

# Environment-Friendly Products

## ■Products made from 100% DIP

Nippon Paper is marketing its Land Series and Ribbon Series of high-DIP-content paper products (primarily products with a wastepaper content of 70% to 80%). These series include the following products that are made from 100% DIP yet have the same quality and printing suitability as traditional paper products.

- Copying paper: Ribbon N 100
- Printing paper:
  - Refresh Land 100 (wood-free paper)
  - Green Land 100 (paper containing ground wood)
  - Super Green Land DX100 (paper containing ground wood)
  - Green Land DX100 (paper containing ground wood)
  - NPi Coat Land 100 (coated paper)
  - NPi Coat Land 100 (M) (coated paper)
  - NPi Coat Land 100L (coated paper)
  - NPi Art Land 100 (art paper)

In addition, Nippon Paper Industries strives to use wastepaper in a wide range of applications, including thermal papers (for cash registers and facsimiles) and paper for ink-jet printers.

## ■Moipuru

Moipuru is a recyclable moisture-proof wrapping paper. Moisture-proof papers used until now have proven difficult to recycle and have been disposed of as industrial waste following use. In contrast, Moipuru can be converted into

pulp using only water in the same manner as ordinary paper. Also like ordinary paper, Moipuru produces no harmful toxic gases when incinerated nor does it cause the corrosion of incinerators. Presently, there is a shift away from the use of polyethylene laminate toward such products as Moipuru.

## ■Crecia Milk Pack 100

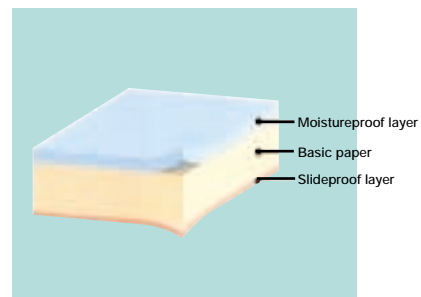
Crecia Milk Pack 100 is an environment-friendly, high-quality toilet paper produced from milk cartons. Milk cartons contain no impurities and are thus an excellent recyclable raw material. Also, milk cartons require no deinking or bleach, making them an environment-friendly material. Nippon Paper Industries uses its own multiscreen production technology (a technology that involves the gentle removal of polyethylene film and the removal of only wood-based pulp fibers) to ensure the same quality as toilet paper made from 100% wood pulp.

## ■Pure-Pak® Barrier Carton (Non-aluminum)

Pure-Pak® Barrier Carton is a carton that will meet the environmental needs of the 21st century. This paper carton, which has been highly acclaimed for being hygienic and lightweight, can also be recycled into paper. Produced using various leading-edge technologies and operations systems, the Pure-Pak® Barrier Carton represents a new environment-friendly paper carton that replaces containers integrating aluminum.



Products made with 100% recycled paper



Structure of Moipuru



Crecia Milk Pack 100



Pure-Pak® Barrier Carton

#### ■Tsutsumundesu

Traditional packing materials such as photosensitive materials that integrate aluminum foil adhesive paper have several drawbacks, namely that they cannot be processed for reuse and produce large amounts of ash when incinerated. Tsutsumundesu, or shading moistureproof paper, features a surface coated with recyclable shading and moistureproof layers.

#### ■Himuka LVL

With applications that include floor panels, furniture, and core housing materials, Himuka LVL is made from 100% planted Japanese cedar trees. Because cedar logs can be used regardless of their quality, such planted trees can be used efficiently. Also, because Himuka LVL contains little formaldehyde, it can be used with peace of mind as a safe wood product.

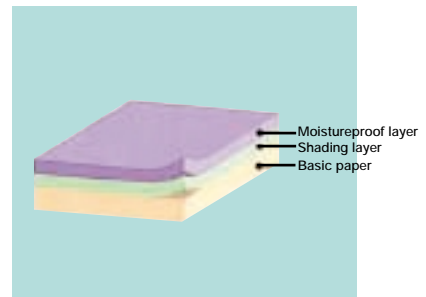
#### ■Using *Eucalyptus grandis* (planted trees) as a plywood material

Such trees as Lauan (Southeast Asian hardwood) have traditionally been the principal material used in plywood. In recent years, however, the use of softwood has grown sharply. Nippon Paper Industries is importing trees (eriotey pine and

pachura pine) exclusively from afforested regions of South Africa for use in plywood mills. Nippon Paper Industries is also developing uses for fast-growing hardwood planted trees (*Eucalyptus grandis*) and has commenced full-scale imports of this wood. The Company is working to firmly position these planted trees as replacements for Southeast Asian wood.

#### ■Kenaf for publishing use

A mallow plant, kenaf has recently attracted attention as a nonwood raw material for use in paper because it grows quickly and can be harvested within a short period of time. Nippon Paper Industries is manufacturing paper for publications using kenaf as a raw material. The use of kenaf easily allows desired paper thickness without the problem of fading that is associated with recycled paper. Also, kenaf enables an appearance that can be provided only by using nonwood-based paper. Although kenaf is not a suitable substitute for trees when considering such factors as the amount of area needed for cultivation, from the perspective of diversifying sources, the present popularity of kenaf is unlikely to wane, and the Company will continue to handle this plant.



Structure of Tsutsumundesu



Himuka LVL



Kenaf

# Environmental R&D

## ■Biotechnologies for solving resource problems

Afforestation is extremely crucial for maintaining and improving the earth's environment because it provides a means for promoting efficient fixation of carbon dioxide and for cultivating future pulp raw materials. Nippon Paper Industries is focusing on two principal afforestation-related areas in which it is applying its biotechnologies.

First, the Company is applying its independently developed MAT Vector System, a gene recombination technology that makes afforestation possible in a wider range of areas. The use of this technology provides trees with resistance to various environmental stress factors, including cold weather, salt, disease, and pests. Furthermore, this technology can be used in nontree-related areas and has been attracting worldwide attention for being the safest type of gene recombination technology.



Second, the Company is developing planting and cultivation technologies. Nippon Paper Industries has completed development of a clone propagation technology that enables the planting of large volumes of genetically elite eucalyptus trees, which are particularly valued as a pulp raw material. The Company is applying this technology in afforested areas overseas, including in Chile and Myanmar. This world-leading technology enables a 1.5-to-1.9-times increase in harvested volumes compared with trees in traditional types of afforested areas. The Company is also carrying out test afforestation to verify whether trees using this technology can thrive in areas previously unsuitable for afforestation.

## ■Technologies for reducing effluent from the pulp and paper production processes

During the production process for kraft pulp, a raw material pulp,

various chemicals are used in bleaching, which adversely affects effluent. Therefore, eliminating the discharge of effluent into the external environment and recirculating this effluent can contribute significantly to the prevention of water contamination. Nevertheless, bleaching effluent contains salt, the recovery of which leads to the corrosion of facilities and energy waste. The Company is carrying out research to utilize bleaching effluent to be condensed for use as a fuel by a process for reducing the use of chlorine-based bleaching chemicals.

To ensure stable quality in the papermaking process, large volumes of water are circulated and numerous chemicals are used. This circulated water contains microfibers and various substances that place a large burden on the environment when discharged. In solving this problem, however, if the amount of effluent is reduced, the density of circulated substances increases, causing problems related to the papermaking process and product quality. In response, the Company carries out research on the control, removal, and effective use of circulated substances.

## ■Advanced technologies for recycling wastepaper

DIP produced from used newspapers is utilized primarily as a raw material for newsprint. To use DIP in printing and publishing paper other than newsprint, a high degree of whiteness as well as a high level of quality characterized by few impurities are necessary. The

Company is carrying out research in this field.

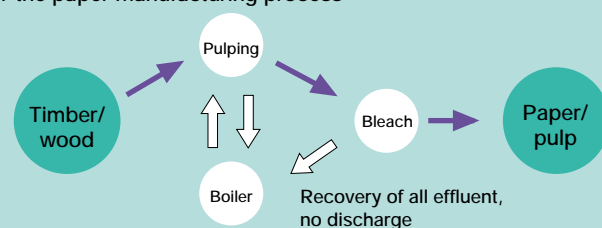
Nippon Paper Industries is also researching such new technologies as a neutral deinking system. The present technology for removing ink from wastepaper involves the use of alkaline, which damages pulp fibers and leads to a deterioration in strength. The new neutral deinking technology developed by Nippon Paper Industries controls the deterioration of fibers and uses an enzyme to prevent water pollution.

The Company has developed the Land 100 series of 100% recycled papers and recycled paper with such applications as receipts, plain-paper copier (PPC) paper, and facsimile paper. In addition, the Company has developed a paper surface treatment technology for removing printed ink during the wastepaper treatment process.

## ■Technologies for the effective use of coal ash and paper sludge

Coal ash from boilers for in-house electric power generation has been used as a cement raw material. Taking a new approach in this field, Nippon Paper Industries is cooperating with Tokyo University of Agriculture and the city of Abashiri, in Hokkaido, to develop a technology for using coal ash as a dehydrating agent for sewage sludge, which is then fermented and manufactured into an artificial soil nutrient. The Company is also considering a technology for recovering and reusing paper filler from sludge produced during the pulp deinking process.

Following the completion of a closed system for effluent for the paper manufacturing process



# Environment-Conscious Technologies

## ■Pulp bleach that minimizes the environmental burden

Chlorine plays an important role as a pulp-bleaching chemical. However, overseas large volumes of chloride have been shown to cause the formation of dioxin and to polluting effluent. In response to this situation, since the 1980s Nippon Paper Industries has been aggressively reducing its chlorine consumption, including the use of oxygen delignification in all processes, and has lowered its use of these bleaches to one-third of previous levels. To make further reductions, in June 1996 the Kushiro Mill commenced production of Elementary Chlorine-Free (ECF) bleaching, marking the first time such pulp has been produced in Japan.

## ■Discontinuing the use of carbon tetrachloride

In the past, the Iwakuni Mill used a carbon tetrachloride solvent to manufacture chlorinated polyolefin, a pillar of its chemical products business. However, under the Montreal Agreement, since the end of 1995 the use of carbon tetrachloride has been banned because it is an ozone-layer-damaging substance, prompting other companies in Japan to withdraw from the chlorinated polyolefin business. In contrast, several overseas companies continue to use carbon tetrachloride. In April

1994, Nippon Paper Industries independently developed a technology that enables chlorinated polyolefin to be manufactured without using carbon tetrachloride, thus becoming the world's first company to succeed in converting to the use of a noncarbon tetrachloride substance to manufacture chlorinated polyolefin.

## ■Effectively using incinerated paper sludge

The Company is working to find effective applications for incinerated paper sludge, which has deodorizing functions and is produced through a controlled incineration process. Using incinerated sludge, the Company has developed the PMC method of planting greenery along the sloped sides of highways built through mountains and hills. The PMC method combines incinerated paper sludge with sewage sludge—which contains an abundance of various nutrients—and ferments these two types of waste material to produce an artificial

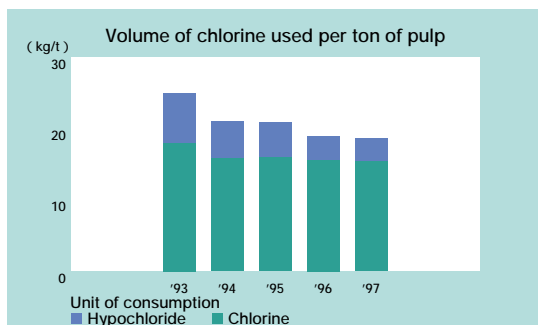


PMC method of planting greenery

fertilizer. This fertilizer is mixed with plant seeds and then sprayed onto the sloped sections along newly built highways. The PMC method promotes fast plant growth, allowing greenery to appear within a short time following the completion of highway construction and enabling rapid soil stabilization.

## ■Facilities for sludge carbonization

Tree fiber and minerals are the principal ingredients of paper sludge. Incinerated ash from paper sludge has applications as a simple activated charcoal as well as heat insulation with heat-generating capabilities. Nippon Paper Industries was a front-runner in cultivating new applications for paper sludge, including use as a soil-improvement agent and temperature-preservation material for steel manufacturing. The Company has developed a specialized manufacturing system for carbonized sludge that further enhances the activated carbon functions of sludge and improves its ease of use through a corning process. This system was installed in the Nakoso Mill in 1997 and the Komatsushima Mill in 1998. These mills are providing users with valuable carbide products produced from sludge that previously would have been treated as industrial waste.



Restrictions for carbon tetrachloride reductions and actual reductions

|                      | '89  | '90            | '91            | '92            | '93            | '94            | '95           | '96 |
|----------------------|------|----------------|----------------|----------------|----------------|----------------|---------------|-----|
| Restriction schedule | 100% | Less than 100% | Less than 100% | Less than 100% | Less than 100% | Less than 100% | Less than 15% | 0%  |
| Actually used        | 100% | 81%            | 72%            | 75%            | 59%            | 31%            | 0%            | 0%  |