

# How to Handmake Hemp Paper for fun!

A resource guide from

**[www.hemp.co.uk](http://www.hemp.co.uk)**

## Introduction

Welcome to this introduction to making hemp paper.

In this brief introduction I will presume you have an overview of the industrial hemp market, or have read [Modern Introduction To Hemp](#).

You will find some history of hemp paper, facts and figures and comparisons of hemp and trees as sources for paper.

Then you will find a guide showing you how to make hemp paper by hand. There are links to other websites and youtube videos that show you how to do this in detail.

This guide culminates in an excellent paper on the use of industrial hemp crops for the paper industry – a potentially massive consumer of industrial hemp. Today hemp paper is made predominantly in France for the production of hemp papers, though there are many other opportunities I hope you will explore.

At time of going to press, a Canadian paper mill with facilities for production of hemp paper was available for sale at Euro1.1m. Let me know if such an opportunity would interest you!

Have fun, and whatever you choose, choose it for you as you are part of this Earth and all that it reflects will be you.

Hempfully yours,

Paul

## About The Author

Paul Benhaim is a recognized world-authority in hemp research and development, as well as a published author of Hemp-related books and DVDs. He manages the world's most popular Hemp web sites and advises a number of international companies.

As well as acting as an independent consultant and mentor to those interested in business, usually the hemp business, Paul is CEO and Director of a cutting edge Hemp companies involved with hemp plastic and hemp food products.

Paul continues his quest to ensure the path for the widespread use of industrial hemp is accessible to all so new and revolutionary Hemp products may become available to a worldwide audience.

Born in London, after travelling the world for a decade, Paul now lives and works from his rainforest home in coastal Australia.

For further information on some of Paul's projects enjoy: [www.hemp.co.uk](http://www.hemp.co.uk) and [www.hempplastic.com](http://www.hempplastic.com)

## DISCLAIMER

This book is intended to help you decide if you want to start a hemp business. This book is not intended to be the only business you receive. You are recommended in this book to write a business plan. You should check all the data and facts are up to date and relevant to your location, state and federal laws. It is also strongly recommended that you speak with your lawyer, accountant and bank manager before moving ahead with any business. You may want to consider a personal business mentor as well.

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## **Hemp Paper Facts**

**Thanks to [Living Tree Paper](#) company for these facts.**

Producing pulp and paper casts an ecological shadow far beyond its impact on the world's forests. Converting trees into paper uses large amounts of water, energy, and chemicals and generates vast amounts of air and water pollution.

The pulp and paper industry is the fifth largest consumer of energy, accounting for 4 percent of all the world's energy use.

The pulp and paper industry uses more water to produce a ton of product than any other industry.

Consumers play a pivotal role in reshaping the future of the pulp and paper industry.

40 percent of office paper still ends up in overburdened landfills.

Expanding the reuse of paper reduces the pressure to cut more trees, reduces demand on overburdened waste disposal systems and cuts energy use and pollution. One ton of recycled paper produces one ton of new paper, which is far more efficient than using virgin wood fiber.

Annual plants such as flax and hemp have been used in papermaking for thousands of years.

Non-wood fibers such as flax and hemp are rapidly renewable resources that can contribute to more environmentally-sound fiber blends.

Flax and hemp yield longer fibers and can assist in creating high quality paper when added to shorter fiber resources such as recycled office paper (post-consumer waste).

1 ton of Living Tree Paper Company's Vanguard Recycled Plus\* requires 43.69% less energy to produce the the same amount of virgin pulp paper. That is an energy saving equal to 4,920 Kilowatt Hours of Electricity, an amount equivalent to operating the average Northwest home for 6 months. This

reduces the atmospheric emissions of Greenhouse Gases by 2097 pounds, an amount equal to driving the average car for 2468 miles.

### **Hemp as Paper**

Hemp fabric was smashed down into thin sheets to make the world's first paper. 75-90% of all paper in the world was made with hemp fiber until 1883. The Gutenberg Bible, Thomas Paine's pamphlets, and the novels of Mark Twain were all printed on hemp paper. Both the U.S. Constitution and the Declaration of Independence were drafted on hemp, and then copied onto parchment.

Both the long bast fiber and the short bast fiber (hurd or pulp) can be used to make paper. Fiber paper is thin, tough, brittle, and rough. Pulp paper is not as strong, but is easier to make, softer, thicker, and preferable for most everyday purposes.

In the next 20-30 years the paper demand is suppose to at least double due to the economic emergence of third world countries, and the ever-expanding worldwide population. There is no way to meet this demand without clear-cutting every tree in the entire world. Paper is big business, and 93% of the world's paper is made of wood.

### **Hemp Pulp vs. Tree Pulp for Paper**

Making paper from trees is kind of a joke, because trees are made up of only 30% cellulose. The other 70% of the tree must be removed using toxic chemicals, until the cellulose can be formed into paper. The higher the percentage of cellulose in a plant, the better, because fewer chemicals need to be used, and less work needs to be done before the paper can be made. Almost any plant in nature with a strong stalk is better suited to make paper than trees, especially hemp because it can be 85% cellulose.

Hemp makes paper stronger and which lasts centuries longer than wood paper, which could be very valuable for people who want to keep records aside from on computers. Hemp paper does not yellow, crack, or otherwise deteriorate like tree paper

does now. The acids which are needed for wood paper eventually eat away at the pulp and cause it to turn yellow and fall apart. Because of this publishers, libraries, and archives have to order specially processed acid free paper, but they could just buy hemp paper which already meets their quality standards.

Hemp paper also does not require any bleaching, and so does not poison the water with dioxins or chlorine like tree paper mills do. The chemicals involved in making hemp paper are much less toxic, in fact, both paper made from hemp hurd, and from the long bast fiber can be made without any chemicals at all, but it takes longer to separate the fiber from the lignin. Making paper from hemp could also eliminate erosion due to logging, reduces topsoil loss, and water pollution caused by soil runoff.

One acre of hemp can produce as much paper as 4 to 10 acres of trees over a 20-year cycle, but hemp stalks only take four months to mature, whereas trees take 20 to 80 years. This information was known in 1916, according to a USDA report. Hemp paper can also be recycled more often, though this fact is not of much value, since hemp is a reusable resource.

### **Deforestation**

Since 1937, when hemp was effectively outlawed, 70% of American natural forests have been destroyed. Today, only 4% of America's old-growth forest remains standing, and there is talk of building roads into that for logging purposes! Hemp growing could completely negate the necessity to use wood at all because anything made from wood can be made from hemp.

The plant kenaf is better suited than hemp for making some qualities of paper, but hemp has one huge advantage, hemp generates an immense amount of plant matter in a four month growing season. Plants like Kenaf just cannot produce enough plant material to make enough paper for what the world demand is and will soon become, making hemp the only organic paper which makes sense. If hemp farming were only

geared toward papermaking, it would still be a giant move to improve the planet.

Germany's largest paper company converted two mills to hemp-based paper production, even though large mills require 40-60% of the equipment to be retooled to switch to hemp based paper. Hemp paper is the one area of the possible hemp market that would require a lot of equipment change, but the need exists to change the equipment, or we will not be left with any more trees for shade, scenery, and good old-fashioned air. The construction costs to convert our paper mills from tree-based paper to hemp is around \$100-300 million, which would at the same time open doors for new jobs and opportunities to build new equipment.

The reason for these equipment changes lies in the fact that the hemp fiber is so strong. The chains of cellulose molecules are arranged as a rigid structure glued together by the lignin, which must be separated before the fiber can be arranged into paper.

Hemp currently makes up around .05% of the world annual pulp production volume at around 120,000 tons/year because importation costs result in prices which are 2-3 times that of tree paper, but Living Tree Paper Company out of Oregon is starting to make headways. Their paper, which is 10% hempflax & 90% post-consumer waste, is now being sold in 1,000 Staples stores across the country. Next time you need paper for your computer, choose the paper which is friendly to the environment. One of Living Tree Paper Company's slogans is, "The paper you choose says as much about you as the image you print on it."

Pure bleached white hemp cellulose is now freely available on the market. Contact [hemp.co.uk](http://hemp.co.uk) for your quote today.

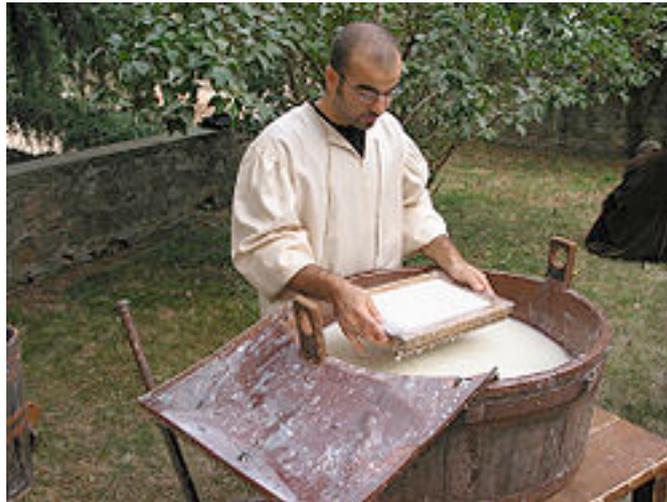
## How to Make Hemp Paper

Before you begin, here are some things you will need:

- Hemp
- Blender
- Deckle (a removable wooden frame, see [video](#))
- Water
- Newspaper or towels
- 12 oz. of hemp or hemp stems
- Large pot
- Shallow pan
- Rolling pin
- Iron
- Soda ash

1. Purchase hemp from a reputable buyer (see [www.hemp.co.uk](http://www.hemp.co.uk)). Hemp is legal in most countries in the world to grow (current not yet in the United States). However, it seems that no where is it illegal to own hemp or hemp products, except for food.
2. Soak the hemp for 12 to 24 hours in water.
3. Put the hemp on low heat and add some soda ash. Cook the hemp for about 8 hours. The hemp should still feel tough.
4. Put the hemp into a blender for about 2 minutes until it turns fluffy or soft. For a different texture of paper, try adding shredded newspaper or similar soft paper to the mixture. You can also increase or decrease the amount of time you use to blend the materials. You can also choose to add dyes to the mixture.
5. Pour the hemp substance (known as slurry) into a shallow pan.
6. Scoop your deckle into the bottom of the pan and lift straight up very slowly. Once the deckle is free from the mixture, allow any excess water to drip off before moving to Step 7.
7. Flip the deckle paper side down onto a clean towel or newspaper. The paper should come off onto the towel.

8. Place another towel on top of the paper. Roll over the towels and paper with a rolling pin to squeeze out any excess moisture.
9. When paper is almost dry, iron it using the hottest setting on your iron. This will help finish the drying process and flatten it at the same time.
10. If you have excess slurry, you can put it in a plastic bag and freeze it



*the art of papermaking*

## **Video on How to Make Hemp Paper**

Watch this excellent video produced by Bob Newland, Matt Rankin, Jeremy Biggs and Rob Robison of the Lakota Hemp Project

<http://www.youtube.com/watch?v=iUQkMnvQoaQ>

# Hemp: Specialty Crop for the Paper Industry

*A report courtesy of Anthony Capelle*

In 1994 a four year research program to evaluate the feasibility of the cultivation of hemp (*Cannabis sativa* L., Cannabinaceae) as a raw material source for the paper industry was finalized. Three aspects, primary production, pulp processing, and paper production, based on an integrated chain model from farm to factory were studied ([Fig. 1](#)).

This research program was part of a broader business concept study as a basis for starting a commercial hemp pulp processing unit. In this paper a summary of the research results will be presented. For more detailed information see van Berlo (1993).

## Primary Production

### Genetic Collection/Optimization

Since 1986, a collection of commercial available germplasm including old cultivars and wild material was initiated. The research objectives which cultivar was best suited for paperpulp production under Dutch condition. The stem composition and content of cannabinoids were used as the selection criteria.

Based on earlier studies it was concluded that a late flowering resulted in a higher yield. In field trials carried out in successive years, several cultivars (Kompolti Hybrid TC, Kompolti Sárgaszáru, Kompolti Hyper Elite, Kozuhara, and Fedrina 74) were evaluated. “Kompolti Sárgaszáru” and “Kompolti Hyper Elite” proved to be the best suited in regards to yield and fiber quality. Yield in dry matter varied between 11 t/ha for peat soil and 17 t/ha for clay soils. The bast fiber content varied between 12% and 35%, the woody core varied between 50% and 75%. The total of the two fractions remained more or less constant at 85% of the stem dry substance. Cannabinoids content of the different accessions varied between 0.06% and 0.22% for THC, in comparison with

10% THC for drug types.

### **Cultivation**

Growth trials were carried out at three different locations (peat soil, sandy clay, and heavy clay) in a three year period ([Fig. 2](#)). Hemp gives the best results when cultivated on light soil at a soil pH of at least 5. Fertilization of 12 kg N, 15 kg K<sub>2</sub>O and 4 kg P<sub>2</sub>O<sub>5</sub> is needed per ton of dry matter. Seeding should start from mid Apr., as soon as soil conditions make it possible. On heavy clay soils compaction must be prevented as this severely hinders the growth. Hemp can be grown as a row crop with optimum distance 12.5 cm between the rows and a plant density of 900,000 plants/ha. At a seed weight of 19 mg and an emergence of 85% a quantity of 20.1 kg seed/ha is required for planting.

No herbicides are necessary as the crop suppresses weeds. On weed infested soils, plant density should be relatively higher and the row distance less. No major diseases have been identified, however during wet seasons, Sclerotinia and Botrytis, result in lower yields. Spraying with fungicides had no effect.

### **Harvesting/Postharvest Treatment**

The best harvest time is from the beginning to mid Sept. depending on the cultivar.

Harvesting and postharvest treatment with existing equipment is a decisive factor in the production of hemp pulp. If the farmer can carry out most of the needed activities with already available equipment, the direct costs will be low thereby promoting a successful adoption of this crop. The following harvesting techniques were studied: topping, cutting, windrowing, chopping, press baling, and ensilage. In topping, most of the leaves and flowers from the top of the plant are removed prior to harvesting. The cutting has to be done in such a way that as little sand as possible is picked up, while maintaining optimum yield. It is best carried out with a so called row distance independant cutter bar in front of a forage harvester.

After chopping the hemp can be ensiled at the farm. To optimize the processing of hemp into pulp over the year drying and ensilage was studied as a conservation storage technique. Ensilage is appreciable cheaper than drying and more reliable. The paper quality of ensiled hemp is slightly less than of the dried hemp, but still of acceptable quality.

## Pulp Processing

### Preprocessing

The hemp stem consist of about 65% corefibers and 35% bast. The corefiber consist of 40% cellulose, 24% hemicellulose and 22% lignin, the length is 5.5 mm. The bastfiber is 75% cellulose, 9% hemicellulose and 5% lignin with a length of average 20 mm. As the differences between these two fractions merit a separation into two separate raw materials, research was carried out into this aspect.

Separation can be carried out before of after storage at farm level or at the pulping facility. As harvest takes place in Sept., a rather wet period, dry separation was discarded. Two options were selected, sieving and flotation. Flotation proved to be a feasible technique with a selectivity of more than 90% for bastfiber.

### Pulping

Four pulping processes were investigated for hemp ([Table 1](#)). Depending on the end application of the pulp, thermomechanical pulping (TMP) of the whole stem is possible. A more optimal result was reached when the core fraction from the earlier in core and bast fraction separated stem was thermomechanically pulped and milled in a refiner and the bast fraction, together with an alkaline (pre)treatment, was extruded in a double screw extruder (Fig. 3, 4). Extrusion has the advantage of 30% less energy consumption, while the length of the fiber was better controlled by fine tuning of the extrusion conditions. A patent was filed for this process by ATO-DLO.

In most cases, especially for short lived applications, there is no lignin removal. The desired color of the paper can be adjusted by bleaching with peroxide ([Fig. 5](#)); when pure

cellulose is the end product, an ozone treatment is possible.

### After Treatment

An important factor to be considered in pulping ([Table 1](#)) is the cost of waste water treatment. In waste water treatment, biological oxygen demand, aquatic toxicity, and the color of the water are important factors. In principle the waste water contains easily degradable components such as sugars, fatty acids, and alcohols while lignin an almost non-degradable component is responsible for the color. A combined anaerobic-aerobic treatment with an upfront dilution process to remove the resins, effectively solves the problems.

### Paper Production

Different types of paper were produced from the pulped hemp. The traditional applications for hemp papers vary from cigarette paper to art papers and represent a total volume of about 120,000 t/year worldwide, making up about 0.05% of the world pulp volume. However, for these applications a chemical pulping is necessary. For wider bulk applications, such as printing and writing papers and corrugated board, cost is the decisive factor ([Table 2](#)).

The properties of chemomechanical core and bast pulp compare very favorable with the traditional wood pulps ([Table 3, 4](#)).

### Conclusion

We conclude that hemp pulp is very competitive with the usual pulps when printing and writing paper application is taken into consideration ([Table 5](#)).

The building of a pilot unit with the capacity of about 5,000 t/year for upscaling studies is now under consideration.

### References

van Berlo, J.M. Dec. 1993. Papier uit hennep van Nederlandse grond. ATO/DLO, Wageningen.

\*Special thanks to Mrs. M.J.J.M. van Kemenade for ATO-DLO at Wageningen, the Netherlands for making available all relevant information.

**Table 1.** Comparison of four pulping processes investigated for hemp.

Pulping process	Temp. (°C)	Time (h)	Fiber/liquid	Comments
Thermomechanical (TMP)	120	2	10:1	
Akaline TMP (CTMP) <sup>z</sup>	120			Extruder <4% NaOH
Soda	165	0.5	10:1	2% NaOH
Organosolv	195	0.5	9:1	Ethanol/water = 1.2

<sup>z</sup>CTMP = chemithermomechanical pulping.

**Table 2.** Cost of chemical and chemomechanical processes for hemp vs. chemical processing for softwoods.

Process	Chemical	Cost (US\$/t)	
		Hemp Chemomechanical	Softwood Chemical
Pulping	2,100	530	820
Papermaking	1,900	800	800
Total cost	4,000	1,330	1,620

**Table 3.** Chemomechanical characteristics of bast pulp vs wood pulps for printing and writing grade blends.

Fiber	Beating degree (SR) <sup>z</sup>	Density (kg/m <sup>3</sup> )	Tensile strength (Nm/g)	Burst strength (kPa.m <sup>2</sup> /g)	Tear strength (mN.m <sup>2</sup> /g)	Brightness (ISO) <sup>z</sup>	Opacity (ISO)
Softwood sulphate	30	720	91	4.0	11	90	75
Hemp bast	50	550	48	4.2	12	82	76

<sup>z</sup>SR = standard reflection, ISO = international standardization organization.

**Table 4.** Chemomechanical characteristics of core pulp vs wood pulps for printing and writing grade blends.

Fiber	Beating degree (SR)	Density (kg/m <sup>3</sup> )	Tensile strength (Nm/g)	Burst strength (kPa.m <sup>2</sup> /g)	Tear strength (mN.m <sup>2</sup> /g)	Brightness (ISO)	Opacity (ISO)
Aspen APMP	56	709	53	2.5	2.2	82	73
Hemp core refiner	59	714	59	2.7	2.8	78	75

**Table 5.** Economics of hemp assuming high yield, small module scale, and no recovery system. Investment is calculated for a 5,000 ton/year pilotplant.

Operation	Annual cost/tonne (US\$)
Investment estimates	
refit	480
greenfield	600
Operational costs	
fiber crop	130
pulping operation	400
Total	530
NBSK <sup>z</sup>	950

<sup>z</sup>Non-bleached standard kraftpulp, price is used as a reference.

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Capelle, A. 1996. Hemp: Specialty crop for the paper industry. p. 384-388. In: J. Janick (ed.), Progress in new crops. ASHS Press, Arlington, VA.

# The Hemp Network Business Opportunity

## The Time For Hemp Is Now... Join The Hemp Revolution!

**The Hemp Network** represents the first marketing distribution channel in history that will provide consumers with hemp products on a direct sales and a network marketing platform.

We are in an industry that has been around for thousands of years, with new uses for hemp being constantly developed. The use of hemp is growing dramatically and will continue as more recognized uses occur.

Over the past few years it has become apparent that with the increasing pace of new products hitting the market, there is a need to move those products throughout the world at a very fast rate.

**The Hemp Network** has been formed to provide a marketing vehicle for massive global distribution of these new products and services as they hit the market, which is imperative to capture market share.

Expectations are that our marketing team will become a major force in the exploding hemp product marketplace... and we are offering individuals like you the opportunity to capitalize on this exploding market.

**The Hemp Network** offers the winning combination of product, people, management and vision to all work together to create a very large global marketing company with our agents earning income from people spread around the world.

There has never been a more perfect time to take advantage of an industry that has been around for thousands of years, with products derived from hemp being used by millions of people today. Over the past few years it has become apparent that with the increasing pace of new hemp products hitting the market, there is a need to move those products throughout the world at a very fast rate.

Join our very special team and get unique support for your new business! Go [here](#) now.

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