

# Environment-Conscious Technologies

## Clone Cultivation Technologies

Forestation techniques applying clone cultivation technologies are a beneficial tool for supporting the creation and preservation of forest resources, which is one of the Action Guidelines in the Nippon Paper Environmental Charter.

By increasing the quantity of trees that have high growth potential and are well suited to pulping conversion, we are able to enhance the growth potential of wood chips and decrease the scale of tree felling. Also, by supplying chips with high pulp-yield rates, the amount of energy consumed in the pulp-producing process can also be reduced.

However, while Nippon Paper makes wide use of eucalyptus trees in its forestry operations, the cloning of eucalyptus trees with high growth potential and high levels of pulping suitability has proven to be technologically difficult.

In response to this dilemma, we have applied our own photo-cultivation techniques, which use carbon dioxide, light, water, and no sugar to cultivate plant life, and which promote photosynthetic capacity. The result was the successful cloning of tree species that had hitherto resisted cloning. Because the technique uses no sugar, it eliminates the need for troublesome sterilization procedures and substantially enhances the growth potential of seedlings. Furthermore, through the development of low-temperature storage technologies that enable the supply of clone seedlings whenever needed, we were able to control the production of clone seedlings and succeeded in advancing to the practical application stage of clone forestation.



In the trial cultivation of clone seedlings conducted thus far in Chile, Myanmar, and China, the specimens continue to display steady growth. In June 2000, we established an outpost branch of the forestry research division in Collie, Western Australia, where we have begun full-fledged proving trials on clone seedling cultivation.

## Genetic Engineering

Using Nippon Paper's very own biotechnologies to introduce advantageous genes into trees and other flora, plants with superior qualities can be cultivated. The development of trees with high growth rates and high pulp conversion suitability will help to both increase energy efficiency and decrease environmental impact.

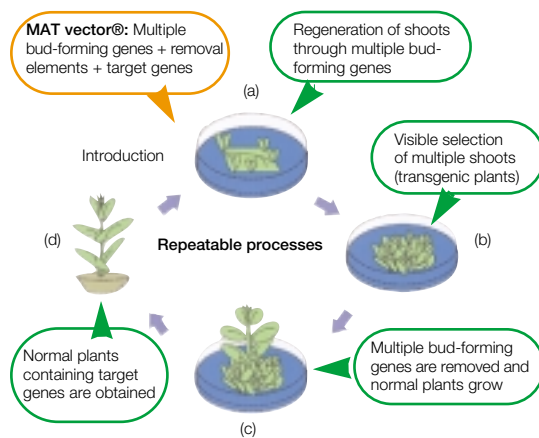
### ●Recombinant Gene Technology

Nippon Paper has independently developed the MAT vector® system, which is an effective means of introducing genes into plants.

The MAT vector® system is different from previous technologies in that it does not leave marker genes behind in plants, which increases ecological safety. The system is a breakthrough technology that allows for the repeated introduction of additional genes into a single recombinant plant.

The MAT vector® system is patent pending in countries worldwide and has already been patented in the United States, Australia, and New Zealand.

### The MAT vector® System



### ●Seeking Useful Genes

Nippon Paper is seeking to identify genes that will help create trees with low lignin content and rapid growth rates as well as increased resistance to cold, salt, and air pollutants. The Company has already identified the Ntlm1 gene as being closely related to lignin synthesis.

Currently, the Company is carrying out effective genetic research involving the application of the MAT vector® system to a diverse range of plants other than trees.

### Electrolytic Oxidation Polysulfides

Nippon Paper, in cooperation with quinone chemical manufacturer Kawasaki Kasei Chemicals, Ltd., and Asahi Glass Company, which possesses ion-exchange membrane electrolysis technology, has succeeded in developing an electrolytic oxidation process to produce polysulfide, which is used in an environment-friendly pulping technology.

This technology oxidizes sodium sulfide cooking liquor in an energy-efficient way using special electrolytic cells. Compared with conventional air oxidation processes, this technology produces polysulfide cooking liquor with twice the concentration. Manufacturing pulp using this cooking liquor enables increased pulp-yield rates and savings of approximately 5% in such raw materials as wood chips compared with conventional KP cooking. For example, it is possible to conserve wood resources of 50,000 cubic meters per year at a pulp mill producing 1,000 tons of pulp per day.

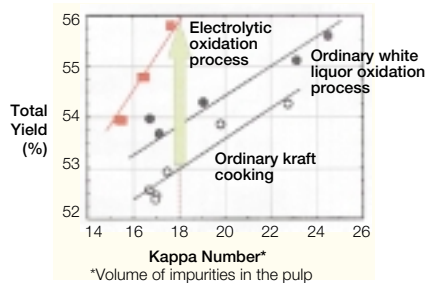
The new method also has the potential to contribute to the achievement of zero wastewater at pulp plants. Because it allows the in-house production of caustic soda, pulp bleach wastewater could in the future—and in combination with non-chlorine bleaching methods—be condensed and combusted as a fuel source, while bleaching chemicals can be recovered and recycled in-line. We have already developed high-efficiency special electrolytic cells and, having received a grant from MITI for “Developing Creative Industrial Technology,” have installed pilot apparatus at our Iwakuni Mill and are continuing to conduct practical application tests. With the establishment of such long-term sustainable-operations technology anticipated, we have also commenced feasibility studies on commercial-scale equipment installation.

### Ozone ECF

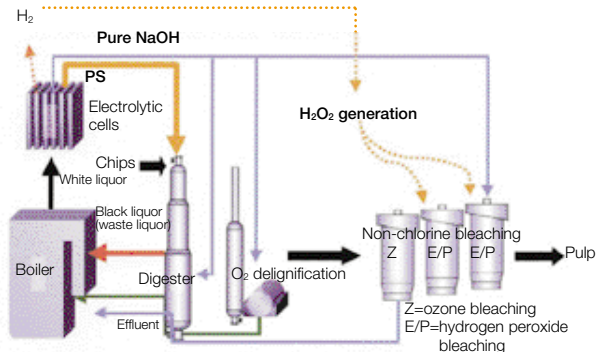
Based on its Environmental Charter, Nippon Paper is working to incorporate ECF (a bleaching sequence that uses no chlorine gas) at all its mills. In ECF, the

bleaching sequence stage consists of either chlorine dioxide ECF, whose main constituent is chlorine dioxide, or ozone ECF, whose main constituent is ozone. At our R&D centers, we have determined the environmental advantages of ECF and found that it yields pulp quality equivalent to that achieved with mainstay chlorine bleaching and is sufficiently cost-competitive. Furthermore, we have made the decision to install ozone ECF in hardwood bleaching kraft pulp manufacturing equipment (daily capacity: 520 tons) at our Yufutsu Mill. This will be the first ECF installation in Japan. Construction of medium-density ozone bleaching equipment was completed within the year and operations were commenced in January 2001. Our ozone generators produce 120 kilograms of ozone per hour per unit, with a density of 12%, and are designed to have the world’s largest operating capacity. We will also install PSA oxygen generators, which have the capacity to generate 30 tons per day (approximately 900 cubic meters per hour) of oxygen, which is extracted from the atmosphere and condensed for use as the basic ingredient in ozone. Because the concentration of organic chlorine compounds (AOX) in wastewater from ozone bleaching is nearly zero, COD and chromaticity can be reduced through wastewater recovery. Seizing the opportunity presented by the installation of ozone bleaching equipment, we will attempt to achieve zero wastewater BKP plant status.

### Yield Improvement with Electrolytically Oxidized Liquor



### A Capable Closed System for BKP Production



## Products That Promote Environmental Protection

### **KC Flock raw dissolving filtration promotion agent**

Up to now, diatomaceous earth was the primary material used in “promotion agents” for the filtration of oil, boiler water, and beverages, such as juice and beer. However, used diatomaceous earth is difficult to incinerate, which causes problems with numerous types of industrial waste. In contrast, KC Flock can be incinerated because it uses a powdered cellulose, a wood element, as a raw material. The volume of waste materials from incinerated KC Flock is low, which enables a sharp reduction in waste material emissions at production facilities.

### **Super Clone resin for water-based paint**

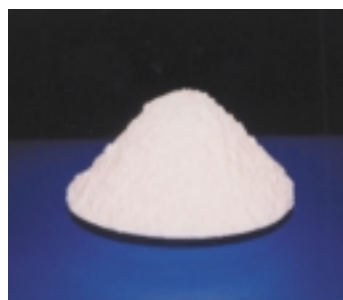
When painting on polypropylene, which has poor adhesive qualities, it is necessary to paint a primer layer—an undercoating of paint that has superior adhesive qualities. Nippon Paper’s Super Clone resin is being widely used as such a primer. From the perspective of lowering the environmental burden of paint, there has been a shift away from solvent-based paints to water-based paints. In response, Nippon Paper developed a water-based primer through a technology that enables non-water-soluble resins to be dissolved using water. This new product is expected to contribute significantly to a reduction in VOC, for which government restrictions are being tightened.

### **Eucalyptus pine plywood from planted trees**

In the past, hardwood from South Pacific countries was the primary type of wood used in the production of plywood. Recently, however, the use of softwood has been rapidly rising. Nippon Paper is exclusively importing afforested timber (eriotey pine and pachura pine) from South Africa for use at plywood manufacturing plants. At the same time, the Company is also working to develop uses for fast-growing afforested hardwood (Eucalyptus grandis) and has commenced full-scale imports of this wood. The Company will work to firmly position these afforested trees as substitutes for timber from South Pacific countries.

### **Non-PVC-base paper for wallpaper**

Vinyl wallpaper is used widely because of its ease of application and affordable price. Recently, however, it has been discovered that PVC, a principal material used in wallpaper, emits dioxins when incinerated, which has heightened concern for health and safety among consumers. This awareness has underpinned growing demand for non-PVC materials. Together with users, Nippon Paper worked to develop a non-PVC-base paper for wallpaper. Before successfully commercializing this product, Nippon Paper solved such issues as improving levels of whiteness and opaqueness as well as extending open time (the time from the application of the paste to drying).



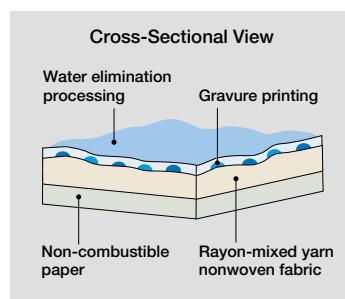
**KC Flock raw dissolving filtration promotion agent**



**Super Clone resin for water-based paint**



**Plywood produced from eucalyptus and pine**



**Non-PVC-base paper for wallpaper**

### **Ribbon CCP 100 recycled non-carbon paper**

Using newspapers and magazine wastepaper as its main material, Ribbon CCP 100 recycled non-carbon paper has a 100% wastepaper content. From the perspective of protecting resources, a recent trend among government agencies and companies has been to vigorously utilize invoices and various types of ledgers—which are consumed in offices in mass quantities—that are produced with recycled paper. Ribbon CCP 100 recycled non-carbon paper has the same quality as wood pulp-based products, and there are hopes that this product will promote the increased use of recycled products in the business form industry.

### **Scotty Popee recycled toilet tissue**

Toilet tissue contacts people's skin directly. Besides placing emphasis on recycled toilet paper, users also stress "sense of feel on their skin" and quality. Meeting these basic needs, Scotty Popee is a recycled toilet tissue developed by Crecia with that company's own advanced mixture technologies that enable wastepaper to be used as a basic ingredient of this tissue. Striving to conserve forest resources, Crecia is vigorously promoting the use of wastepaper pulp in addition to traditional wood pulp as it works to develop products with sufficient consideration to conserving raw material resources.

### **One Wrap non-dioxin producing wrap film**

One Wrap, a wrap film for food packaging, is composed of a 100% non-additive polyethylene. This environment-friendly wrap film does not lead to the creation of dioxins or environmental hormones (endocrine disruptors) and, thus, has no adverse effect on humans. Also, by using a cutter made from paper, empty wrap containers can be disposed of as combustible refuse. Because of such features, this wrap is environmentally safe. As sister products, we are also selling Super One Wrap, featuring a three-layered structure with superior heat resistance, and Bacteria-Resistant New One Wrap.

### **Color Land 100 colored top-grade paper with a 100% wastepaper content**

In 1991, Nippon Paper commenced sales of Eco Color, Japan's first recycled top-grade color paper made from recycled paper. Color Land 100 integrates the technologies developed by Nippon Paper following the introduction of Eco Paper. Composed of 100% wastepaper, Color Land 100 responds to recently rising demand for recycled paper with a high wastepaper mixture. Also, Color Land 100 has neutralized paper features that give it outstanding preservability. The Color Land 100 lineup consists of products available in 10 colors, each in four thicknesses.



**Ribbon CCP 100 recycled non-carbon paper**



**Scotty Popee toilet paper produced from recycled paper**



**One Wrap wrap film for food packaging**



**Color Land 100 top-grade color paper produced from 100% wastepaper**