCF mills, especially those producing dioxins and higher AOX emission levels, are to be encouraged to upgrade their operations and switch to cleaner 'best in class' technology.

In the absence of robust regulation, a stronger case must be made to the industry for TCF and promotion of the development of breakthrough methods such as near waterless production using [flash condensing with steam](#) or utilising plant-based [deep eutectic solvents](#) to reduce energy and chemical residue, as developed by CEPI's 2-Team project. Building market demand for TCF products is critical. These recommendations are explored in more detail in **Section 4**.

### **3: WHY ACT NOW? PUTTING THE SPOTLIGHT BACK ON CHLORINE**

More and more industries are coming under increasing pressure to detox their supply chains as their ethical practices are called to account. Elimination of dioxins and other toxic and bioaccumulative chemicals should be the ultimate end goal for the pulp and paper industry, but instead, it remains one of the largest and [most polluting industries](#) in the world.

The focus on pulp bleaching has waned in recent years. It has largely become a forgotten issue among the public and even among some environmental NGOs, who may have assumed the case for TCF had previously been won. A poll made ten years ago in Germany showed that around 75% of the people were convinced that all paper were TCF. This, coupled with the fact that production levels of TCF pulp are now so low in comparison to ECF, means there is a real risk that the issue will fade away completely. With more new ECF mills coming on stream, it is time to bring the chlorine debate back to the table.

Elemental chlorine still accounts for around 5% of global bleached Kraft pulp production<sup>2</sup>, and acceptance of only partial detox should be considered not good enough. The situation isn't likely to improve without further intervention – in its recent [assessment](#) of the pulp industry, the Environmental Paper Network warns that even new mills pose a serious risk of pollution unless they are built in countries able to enforce environmental standards.

TCF technology has now advanced to a point where it should be considered a disadvantage – both economically and environmentally – to invest in, or continue to use, chlorinated substances to bleach pulp. For mills with strict environmental targets, TCF represents a clear opportunity to reduce mill effluent loads to [zero discharge](#) – a goal previously thought impossible.

This is especially relevant given that production methods that use less chemicals, water and energy may one day become necessary. The Confederation of European Paper Industries notes that if the pulp and paper industry is to reduce its carbon impact whilst creating added value, then it must adopt [breakthrough technologies](#). These include trialling new methods such as near waterless production using [flash condensing with steam](#) or utilising plant-based [deep eutectic solvents](#) to reduce energy and chemical residue. These aims are already achievable, to some extent, with existing TCF technology, but developing and testing these methods might also offer further opportunity for a toxic-free future.

Given the push towards responsible sourcing, forest conservation and cradle-to-cradle lifecycle thinking, the elimination of chlorine makes good business sense. As customers and consumers exercise more diligence over the purchasing choices they make, those mills who can not only meet, but exceed, supplier specifications around sustainability and ethics are likely to prosper going forward.

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<sup>2</sup>A graph over time of chlorine/ECF/TCF bleaching, produced by the chlorine industry lobby organisation, AET is here: [http://www.aet.org/science\\_of\\_ecf/eco\\_risk/2010\\_pulp.html](http://www.aet.org/science_of_ecf/eco_risk/2010_pulp.html)

#### **4: CALL TO ACTION – A TARGETED CAMPAIGN MANIFESTO**

There are a number of influential NGOs running targeted Detox campaigns such as [Greenpeace](#), [5Gyres](#), [Amnesty International](#) and [38 Degrees](#). The spotlight should fall next on the pulp and paper industry, and its use of chlorine and chlorine derivatives. A four-pronged approach may be helpful here, calling for action on four specific fronts: producer responsibility, markets, investors and regulation.

##### **Strengthen individual producer responsibility**

Campaign manifestos should demand better disclosure and transparency of mill factory practices relating to hazardous chemicals use. Non-TCF mills should be encouraged to commit to ‘zero discharge’ policies by adopting clear deadlines for the elimination of chlorine and chlorine derivatives from their production processes. This could encompass a stepped approach to phase-out.

For new mills due to come on-stream, but still in planning, TCF should be promoted as the technology of choice. As pointed out in **Section 1**, TCF offers a number of additional benefits – these include lower water usage, no need for on-site production of chlorine dioxide, and reduced risk of hazardous accidents. Investors in new pulp mills and financiers of companies undergoing production expansion or upgrades should be demanding the use of TCF as a condition of finance.

The sharing of best practice would be helpful: those mills that have made, or are making, the transition to TCF should be encouraged to promote their experiences so others can learn and follow. Both Södra’s [Värö facility](#) and SCA’s [Östana plant](#), for example, have a proven track record in producing high quality TCF pulp, yet they claim a reduction in demand for TCF both in Europe and in China, and indeed that there is demand from China only for ECF. This needs to be challenged and evidence provided to generate a preference for TCF from the Chinese market.

##### **Create market demand for toxic free products**

Greater demand for toxic-free products would encourage more mills to make the switch to TCF and develop and test innovation. Public and private sector procurement has a key role to play here. Corporate paper buyers should be encouraged to stipulate tighter supplier specifications for toxic-free paper production, and demand disclosure of quantities of dioxin / AOX emissions released. Governments could show real leadership here with their public procurement policies. More needs to be done to raise public awareness of the issue through educational and media campaigns.

##### **Call for robust regulation**

Government intervention generally remains weak in this area. Chemicals management policies such as the US Environmental Protection Agency [Cluster Rule](#) and the European Commission [BREF document](#) for paper and pulp production must be strengthened if they are to effectively encourage the elimination of chlorine use within the industry. National governments should also be called upon to create a publicly available register of paper mill data on dioxin/AOX discharges, emissions and other pollutant releases. Current reporting standards differ a lot both between companies and countries; Austrian governmental bodies have high standards, as do some Swedish companies, and these should be the norm. Transparency is very important and should be an important regulatory issue given that the companies pollute public air and water.

##### **Divest from toxic production**

NGOs should call upon financial institutions and investors to stop funding toxic pulp and paper production methods, encouraging them to move assets such as stocks, bonds or funds out of. In particular, divestment strategies should target any new pulp mill project which is not installing the cleanest, most water-efficient TCF processes or any newer technology leading to zero discharge. Appetite is high for the divestment agenda – a case in point being the phase out of [fossil fuels](#), which has become the fastest growing divestment campaign in history.

## **PULP FICTION? THE TCF MYTH BUSTER**

### **TCF is an expensive technology to install**

When converting an ECF mill to TCF there will be upfront costs to consider, especially in the decommissioning of any on-site chlorine dioxide production equipment. However, for new build mills the economics of choosing TCF over ECF are comparable, if not cheaper. A [recent study](#) which directly compares these operating and investment costs suggests that in some cases, TCF can result in cheaper installation and running costs.

### **Use of TCF results in an inferior pulp quality**

Oxygen-based Kraft pulps should show no loss in quality or brightness when compared with chlorine dioxide bleached products if produced in a well managed mill using best available technology. Most modern mills employ a 'prolonged cooking' pulp treatment process prior to bleaching. This makes the pulp easier to whiten, and means TCF can achieve the same brightness levels as ECF.

### **More timber and energy is used in TCF mills**

This may be true if TCF pulp is manufactured in old bleaching units, or originally designed for chlorine dioxide. Two modern TCF mill operators, which have produced 100% TCF for twenty years, report no increase in timber consumption, per ton produced pulp, since introducing TCF<sup>3</sup>.

### **TCF is unnecessary as ECF improves**

While the most modern and best managed ECF mills can achieve extremely low levels of dioxin and AOX emissions, these are in the minority. These lower toxicity outputs are largely due to advances in oxygen technology; the partial replacement of chlorine dioxide with oxygen-based bleaching agents. The environmental performance of ECF mills still varies markedly.

## **DATA DIGEST: PULP BLEACHING STATISTICS**

### **Global picture**

Bleached Kraft pulp accounts for [more than 50%](#) of the wood pulp used for papermaking, and demand is predicted to grow significantly in the coming years, primarily because of predicted growth in packaging. The vast majority of global Kraft pulp production is bleached using ECF technology – it currently commands over 90% total market share. In 2012, ECF pulp production reached 93.9 million tonnes. TCF's market share meanwhile is much smaller – around 5%. In 2012, TCF pulp production reached 4.7 million tonnes, while pulp bleached with some elemental chlorine accounted for 2.4 million tonnes.

### **Regional breakdown**

Uptake of ECF is rising throughout the world. In North America it dominates, accounting for 99% of bleached chemical pulp production, while in South America it represents over 97% of production. New investments relating to ECF are planned for several countries including China, Uruguay, Sweden and Brazil. Some nations such as Russia, China, India and Japan remain significant users of elemental chlorine, but there is an ongoing conversion to ECF. Conversely, Europe boasts the highest production of TCF (nearly 20%) in the world. The Scandinavian countries lead the way here where TCF accounts for more than a quarter of output, driven to a large extent by German market demand. In 2012, Scandinavia produced 2.8 million tonnes of TCF bleached pulp compared to 10 million tonnes of ECF.

\* Statistics quoted relating to ECF/TCF market share are based on best available [market data](#)

EPN is keen to facilitate dialogue on this topic among our member organizations and with other stakeholders in the pulp and paper industry. To this end, this discussion document will be posted on our website and accompanied by a webinar, which will be recorded and made publicly available. Please feel welcome to send comments to Mandy Haggith, EPN Co-ordinator, [hag@environmentalpaper.org](mailto:hag@environmentalpaper.org).

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<sup>3</sup>Presentations from Södra and SCA, available on request.