# 5. RESOURCES

# 5. RAW MATERIAL

## 5.1 Forest Resources

This section describes the overall situation of forestry resources potentially available to the NATRON Mill in Maglaj. It was very early evident that the pulping capacity in the Maglaj mill exceeds the availability of coniferous pulp-wood to support the total pulping capacity of the mill. Taking this fact into consideration and apparent availability of deciduous wood within the country, the availability and properties of predominant domestic deciduous woods has been included within the study.

It is estimated that in the long term, 450,000 $m^3$/year coniferous as well as more than 400,000 $m^3$/year deciduous pulp wood can be made available for NATRON.

### 5.1.1 Forest resources within the Federation of Bosnia and Herzegovina

Bosnia and Herzegovina, BH, is by the Dayton Agreement signed in Paris on 14 December 1996, divided into Republika Srpska and the Federation of Bosnia and Herzegovina. By this agreement 51% of the total land area of 51,564 $km^2$ is within the federation.

The woodlands in the Federation are divided into 36 regions of which 27 are shared by the Federation and RS, each of them between 20-85 thousand hectares of size, see enclosed map. Each region is reporting to an SPP (Sumsko Privredno Podrucje of Forestry Economic Area) organisation. The SPP organisations have until the war been responsible to prepare comprehensive 10-year plans for maintenance, re-forestation, silvicultural development and forest road construction. The Annual Allowable Cut quotas and cut schedules for an individual forest area had been determined on this basis. The current situation of Bosnia Forests is unclear and no new 10 year development plans have been developed since the outbreak of the war. In BH 95% of the forests are natural and only 5% cultivated. The objective with silviculture is to retain the natural diversity of the forests.

The local SPP organisations carries out the function of cutting and marketing the logs to the mills. This activity is relatively free from state control. The SPP organisations are free to sell logs to any enterprise within BH, but not to export. It is anticipated that in the future cutting rights will be sold to private firms and entrepreneurs and the role of the SPP organisations will be changed, but how was at the time of the study, was still unclear.

Out of the total forest area of two million ha within BH, 56% is within the Federation. The total annual yield is 10.5 million $m^3$ of which 5.6 million $m^3$ is within the federation, see table below:

**Table 5-1 Forest resources within the Federation of Bosnia and Herzegovina**

| Type of Forests | | BH | Federation | % |
|---|---|---|---|---|
| **Total forest area, of which** | **ha** | **2,028,000** | **1,136,000** | **56** |
| High productive forests | ha | 1,198,000 | 639,000 | 53 |
| Low productive forests | ha | 472,000 | 258,000 | 55 |
| Open areas for plantation | ha | 236,000 | 164,000 | 69 |
| Open areas not suitable for plant. | ha | 122,000 | 74,000 | 60 |
| **Standing Volume, total** | **$m^3$** | **359,000,000** | **200,000,000** | **56** |
| Coniferous | $m^3$ | 132,000,000 | 79,000,000 | 59 |
| Deciduous | $m^3$ | 226,000,000 | 121,000,000 | 54 |
| **Annual Yield, total** | **$m^3$** | **10,500,000** | **5,600,000** | **53** |
| Coniferous | $m^3$ | 4,200,000 | 2,400,000 | 57 |
| Deciduous | $m^3$ | 6,300,000 | 3,200,000 | 51 |
| **Annual Allowable Cut, total** | **$m^3$** | **6,900,000** | **3,800,000** | **56** |
| Coniferous | $m^3$ | 2,600,000 | 1,500,000 | 59 |
| Deciduous | $m^3$ | 4,300,000 | 2,300,000 | 54 |

As can seen from the table above the total forest area for the Federation has been reduced to about the half of the pre-war Bosnia and Herzegovina. It is estimated that the Annual Allowable Cut, AAC, is close to 4 million $m^3$. The harvest is at the present less than half this volume. About 60% of the standing volume consists of hardwoods. Beech constitutes about 75% of the hardwood stock. The remaining is softwood of which spruce constitutes 85%, the rest is pine.

The quality of the timber has deteriorated during and since the war. War damage is also substantial. The war has left as much as 15-20% of the Federation's forest areas inaccessible due to mines (informed by BiH Forests in Sarajevo). The areas with mines are concentrated along the frontiers during the war (The attached mine map made in 1996 year contains only 50% of known mine fields). Furthermore, trees contain shell and bullet fragments which could cause problems in wood processing at the mill. The total damage of the forests due to the war has been estimated at DM 4,000 million The most prominent problem for the forest organisation today is the lack of equipment. Most of it was destroyed during the war, see table below:

**Table 5-2 Availability of Forestry Equipment before and after the war.**

| Type of equipment | BH | Federation |
|---|---|---|
| Chain saws | 5,580 | 300 |
| Standard tractors | 342 | 35 |
| Heavy tractors | 335 | 75 |
| Cable (rail)way | 60 | - |
| Forest lifts | 156 | 32 |
| Trucks to transport timber | 650 | 97 |
| Buses to transport workers | 180 | 33 |
| Terrain vehicles | 280 | 53 |

The organisation has received a gift from Japan worth DM 6 million to purchase 800 chain-saws 50 tractors and 10 trucks.

The government is expected, by April 1998 latest, to open a credit line from the World Bank of ECU 10 million, equivalent to DM 21 million. Of this DM 17.5 million will be utilised to mechanise the forests and DM 4 million for forest management and inspection. Before the war 65% of the transportation work in the forests were mechanised and 35% performed by horses. All cutting was executed with chain-saws. The WB credit will restore this to 70% of the pre-war level.

5.1.2 Properties of Coniferous and Deciduous woods

Wood can be classified into two broad groups; coniferous or softwoods and deciduous or hardwoods. The two groups differ from each other in respect to the pulp properties which can be produced. Growth of the tree takes place in the outer layer of the tree just under the bark, in the cambium layer for both groups.

Several different types of cells are formed from the cambium. There are four main elements; tracheids, fibres (libriform fibres), parenchyma and vessel elements. The proportion of these elements varies between wide limits within the species and between the species. Se table below:

**Table 5-3 Structural Elements in Wood, by Volume by Percentage**

| Species English Name | Scientific Name | Tracheids, Libriform Fibres | Parenchyma | Vessels |
|---|---|---|---|---|
| Scandinavian. Spruce | Picea Abies | 95 | 5 | 1 |
| Scots Pine | Pinus Silvestris | 93 | 7 | - |
| Silver Birch | Betula Verrucosa | 65 | 10 | 25 |
| European Beech | Fagus Silvatica | 37 | 32 | 31 |

Tracheids is the scientific name for the softwood fibre and the main function is to serve as a water conductor and to give mechanical support in the main body of the trunk. The corresponding cell in hardwood is the libriform fibre whose main function is to make the wood rigid. The vessel elements serve as water conductors in hardwood. The function of the parenchyma cells is to facilitate transport of water and food for the continued growth of the tree.

In softwood, tracheids influence pulp quality and in the same way libriform fibres and vessels influence the pulp quality based on hardwood. The meaning of word fibre, frequently used in pulp technology, is a variety of structural elements in wood or other elements. All wood contains parenchyma cells, but need not contain all the other types of structural elements. In softwoods the tracheids dominate, with few libriform fibres and no vessels, whereas tracheids are scarse in hardwoods, and the corresponding functions are instead performed by the more specialized libriform fibres and vessels. This difference is due to the more pronounced need of rapid water transport in case of hardwoods, which develop their leaf crowns during a very short period in springtime.

For important species of softwood, the length of the tracheids varies between 2-5 mm. The Libriform fibre in hardwood is substantially shorter, 1-2 mm with the average close to 1 mm. The relation between length and diameter of the main structural elements varies considerably, but is roughly 50-100.

Vessel elements are different are different from libriform fibres. They are short and often quite wide. Parenchyma cells are very small and they do not contribute to the pulp quality. See figure below:

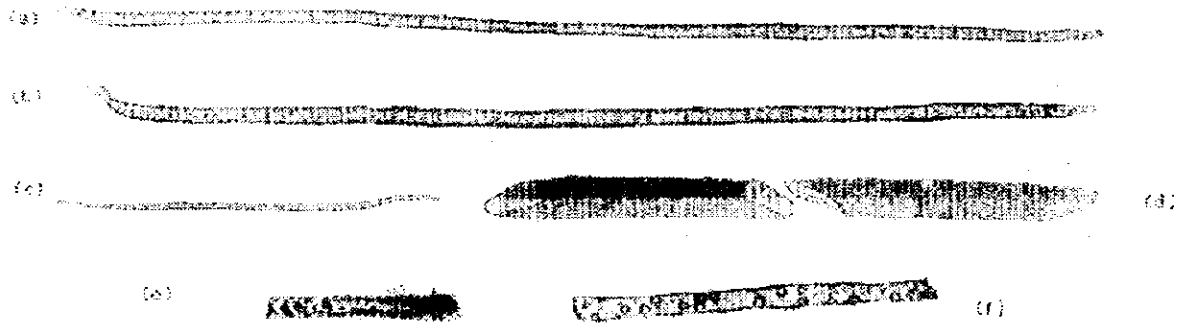
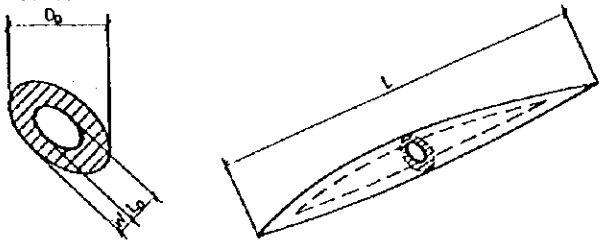


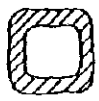
Fig. 2.3 The main wood elements (Meier)
(a) Spruce tracheid (× 55)
(b) Pine tracheid (× 55)
(c) Birch libriform fiber (× 55)
(d) Birch vessel element (× 55)
(e) Spruce ray parenchyma cell (× 282)
(f) Spruce ray tracheid (× 282)

Source: Pulping Processes, Rydholm 1965

The fibre dimensions are very important due to its influence on pulp properties. The tables below presents the fibre dimensions of some important wood species. The fibre flexibility ratio is defined as the ratio between fibre lumen diameter and fibre width, Lo/Do.




## Table 5-4 Fibre Dimensions Softwood

| Wood Species | Picea Abies<br>Scan. Spruce | Pinus Silvestris<br>Scots Pine | Pinus Contorta<br>Lodgepole Pine | Pinus Elliottii<br>Slash Pine | Pinus Radiata |
|---|---|---|---|---|---|
| Average | | | | | |
| Length | 3.5 mm | 3.0 mm | 3.0 mm | 3.0 mm | 3.0 mm |
| Width | 27 µm | 28 µm | 32 µm | 36 µm | 31 µm |
| Density | 0.41 g/cm³ | 0.41 g/cm³ | 0.38 g/cm³ | 0.56 g/cm³ | 0.41 g/cm³ |
| Wall-thickness | 2.9 µm | 3.2 µm | 2.4 µm | 3.8 µm | 5.5 µm |
| |  |  |  |  |  |
| Flexibility Ratio | 0.78 | 0.77 | 0.85 | 0.79 | 0.65 |

## Table 5-5 Fibre Dimensions Hardwood

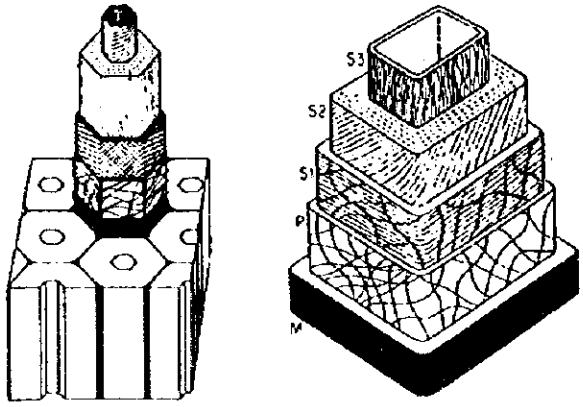
| Wood Species | Populus Tremula<br>Eur. Aspen | Betula Verrucosa<br>Silver Birch | Eucalyptus Globulus<br>Blue Gum | Eucalyptus Camaldulensis<br>Red Gum | Eucalyptus Saligna<br>Sydney Blue Gum | Fagus Silvatica<br>Eur. Beech | Fraxinus Excelsior<br>Eur. Ash |
|---|---|---|---|---|---|---|---|
| Average | | | | | | | |
| Length | 0.95 mm | 1.25 mm | 1.00 mm | 0.80 mm | 1.00 mm | 1.3 mm | 1.1 mm |
| Width | 21 µm | 18 µm | 13 µm | 11 µm | 13 µm | 29 µm | 16 µm |
| Density | 0.37 g/cm³ | 0.51 g/cm³ | 0.60 g/cm³ | 0.68 g/cm³ | 0.51 g/cm³ | 0.58 g/cm³ | 0.60 g/cm³ |
| Wall-thickness | 4.3 µm | 3.7 µm | 1.6 µm | 1.2 µm | 1.4 µm | 5.2 µm | 3.8 µm |
| |  |  |  |  |  |  |  |
| Flexibility Ratio | 0.59 | 0.59 | 0.75 | 0.78 | 0.78 | 0.64 | 0.52 |

As presented above, in softwood the average of tracheids is as high as 92% of the total wood volume. Corresponding figures for hardwood are; libriform fibres ca. 50%, parenchyma cells ca. 20% and vessel elements ca. 30%. The conclusion from this that the amount of good fibres, suitable for strong papers, particularly for tear properties, is less in hardwood than in softwood.

When it comes to fibre dimensions it is important to compare not only the length and the width for different species, but also the fibre wall thickness. In paper making it is desirable that the

so-called wall fraction is less than 40%. This means that the fibre wall thickness should be less than 40% of the fibre width. The wall fraction indicates the flexibility of the fibre in papermaking. Dense hardwoods usually have much higher wall fraction than softwoods.

Even though the size is quite different when comparing tracheids in softwood and libriform cells in hardwood, the structure of their cell walls is similar. In a very schematic way the structure of the fibres is presented below.

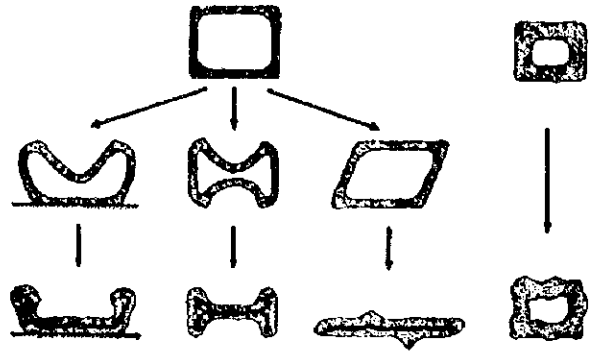



M: Middle Lamella
P: Primary Wall
S1: Transition Lamella
S2: Main Layer of Secondary Wall
S3: Tertiary Wall

The fibre wall is composed of different layers. The first is the middle lamella consisting mainly of lignin. This layer separates the fibres from adjacent fibres and at the same time keeps tracheids or libriform cells together in a rigid wood structure. The middle lamella (M) has a glue-like function.

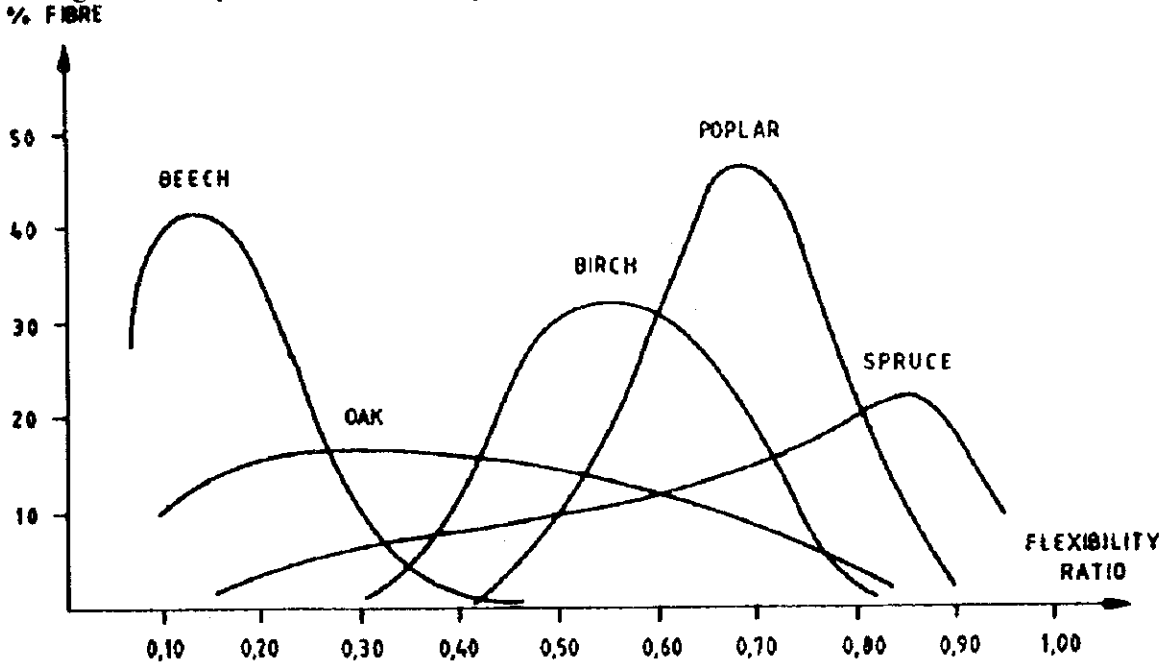
The primary wall (P) is the first layer belonging to the fibre and this wall is formed after the cambial cell division. The secondary wall (S) is not homogeneous but divided onto three lamellas; transition lamella (S1), main secondary wall (S2) and tertiary lamella (S3).
The significance of the fibre morphology on paper structure is complex and cannot be specifically stated. However the following general rule can be established:

- Fibre length is an important parameter for primarily tear strength.
- Fibre width is of limited importance
- Fibre flexibility, which depends on fibre wall thickness and fibre diameter is considered to be very important as it correlates to the fibre to fibre bonding , see figure below:



The thin walled fibre collapses more easily thus increasing the fibre to fibre bonding surface.

The flexibility ratio which is defined as the ratio of fibre lumen diameter divided by fibre width describes the ability of the structure to bend under application of force perpendicular to its axis. The figure below presents the flexibility ratio of different types of wood:




5.1.3 Suitability of Fibrous Raw Materials for Paper Making

From the paper maker's point of view, fibre length and fibre flexibility are essential parameters which determine the suitability of the fibre for paper making. Conifers such as spruce and pine give long and flexible fibres with collapsible lumens which will provide a large bonding area and thus gives a better consolidated structure.

The most important strength parameter for sack paper is its Tensile Energy Absorption (TEA) value. A detailed study in Sweden to compare the relative order of TEA values for papers produced from different wood species reveals that pine normally produces a paper with a slightly higher TEA value than spruce.

When producing pulp for fluting the stiffness of the fibre is of importance. Experience has showed that both birch and beech produces and excellent semi-chemical pulp for fluting.

### 5.1.4 Forest Resources available for NATRON Mill in Maglaj

A proposed production plan for the Maglaj mill has been developed. This plan would imply the utilisation of both coniferous and deciduous pulp-wood.
At the time of the field visit at Maglaj the political situation between The Federation of BH and Republika Srpska was still unclear. The mill management was, however, convinced it would be fully possible to receive shipments from that region. In this study, however, we assume that most of the pulp-wood would be supplied from within the Federation.

The Annual Allowable Cut, AAC, within the Federation has been estimated to 1.5 million $m^3$ for coniferous wood and 2.3 million $m^3$ for deciduous woods. Of that, all the coniferous would be economically harvested while 20% of the deciduous wood is from forests with low productivity and therefore excluded from consideration.

**Table 5-6 Available Pulp-Wood from within the Federation for Maglaj**

| **Coniferous in 1,000 $m^3$ per year** | | |
|---|---|---|
| Total | 1,493 | 100% |
| Not extractable | 243 | 16% |
| Net available | 1,250 | 100% |
| F Logs | 25 | 2% |
| Log classes I-II-III | 847 | 68% |
| Poles | 85 | 7% |
| Pit-props * | 145 | 11% |
| Pulp-wood | 148 | 12% |

* The demand of wooden pit-props is substituted by metallic ones and has diminished.

Pit-props and pulp-wood then altogether makes about 300,000 $m^3$ per year. The saw mill industry normally produces substantial amounts of saw-mill chips which preferably can be used for pulp production. A portion of this is expected to be made available for pulp production in the future when saw mills have invested in debarking equipment. It is therefore estimated that about 450,000 $m^3$ coniferous pulp-wood, including saw-mill chips, can be made available for pulp production in the future.

**Table 5-7 Economically available deciduous wood in 1,000 m³ per year**

| | | |
|---|---|---|
| Total | 1,933 | 100% |
| Not extractable | 226 | 12% |
| Net available | 1,707 | 100% |
| F&L Logs | 72 | 4% |
| Log classes I-II-III | 550 | 32% |
| Pulp-wood | 423 | 25% |
| Fuel-wood ** | 662 | 39% |

** The use of fuel-wood is temporary and is expected to be reduced in the future.

The total quantity of deciduous pulp-wood is expected to become substantial in the future, at minimum 400,000 m³/year but could as well become twice as much when the demand for fuel-wood has decreased..

5.1.5 Cost of Wood

The government has till now exercised price control for logs with minimum prices. These minimum prices appears now to be subject for negotiation so both lower and higher prices can be expected.

During the field mission it was, however, made clear that the different regional forestry organisations are prepared to undercut the official minimum price list. The roadside prices proposed were DM 40-60 /m³ instead of the "list price" of DM 60/m³ for coniferous pulpwood and DM 50 for pitprops.

**Table 5-8 <u>For the NATRON mill the prices for pulpwood would be as follows, in DM/m³sob.</u>**

| **Pulp Wood** | | **Stumpage** | **At truck-road** | **On truck** |
|---|---|---|---|---|
| Coniferous | m³ | 45 | 60 | 65 |
| Deciduous | m³ | 35 | 50 | 55 |
| **Pit-Props** | | | | |
| Coniferous | m³ | 35 | 50 | 55 |
| Deciduous | m³ | 30 | 45 | 50 |

Pitprops is a declining assortment which may in a longer perspective decrease the general price level for pulpwood.

The BH price level as presented above should be seen in an international perspective. The table below presents the actual price situation for coniferous and deciduous pulpwood in Sweden, Germany, Poland as well as in BH. A corresponding comparison for beech hardwood has not been possible to make. Beech is normally accepted as a minor proportion of other deciduous species.

Table 5-9 Roadside Prices in DM per m³sob for Pulpwood in some European Countries

| Country | Coniferous | Deciduous |
|---|---|---|
| Sweden | 48 | 52 |
| Germany | 38 | 43 |
| Poland | 29-35 | 28-34 |
| Bosnia-Herzegovina | 60 | 50 |

The higher Swedish prices of deciduous pulpwood is a reflection of less abundant deciduous wood resources compared to continental Europe and BH. The low German prices reflects the present unbalance between demand and availability of wood raw material.

The figures in Poland are actual figures 1998.

Considering the present low labour cost in BH, compared to Sweden, Germany and also Poland, the price level of pulpwood in BH is high. The sustainable BH price level will depend on the efficiency of the forest operations. We therefore strongly recommend an in-depth study to evaluate the cost structure of the forest operations in BH and to propose means to reduce these costs. The typical cost structure of a forestry region in BH is as per the table below:

**Table 5-10 Cost Structure of the Forest Operations in BH**

| Activity | Cost in DM/m3sob |
|---|---|
| Felling and bucking: | 5 |
| Extraction with horse: | 5-10 |
| Tractor transportation to road side: | 10-15 |
| Total costs: | 20-30 |

The corresponding cost for Sweden were DM 20/m³sob (1995) and in Germany, as quoted from a domestic study (1997) is about DM 25-30/m³sob. No actual costs figures were available for Poland but are expected to be roughly the same or less than in Germany.

To above figures for BH should be added the tax of 23% of which 20% is for reforestation and forest maintenance. The remaining 3% on the gross sale is for financing of special silvicultural development and forestry upgrading program.

Furthermore, for the loading and trucking 100 km to the NATRON mill another DM 25/m³sob should be added on average. The price at mill site for the cost calculations was agreed with the NATRON mill at DM 75/m³sob. No account was taken of future possible supply of chips from

existing saw mills. They cannot, at present, supply wood as they are not equipped with debarking equipment. The corresponding cost in Poland is DM 43/m³sob delivered at mill.

The agreed cost figure for wood is on the high side and it could probably be reduced when production has commenced. The price of DM 75/m³sob for NATRON corresponds almost to the cost of pulpwood in Sweden delivered to the millgate. This in spite of the fact that the current cost of labour per man hour in Sweden is several times higher than pre-war costs in BH. It should also be taken into consideration that Swedish wood prices are high by international comparisons. By this we draw the conclusion that it is realistic to assume that the pulpwood price can be reduced once the mill is operative and the economy of BH is normalised.

The mill has up till now not consumed deciduous pulp-wood and has therefore no experience and no opinion on its price level. One large forestry company in the region of Maglaj mill is the Krivaja company. This is a large furniture company with forestry operation covering 91,000 ha, most of it deciduous woods. This company has not yet delivered any deciduous wood to Maglay but indicated a price of DM 35 at truck side. With loading costs as above of DM 5/m³sob and only half transportation distance would imply a total cost of DM 50/m³sob at Maglaj millgate.

5.1.6 Conclusions and recommendations

Based on the presentation above it can be concluded that in the long term there will be about 450,000 m³ of coniferous wood and well above 400,000 m³ deciduous wood available for pulp production at NATRON mill in Maglaj.

Prices of pulp-wood delivered at mill gate to be used in the calculations are estimated at:

| | |
|---|---|
| Coniferous: | DM 75/m³ |
| Deciduous: | DM 50/m³ |

The price of coniferous is in an international perspective on the high side, the price of deciduous is difficult to establish but realistic. However, the possibility to keep or even reduce the present prices, once the BH economy enters more normal stages, will depend on the further developments in the forestry sector.

We have not included sawmill chips in the NATRON mill wood raw material supply. This is because of lack of debarking equipment at the existing saw mills. Such additions to the existing saw mills should be supported as it would favour not only the economy of the NATRON mill, but also of the sawmills, which would have a buyer for the leftover wood raw material which at present is partially wasted.

With the rise of the BH economy, forest labour costs will also increase. It was not the objective of the present study to identify the possibilities for such rationalisation, but the span of possibilities is given by the figures related above for Sweden. Already the quoted investigation for Germany also indicates a gain of DM 15/m$^3$sob by leaving chainsaws for more advanced mechanisation of the forest harvesting operations. The first step would be to identify suitable means.

Any further planning for development of the BH forest industry will depend on a more reliable information on the forest resources and their yield, and also the mine situation. The present situation of uncertainty is not satisfactory since no planning was possible over the years of war. A first step would be the execution of an inventory using modern methods which, as it seems, will need support from abroad, financed by an international organisation. The present efforts to establish the situation of the forests by the use of satimages (satellite images) can only result in a broad overview.

## 5.2 Waste Paper

This chapter describes the overall supply situation of waste paper as raw material base for paper production at NATRON mill in Maglaj.

During 1998 it is estimated that domestic sources can supply NATRON with approximately 12,000 tons of waste paper. The quality of domestic waste paper is poor, primarily due to poor sorting, and offered at a high price compared to western standards.

It is realistic to assume that the collected quantities can be more than doubled within a few years time.

### 5.2.1 Waste Paper Situation within the Bosnia and Herzegovina

Bosnia and Herzegovina is a small country with a population before the war of 4.4 million. The war resulted in 250,000 deaths and at present approximately one million people are refugees abroad. The GDP per capita was before the war in 1991 less than USD 2,000 per capita. After the war the GDP figure has contracted to about USD 600 per capita.

During 1991 paper production was 230,000 tons, imports 15,000 tons and exports 10,000 tons which gives an apparent domestic consumption of 235,000 tons, equivalent to 53 kg per capita and year. This is a relatively high figure in relation the USD 2,000 GDP per capita figure. As a

comparison Poland had a GDP per capita during 1991 in the same order of magnitude. In Poland the apparent paper consumption was 30 kg per capita.

As a result of the war the economic activity within the country is very low and the waste-paper collecting system is poor. As economic activity gradually recovers, paper consumption will increase and the prospects to collect waste-paper will improve.

At the same time the nation will have to improve its waste paper collection system to increase the recovery rate of paper. This is a time consuming process which starts at Governmental levels with legislation and laws concerning waste paper and refuse collection. It is however realistic to assume that a recovery rate of waste paper at 40-45% within a five year horizon. In Sweden and Japan the recovery rate is bout 53%, the average for western Europe is 46%.

The NATRON mill in Maglay is currently concentrating on producing brown packaging grades, i.e. fluting, sack paper, liner and brown MG-paper. With the proposed future production program of sack paper, fluting and MG-paper, only the fluting quality can utilise waste paper as a raw material source. The waste paper quality would be Old Corrugated Containers, OCC. This report thus concentrates on the availability, quality and price of domestic OCC. Imported quantities are always available at a very fluctuating price as OCC is traded as an international commodity.

5.2.2 Waste Paper Resources available for NATRON Mill in Maglaj

The available raw material base, OCC, is related on the quantity corrugated board consumed within the country. As been mentioned before, the current situation in BH is not normal and the year 1991 is used as the reference point. At that time the consumption of corrugated board has been estimated to be approximately 8 kg per capita per year. This is a realistic figure and compares well with other countries with similar GDP per capita and Western Europe during the late 1950- or early 1960-ies. The specific consumption in western Europe is today substantially higher, see table below:

Table 5-11 Corrugated Board Consumed within Western Europe

| Country | Average consumption of corrugated board in kg per capita, 1991 |
|---|---|
| Germany | 40 |
| Sweden | 35 |
| Greece | 18 |
| Czechoslovakia | 11 |
| Bosnia and Herzegovina | 8 |
| Poland | 7 |
| Turkey | 6 |

The consumption of corrugated containers follows the economic development of a country. With a relatively low consumption as in BH, the incremental growth is initially expected to be higher than the growth in GDP.

A recovery rate of OCC of about 80% is established in countries with developed waste paper collecting systems. This does, however, require a well function infrastructure to enhance waste paper collection, including laws, legislation and information to the public to make it aware of the environmental importance in sorting waste material.

If it assumed that the consumption of 8 kg of corrugated board per capita and year is regained within five years of time and a recovery rate of 70% is achieved then about 30,000 tons of OCC could be made available for the NATRON mill.

Prior to the war NATRON was supplied from 25 locations within BH. The total deliveries were 18,000 tons. Those shipments were reduced to 7,400 tons from in 1997. About half of the deliveries came from one supplier in Sarajevo, Papir Service.

After meeting five of the major waste paper suppliers to the NATRON mill it is estimated that about 12,000 tons of waste paper can be supplied to NATRON from within BH during 1998. The first two months of 1998 showed radical increase in waste paper collection when compared to 1997. Most of the remaining quantity is expected to be supplied from Ljubliana in Slovenia.

The quality of domestic waste paper is very poor, primarily with respect to sorting. It is obvious that very little manual sorting is executed at the waste paper collecting stations. This is primarily due to lack of equipment, and low pressure from the customer, NATRON factory.

The different waste paper collectors run very primitive operations, having only a bale press to press the collected paper. No collector has a sorting conveyor ahead of the bale press to manually

extract paper grades and other contaminants which should not be included. It was observed in Sarajevo that the tucks with collected waste paper simply unloaded the material on ground ahead of the conveyor belt up to the inlet chute of the bale press. Only rudimentary extraction of foreign material took place.

Waste paper in BH is classified according to a quality list inherited from Yugoslavia of which only a few are applicable to NATRON. Those are:

**Table 5-12 Quality List of Waste Paper**

| Domination | Description |
|---|---|
| 4 | Old archive |
| 7 | Kraft paper, paper sacks (emptied) |
| 7A | Own produced waste paper, clippings etc. |
| 8 | Corrugated Board waste |
| 8A (subgroup of 8) | Clippings from corrugated box plants |
| 8B (subgroup of 8) | Collected corrugated waste |

In the future only groups 7+8 are applicable for NATRON.

NATRON has a procedure to control quality of waste paper which stipulates that from each shipment of up to 10 tons, two bales are randomly chosen for analysis. For larger shipments, five bales are selected randomly. From each bale a 10 kg sample is selected and analysed visually and moisture content measured.

The content of the sample is analysed by content of non-paper materials. The payment of the shipment is then adjusted according to the amount of non-paper materials.

These principles might look good in theory but obviously does not function in practice in that respect that domestic waste paper which could be observed on the waste paper yard was very badly sorted. Large amounts of office waste and foreign material could be observed in waste paper bales of primarily OCC content.

### 5.2.3 Cost of Waste Paper

The price of waste paper is normally fluctuating heavily on the international market. The reason is that while the demand for paper goes up and down, the collection is relatively stable. With the market economy principle that price is fixed in accordance to supply and demand, times from

shortage to oversupply can change very quickly. This is particularly relevant for simpler paper grades such as mixed waste which sometimes has a negative value, customers are paid to accept deliveries. Higher qualities which act as pulp substitutes are much more stable in price and follow the world market price of virgin pulp. As an example is the one important market place for waste paper, Germany.

**Table 5-13 Waste Paper according to the Cepac (European Union) classification Market price in Germany, DM/ton**

| | | January 1998 | January 1997 | Change in % |
|---|---|---|---|---|
| A2 | Mixed sorted P&B | 15-20 | -10-10 | n/m* |
| A5 | Shop waste (OCC) | 45-60 | 30-45 | +50% |
| A9 | Mixed news, pams | 75-90 | 80 | -6% |
| B1 | Once-read news | 110-140 | 90-110 | +18% |
| C9 | White wf constant | 410-450 | 400-450 | +3% |

* Not meaningful as price was negative in January 1997.

The cost of corrugated waste in Sweden for OCC from shops, A5, was in early springtime 1998, SEK 350, equivalent to DM 80/ton.

For comparison the cost of collecting old newspapers during the spring in Europe was per the table below:

**Table 5-14 Cost of Collecting Old News in Europe**

| Country | Collection costs | Sorting Costs | Total Costs | Converted to DM |
|---|---|---|---|---|
| Sweden, SEK | 292 | 286 | 578 | 134 |
| Germany, DEM | 100 | 45 | 145 | 145 |
| Switzerland, CHF | 80 | 40 | 120 | 146 |

These table reveal that the market price of used newspapers is in pair with the collection costs in Germany. Similar information regarding OCC is not available.

NATRON mill paid in February 1998 for OCC:
Imported: DM 58 plus freight DM 62, total DM 120/ton
Domestic: DM100 plus freight DM 35, total DM 135/ton

As seen from above the price of imported waste paper is realistic when taking transportation costs into consideration. It is also concluded that the domestic waste paper is very expensive despite the fact that the cost of labour if only a fraction of the cost of labour in western Europe.

This indicates there is great potential to improve efficiency and reduce costs amongst the Bosnian waste paper collection organisations.

5.2.4 Conclusions and Recommendations

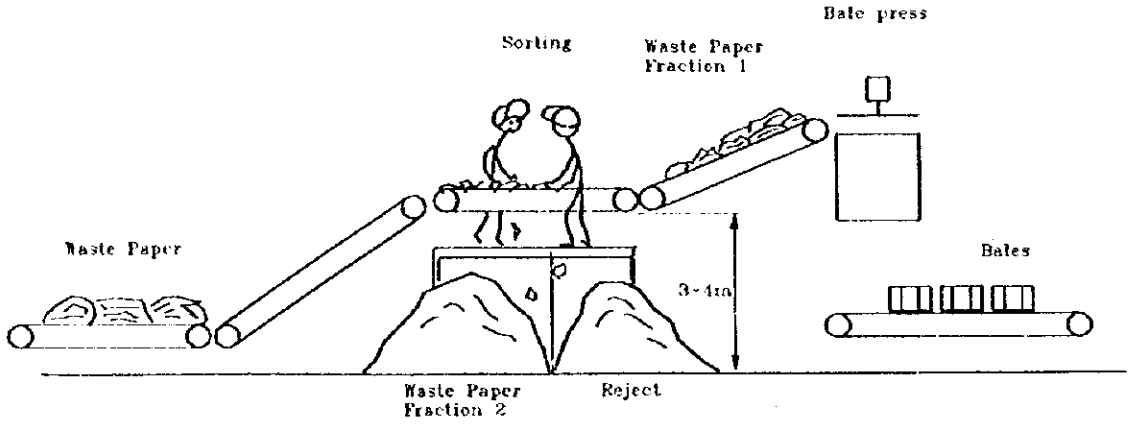
During 1998 it is assumed that only 12,000 tons can be collected from domestic sources. When the economy in BH gradually recovers after the war, greater quantities of waste paper will be made available. Based on data provided by the IMF and World Bank together with expected future recovery rates of waste paper, 30,000 tons of domestic OCC is expected to be available by the middle of the next decade.

There are, however, two problems concerning the domestic waste paper when comparing with international standards; quality and price. The quality is poor and price is high.

The poor quality is primarily an attribute of the waste paper collecting companies who do not sort the material properly. The entire operation is very primitive and the companies do not have the system nor the proper equipment for adequate sorting. They merely unload the collected material on a yard and at best extract the most obvious contaminates. The system should be improved by minor investments in conveyor belts on which the waste paper is loaded and contaminants and inferior paper qualities extracted before the material is fed to the bale press.

NATRON will have put pressure on their suppliers to improve sorting and thus quality of the waste paper. To be able to sort waste paper to quality the sorting activity has to properly organised. The figure below presents a simplified principle on how it could be organised.

Typical Waste Paper Sorting Station




The waste paper is placed on a horizontal and inclined conveyer to be lifted 3-4 meters above ground. At this level the sorting crew is located. While the material is transported on a horizontal conveyor the crew extracts contaminants from the passing waste paper. If the objective is to produce clean corrugated waste, OCC, the waste material is picked out manually. Other paper grades into one chute, non-paper material into another. The sorted paper is then transferred to the chute of the bale press and baled.

After some hours, the paper in the reject heap is introduced as inject waste paper and sorted and baled in the same manner as described above.

Taking into consideration of the relatively low labour cost in BH the cost of waste paper is high. Waste paper is a commodity which on the international market fluctuates drastically in price over a short period of time, particularly for simpler waste paper grades. A price increase of 100% or price drop of 50% within a period of one year for corrugated waste is not unusual.

The high price of waste paper in Bosnia and Herzegovina primarily reflects the inefficiency in their operation. It is therefore expected that when waste paper demand rises the collection activities will improve which will put a downwards pressure on the price of domestic waste paper.

On a governmental level, action should be taken to encourage waste paper collection. When travelling around in the country it easily observed that the garbage collecting system does not function, garbage and litter is all over the place. This is to some extent a result of the recent war in which much of the infrastructure was destroyed. It is anyhow the role of the government to establish the overall framework for resource management of which collection of waste paper, aluminium cans, PET bottles etc. plays an important role.

5.2.5 Swedish Waste Paper Legislation and Organisation.

Sweden introduced in October 1994 a new legislation on recovery of packaging, tires and waste paper. The objective of this new legislation is to make the producer responsible to recover the packaging, tires and waste paper.

This legislation is applicable to all companies which are producing, importing or sells packagings or products which are using packagings made of glass, corrugated board, paper, paperboard, metal and plastic. The producer is thus obligated to arrange collection of those packagings that the material is recovered or taken care of in an environmentally acceptable way.

The companies who are obliged to recover packaging have thus established different material recovering companies responsible to recover the packaging. Those material recovering companies distributes licences in their turn to other companies and entrepreneurs to execute the actual collection, sorting, baling and distribution.

To finance the operation the producer of different packagings are charging their customers an extra packaging fee on each package according to the table below:

**Table 5-15 Packaging Fee**

| Material | SEK/ton | (Approx. Equivalent DM/ton) |
|---|---|---|
| Metal | 80 | 18 |
| Plastic | 150 | 34 |
| Paper and Paperboard | 40 | 9 |
| Corrugated Board | 5 | 1.1 |

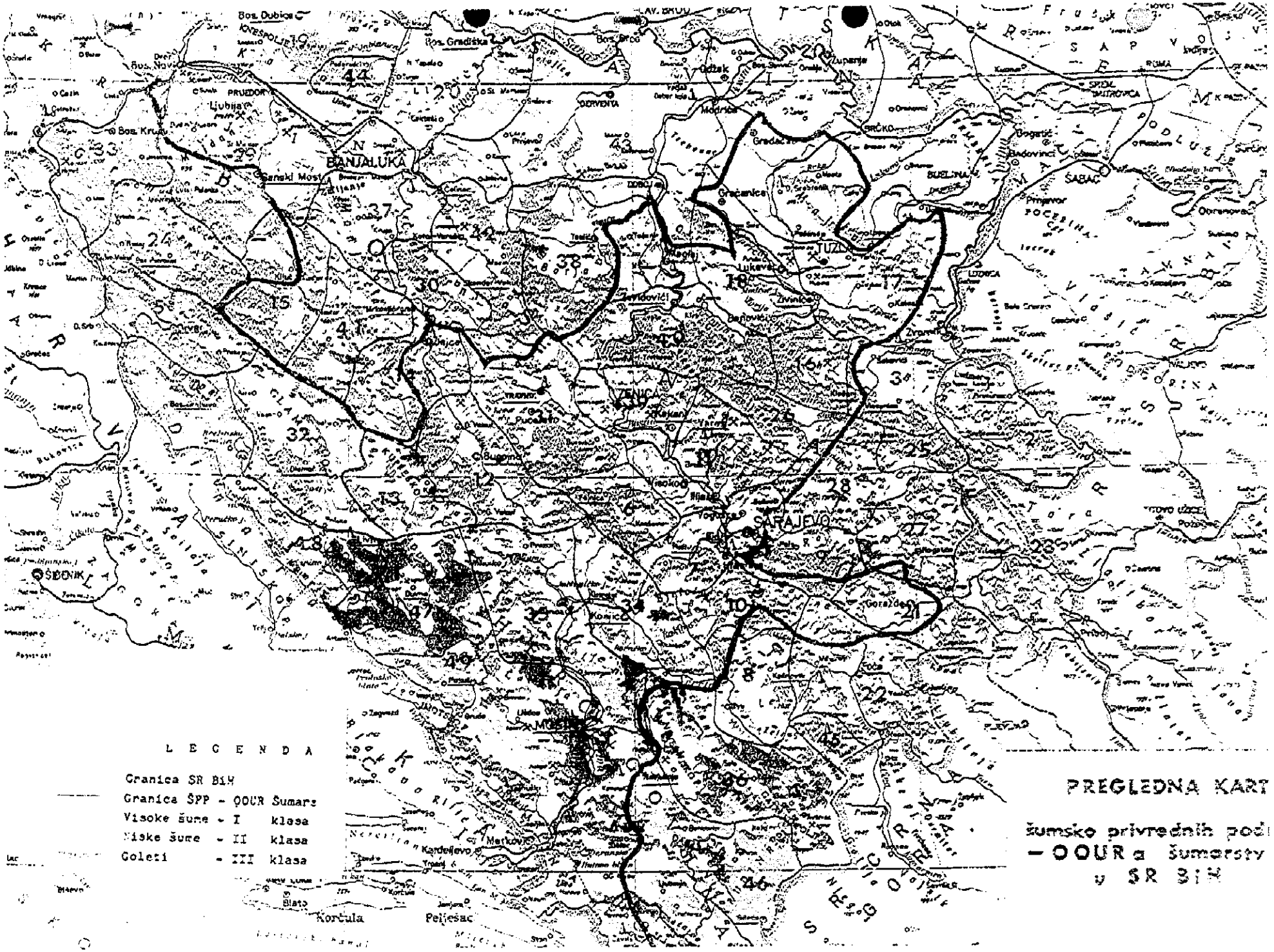
When introducing this new system in 1994, the Swedish government imposed a minimum recovery rate for each type of packaging. Those recovery rates, as presented below, were to be achieved within a three year period, before January 1, 1997. Actually recovery rates came to be higher, see the table below:

**Table 5-16 Minimum Recovery Rate of the Different Packagings**

| | Req. of 1 January 1997 | Actual rec. rate 1 January 1997 |
|---|---|---|
| Packagings of glass | 70% | 72% |
| Plastic containers, excl. PET | 30% | 87% |
| Packagings of paper and paperboard | 30% | 45% |
| Metal containers | 50% | 54% |
| Corrugated Board | 65% | 81% |
| Aluminium containers | 50% | 19% |

The publishers of newspaper and producers of newsprint are in Sweden obliged to, at latest by October 1998 collect 75% of all newspapers consumed within Sweden. The actual recovery rate has by improved collection systems thus gradually increased from 65% in 1994 to 72% in 1996.

These high recovery rates are not possible only by introducing new legislation. The government of BH has to both legislate and impose intensive information and education of the business community as well as the public of the importance of waste paper recovery. Introducing fees for packages is one way to finance and enhance waste paper recovery.


L E G E N D A
Granica SR BiH
Granica ŠPP - OOUR Šumars
Visoke šume - I klasa
Niske šume - II klasa
Goleti - III klasa
PREGLEDNA KART
šumsko privrednih pod
- OOUR a šumarstv
u SR BiH
BANJALUKA
SARAJEVO
TUZLA
ŠIBENIK
Korčula
Pelješac

# 6. PRESENT STATE OF NATRON

# 6 PRESENT STATE OF NATRON

## 6.1 General

The NATRON mill is located in Maglaj town in the northern part of Bosnia-Herzegovina in the territory of the Bosnia-Herzegovina Federation, close to the southern border of Srpska territory, around 100 km north or north-west from Sarajevo.

The existing facilities include two kraft pulping lines, five paper machines and two converting plants, designed for a capacity of 120,000 t/a unbleached kraft pulp, 150,000 t/a packaging paper grades and 80,000 t/a of converted products, mainly corrugated board, corrugated boxes and sacks. A major investment in the mill was made during the mid 1960's with a modernisation programme executed in early 1980's. A new investment programme was planned for prior the outbreak of the recent civil war.

Because of the war main part of the mill has been shut down several years due to lack of markets, lack of raw materials and lack of working capital. Part of the plant was damaged during the war, and the long shut down has caused severe corrosion in some structures and equipment. However, the mill is relatively well kept, considering the long shut down period and other unusual circumstances. Compared with world-class mills the capacity is small and old-fashioned, and in need of investment even irrespective of damages caused by war.

Transport facilities including roads and railway exist physically, but due to postwar confusion the access to neighbouring countries and harbour is currently still problematic. Some repairs to roads and bridges, damaged during the war, is required. Coal - unfortunately of low quality - is available in the mine in the proximity of the mill, and sufficient power supply from the public network is available. Water source and possibility to discharge effluent is available in the river Bosna near the mill site. Wood resources are available, however the political situation currently prevents the use of woodlands in the northern areas belonging now to Srpska territory close to the mill, and part of the woodlands within the territory of the Federation is contaminated by land mines. The town of Maglaj with a population of some 30,000 can provide qualified labour force, schools, hospitals, other facilities and social services to mill personnel and their families.

The layout of the existing mill site is not optimal, but sufficient to start the mill and continue production to the extent as before the war. Installing a modern, big pulp mill or paper machine in the existing mill site is not possible without removing most of the present equipment. However, the mill can be developed as a medium-size plant producing preferably brown packaging grades and converted products, for which it was originally designed. A mill site layout drawing is attached.

## 6.2 Production

The production of the NATRON mill has been only a small percentage of its pre-war level. Only the waste paper plant, PM1 and the converting plants are operating, but only intermittently - one or two weeks in every two months. The wood handling, pulping lines and three of the paper machines have not been operated in several years.

Waste paper and purchased unbleached kraft pulp is used as raw material for PM1, producing corrugating raw materials mainly for own converting. Imported sack paper is used for sack and bag converting, and small quantities of liner is purchased. Corrugated board, sacks, bags and small quantities of PM1 paper is sold.. The production in 1991 and 1997 are shown in Table 6-1:

**TABLE 6-1**
**Production**

| | | 1991 | 1997 |
|---|---|---|---|
| Pulp | t | 120.000 | - |
| Paper | t | 150,000 | 4,700 |
| Corrugated board | t | 32,000 | 2,300 |
| Sacks and bags | t | 35,000 | 2,400 |

Less than 3% of the original production capacity of the departments was used in 1997.

## 6.3 Technical state

The technical state of the mill has been evaluated by different ways: 1) suitability of the process and equipment to the intended production purpose, 2) the mechanical situation, reflected as the need for maintenance and reinvestment to get the mill up running, 3) the strength and the weakness of the organisation and personnel and their equipment and capability.

The suitability of the processes and equipment is discussed in Chapter 7. The mechanical state, the organisation and personnel is discussed in the Chapters 6.3 and 6.4 in the following.

### 6.3.1. Pulp Mill

(1) Technical Description

The pulp production of the mill consists of two different kraft pulp process lines: the batch and the continuous (Kamyr) pulping processes, each of which has a chemical recovery section. The outline is shown in Fig 6/1, Pulping Line Block Diagram.

The design and operating conditions and technical specifications of the digesters are shown as follows.

However, the whole technical information of the processes including wood preparation, washing and screening will refer to Appendix 6-I, Technical Data on Pulp Mill.

1) Batch Digesters

| | |
|---|---|
| Capacity | |
| Design (t/d) | 150 AD t/d Kraft pulp |
| Actual operation (t/d) | 150-172 AD t/d Kraft pulp |
| Operating Condition | Chemical charge 410 kg/AD t pulp as A.A |
| | Steam consumption 2.25 t/AD t pulp |
| | Electric power consumption 44 kWh/AD t pulp |

2) Continuous (Kamyr) Digester

It was installed in 1983 as an expansion project.

| | |
|---|---|
| Capacity | |
| Design (t/d) | 200 AD t/d Kraft pulp |
| Operating condition | Cooking yield 48% |
| | Kappa No. 40-50 |
| | Chemical Charge 365 kg/AD t pulp as A.A. |
| | Steam consumption 0.75 t/AD t pulp |
| | Electric power consumption 212 kWh/AD t pulp |

3) Recovery Section

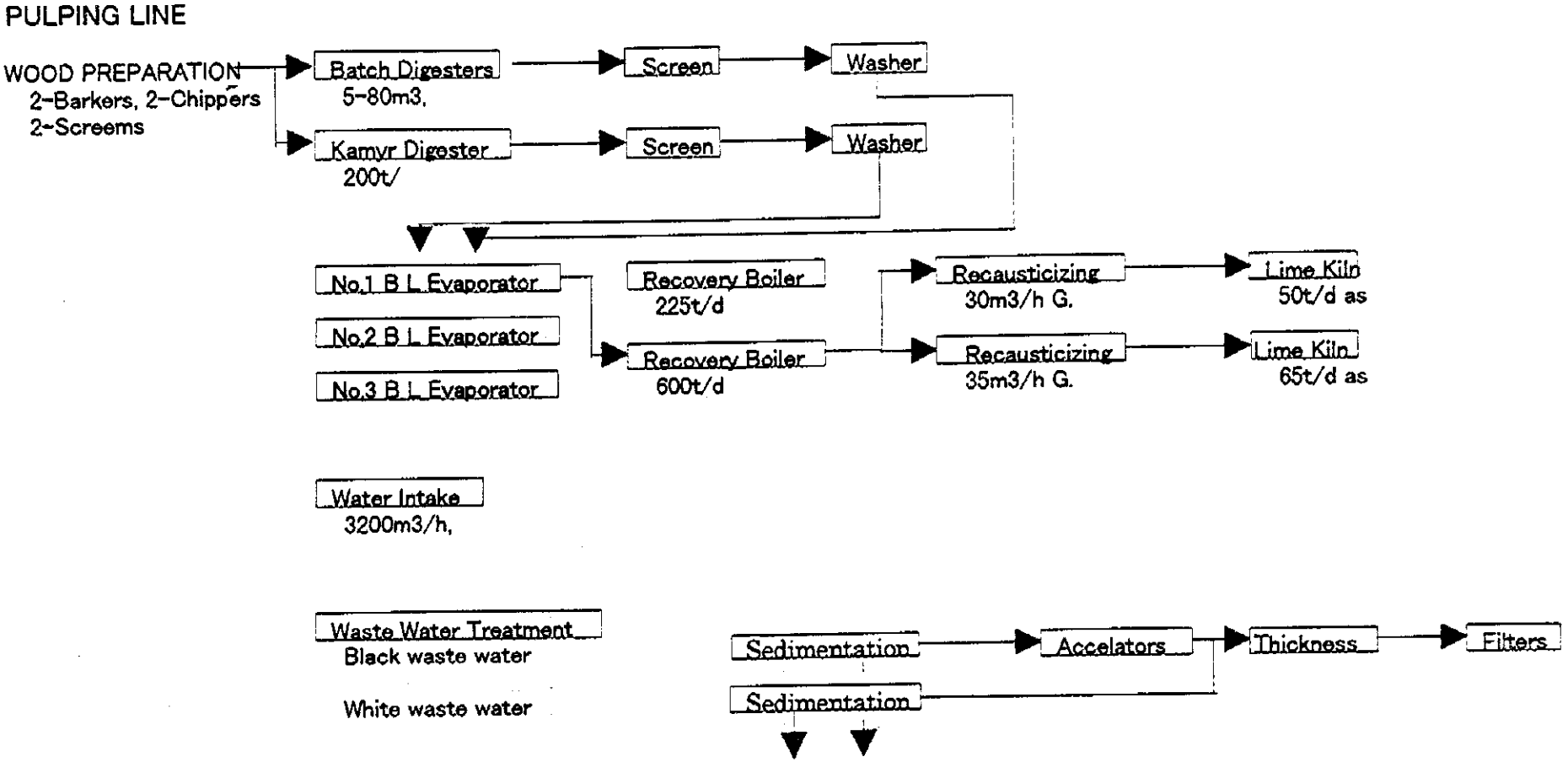
The recovery section has the two lines corresponding to the chemical recovery for the batch and the continuous kraft pulping processes.

They have the independent processes consisting of black liquor evaporator, recovery boiler, recausticizing and lime reburning. However, the strong black liquor is designed to be burned in either of the recovery boilers.

Before the war, No.1 and No.3 black liquor evaporators and new recovery boiler were operated and No.2 black liquor evaporator and old recovery boiler were stand-by.

The whole technical information of each recovery section refers to the Appendix 6-I.

FIG 6/1
Pulping Line Block Diagram



(2) Technical Condition

1) Wood Yard

The wood yard and the wood handling system has still not been restarted after the war. The war damage is very minor except for the chip conveying system which is rather badly damaged. The restoration programme is more like a normal maintenance update of the equipment after quite a few years of production without proper maintenance. The only major item to be replaced is the chipper disc of the main chipper. The electrical MC rooms seems to have withstood the moisture and the cold splendidly in spite of the six years of interrupted production. The conveyers to the digesters are badly damaged by grenades and fire, but they can all be corrected within a normal maintenance program. The burnt out rubber conveyer bands are all in store. The single electrical cable and the few damaged instrument cables can also be easily replaced. The major problem with the wood handling system is its layout and the present debarking system which is not suited for future operations. The present single log barking is not sufficient, there must be a drum barker and also a new chipper to secure the chip quality.

2) Kamyr Pulping Line

The Kamyr pulp line has not been restarted so far. There is no visible damage, except for the outside walls of the building which is damaged from moisture and cold. The high consistency tower has got a bomb hit on the upper twenty five percent of the level and there seems to be some leaks in the lining of the tower. The requirements for restarting this line is mostly normal maintenance. The technical level of this plant is still good and it will be able to competitive for a number of years.

3) Batch Pulping Line

The batch pulp line has not been operational since the war. The digesters are corroded and need to be replaced before restarting the mill. One of the digester shells has been 50% replaced but the other 4 digesters also have to be repaired before the restart of the mill. The material for rebuilding the digesters is there - mostly paid for before the war. The remaining payment is 150,000 DM and the material is stored in Sarajevo for immediate delivery. The rest of the pulp line is in a good condition, but the screen house is rather old and could be switched with the Kamyr line screen house, which will not be used in the semi-chemical cooking concept. The gas collecting system and its incinerator has to be restored before its restart.

4) Recovery Section.

Most of the batch mill recovery line will not be restarted. Thus the recausticizing plant and the recovery boiler is not required. The recovery boiler may be used in the future as a bark boiler. The evaporation department will be used run with mixed black liquor from the Kamyr line and

the batch line. The evaporator is in a good condition so it should be easily restarted. The lime kiln can be put on stand by, until the capacity of the Kamyr line lime kiln has been verified.

The Kamyr line recovery tower is badly damaged from the war. The roof over the recaustisation building has been destroyed and this has caused damage to the recausticizers and also caused huge damage to the instrumentation, mostly from moisture. The whole department is rather old fashioned. The machinery is from the fifties and some of the storage vessels have to be replaced during the next 5 year period, which should not be too costly. The evaporator was partly replaced during the eighties, but the gas incineration system never worked properly and has to be repaired properly. Otherwise the machinery can be restarted without much more effort than normal maintenance, except for the instrumentation where almost all the instruments in the panel must be replaced. Fortunately, the supplier, Foxboro still produces this old fashion type of pneumatic instruments in the USA. They will also continue to deliver spare parts for at least 10 years after termination of this product, and there has not been any indication this will happen soon. This gives NATRON the opportunity to keep this system for the next 10 to 15 years, one with which they are already familiar. This also provides the opportunity to reuse the instruments from the future non operational machines in the mill. The Foxboro office in Vienna can provide the spare parts, and they are only slightly more expensive than the electronic equivalent.

The Gotaverken recovery boiler has not been restarted since the war. The building was badly damaged from the war. One of the main construction beams has been damaged by a bomb, which is critical because the boiler is supported by the main building construction. This has to be thoroughly repaired and checked so that no secondary damage is introduced into the boiler. The most critical part of a recovery boiler is the tubing system. To prevent damage in the tubes, they have been preserved by letting dry air circulate through the whole system. Samples from the tube material in the boiler fireplace have been sent to Nalco USA for material tests. The result confirms the tubes as being suitable for their purpose into the future. The boiler has also been pressure tested up to 60 bar for two hours with the pressure holding, which is also a good sign. The boiler, precipitators and other equipment seems also to be in a good condition and should be easily restarted. This department alone is equipped with mechanical sealing on pumps and a special attention has to be taken to this fact by the maintenance.

In the recausticizing plant of the batch line, a lot of corrosion is observed in machinery, tanks, pipes, etc. Especially the lime slaking parts appear heavily corroded. Thus it may cost more to repair and maintain. No damage could be found in the lime re-burning plant of the batch line, but the kiln tire and rollers are partially eroded. NATRON tried rotating the kiln with no problems after the war.

The piping and auxiliary equipment around the causticizers of the continuous line were destroyed by bombs in the war. These need repair and replacement. The lime re-burning plant of the continuous line has suffered no damage.

In the No. 1 black liquor evaporator of the continuous line, the body of No. 3 effect has a hole made by a gun shot in the war. In the cooling tower, part of the filling has been lost. There is no other damage. The machinery and equipment in No. 2 black liquor evaporator area have been deteriorated, but have no damage.

In the No. 3 black liquor evaporator of the batch line, the auxiliary machinery, such as pumps, has significantly rusted, thus needing special overhaul and maintenance. There appears to be no damage.

The chemical recovery boiler of the batch line has suffered no any special damage. However, it is suggested that if the boiler is to be reused, it should be investigated again by the appropriate technical experts. The Gotaverken recovery boiler must also be re-inspected.

6.3.2. Paper mill.

(1) Technical Description

1) Paper machine 1

| | |
|---|---|
| Year of installation | 1956 Supplier Voith |
| Year of modernisation | 1982 Supplier Beloit |
| Annual capacity | 60,000 t/a |
| Maximal speed | 350 m/min |
| Paper width | 4,250 mm |
| Paper grades | Fluting Testliner Schrenz |
| Grammage | 112 - 300 g/m2 |

At present the paper machine is operating only ¼ of the time. The reduction of operating time is due to low demand from the market and due to shortage of raw materials.

2) Paper machine 2

| | |
|---|---|
| Year of installation | 1957 Supplier Valmet |
| Year of modernisation | 1979 Supplier Valmet |
| Annual capacity | 22 000 t/a |
| Maximal speed | 350 m/min |
| Paper width | 3,260 mm |
| Paper grades | Kraft paper |

| | |
|---|---|
| Grammage | 60 - 200 g/m2 |

The paper machine has not been in operation since April 1992.

3) Paper machine 3

| | |
|---|---|
| Year of installation | 1962 Supplier ErWePa |
| Year of Modernisation | 1980 Supplier ErWePa |
| Annual capacity | 12,000 t/a |
| Maximal speed | 250 m/min |
| Paper width | 2,860 mm |
| Paper grades | MG Paper bag paper wrapping paper |
| Grammage | 40 - 190 g/m2 |

The paper machine was last time in operation August 1996. The machine is at present not in operation due to shortage of kraft pulp.

4) Paper machine 4

| | |
|---|---|
| Year of installation | 1965 Supplier Sano |
| Year of modernisation | 1980 Supplier Beloit |
| Annual capacity | 60,000 t/a |
| Maximal speed | 400 m/min |
| Paper width | 5,450 mm |
| Paper grades | Sack paper Clupak paper |
| Grammage | 60 - 90 g/m2 |

The paper machine was last time in operation April 1992.

5) Paper machine 5

| | |
|---|---|
| Year of installation | 1895 Supplier KMW |
| Year of modernisation | 1970 NATRON |
| Annual capacity | 11 000 t/a |
| Maximal speed | 150 m/min |
| Paper width | 2,150 mm |
| Paper grades | Fluting Schrenz |
| Grammage | 100 - 130 gr/m2 |

The paper machine was last time in operation August 1996.

6) Waste Paper plant

| | |
|---|---|
| Year of installation | 1981 Supplier Beloit |
| Annual capacity | 50,000 t/a |
| Waste Paper grades | OCC, mixed waste and own broke |

The Waste Paper plant is in operation simultaneously with PM 1 for the supply of waste paper pulp.

(2) Technical Condition

The paper machine 1 is currently running. The raw material is waste paper for lower paper grades. The main problems to be solved are the heat recovery system, the electronics for the AC-drive, the building being in a bad shape due to the war and the absence of a proper fibre recovery system. This machine is important for future production and the production rate will be increased. Additional drying cylinders will be added for higher production, meaning that the pope reel has to be moved and the heat recovery casing has to be adjusted. Also the dry end of the machine must be rebuilt (in the wire section) and some small changes made to the inlet box.

The paper machine 3 has been run after the war but not at present due to lack of pulp. The main need for this machine is to grind the Yankee cylinder and to do some maintenance. There may be a market for this type of bag paper and the machine can be run more or less against orders until the market demand improves.

The paper machine 4 has not been run after the war. It is a key equipment for the future. The machine is in a bad state. As well as the heat recovery which has to be renewed, the Accuray system for the paper properties has to be updated and the electronic system for the DC drives must be checked. The HC-refining system must be updated. The winder has to be changed out due to a low technical standard, to meet the future quality demands for sack paper. The building has to be properly repaired, which also is a necessity for the paper quality and the working environment. The wire section will need some additional de-watering elements.

For the other two paper machines the decision has been taken that they are not needed for future production. PM 2 has not been run since the war, and plenty of maintenance is required to get it running. The drive is a very old fashion single shaft drive and the winder does not meet modern quality standards. This machine has a width of 3.20 meters, which does not match todays corrugated box machine standard width.

PM 5 has been run after the war, but it is a very old machine, partly over 100 years, and it will have great problems to meet future quality standards. It is also equipped only with two presses in the press section which gives a very unfavourable energy demand.

For these reasons, it has been decided to use PM 1, PM 3 and PM 4 only.

6.3.3. Converting Plants

Products consist of corrugated board and containers, and paper bags. Paper as the main raw material is self-produced or imported. Other materials - starch, adhesive, ink, wires and printing die, are also available. However, the production rate is far from normal, only 3 to 5 % of the pre-war production. Nevertheless it is considered that the demand for those products will steadily increase with post-war restoration. Product quality has to meet the customer's requirements. Better quality level is essential as an urgent measure.

(1) Corrugated board and containers

Before the war, the plant had the equipment and technology to produce unitary, interior, and shipping packages, though the individual production was small. Small quantities of board products for packaging and transporting purposes will be produced if the new corrugator is restarted on schedule in June, 1998. However, the present quality does not reach a level that satisfies the customer's.

An urgent measure is to improve the basic quality of corrugated board such as flute formation and adhesive strength.

(2) Paper bags

The large-sized paper bag producing facility is old-fashioned, but did not suffer from war damage. It has sufficient production capacity to meet customer's demand. However, there will be no market for kraft paper bags until industries like cement, synthetic resin and feed material, are restarted.

The smaller paper bag making facility is still in good condition, and has sufficient production capacity. However, the product is simply made of kraft paper (unbleached), which does not serve the market. It is essential that a new product is developed.

(3) Production performance investigation

1) Production of corrugated board and containers

1. Production record of corrugated board (sheet), 1991

| Month | 1 - 3 | 4 - 6 | 7 - 9 | 10 - 12 | Total |
|---|---|---|---|---|---|
| by weight (t) | 8,730 | 10,092 | 8,541 | 5,547 | 32,910 |
| by area (1000m$^2$) | 14,411 | 16,564 | 14,181 | 9,807 | 54,965 |

Average basis weight: 32,910/54965 = 0.6 kg/m²

2. Production record of corrugated board (sheet), 1997

| Month | 1 - 3 | 4 - 6 | 7 - 9 | 10 - 12 | Total |
|---|---|---|---|---|---|
| by weight (t) | 585 | 526 | 570 | 1,063 | 2,744 |
| by area (1000m²) | 1, 022 | 966 | 989 | 1,855 | 4,832 |

Average basis weight: 2,744/4,832 = 0.57 kg/m²

3. Sales of corrugated box and sheet, 1991

a) Maglaj mill Four production line, two shift production

| Month | 1 - 3 | 4 - 6 | 7 - 9 | 10 - 12 | Total |
|---|---|---|---|---|---|
| by weight (t) | 4,278 | 4,849 | 4,150 | 3,296 | 16,573 |
| by area (1000m²) | 7,285 | 8,303 | 6,992 | 5,338 | 27,918 |

Average basis weight: 16,573/27,918 = 0.59 kg/m²

b) Bratunac mill One production line, one shift production

by weight 2,137 t/a

by area 3,562,000 m²/a

c) Citluk mill One production line, one shift production

by weight 2,515 t/a

by area 4,191,000 m²/a

d) Sheet sales

by weight 10,315 t/a

by area 17,192,000 m² /a

4. Sales of corrugated box and sheet, 1997

a) Maglaj mill Four production line, two shift production

| Month | 1 - 3 | 4 - 6 | 7 - 9 | 10 - 12 | Total |
|---|---|---|---|---|---|
| by weight (t) | 525 | 466 | 549 | 759 | 2,299 |
| by area (1000m²) | 881 | 794 | 941 | 1,250 | 3,866 |

Average basis weight: 16,573/27,918 = 0.59 kg/m²

b) Bratunac mill production Nil

c) Citluk mill Nil

d) Sheet sales

by weight 231 t/a

by area 34,000 m²/a

2) Paper bags (Sack and sacks with handle)

1. Large sacks, 1991 (1000 pieces)

| Month | 1 - 3 | 4 - 6 | 7 - 9 | 10 - 12 | Total |
|---|---|---|---|---|---|
| VL | 10,902 | 17,187 | 15,156 | 7,709 | 50,954 |
| VLR | 6,094 | 9,607 | 8,491 | 4,309 | 28,501 |
| OL | 7,178 | 11,315 | 9,978 | 5,081 | 33,552 |
| OS | 2,994 | 4,717 | 4,162 | 2,117 | 13,990 |
| Total | 27,168 | 42,826 | 37,787 | 19,216 | 126,977 |

Weight: 126,977,000 x 0.275 kg/piece = 34,924 t/a

2. Large sacks, 1997 (1000 pieces)

| Month | 1 - 3 | 4 - 6 | 7 - 9 | 10 - 12 | Total |
|---|---|---|---|---|---|
| VL | 899 | 1,871 | 1,911 | 795 | 5,476 |
| VLR | 189 | 213 | 77 | 158 | 637 |
| OL | 442 | 531 | 332 | 465 | 1,770 |
| OS | 153 | 121 | 157 | 181 | 612 |
| Total | 1,683 | 2,736 | 2,477 | 1,599 | 8,495 |

Weight: 8,495,000 x 0.275 kg/piece = 2,336 t/a

3. Small sacks, 1991 (1000 pieces)

| Month | 1 - 3 | 4 - 6 | 7 - 9 | 10 - 12 | Total |
|---|---|---|---|---|---|
| KSR | 8,217 | 6,803 | 6,273 | 8,228 | 29,511 |

Weight: 29,511,000 x 0.035 kg/piece = 1,033 t/a

4. Small sacks, 1997 (1000 pieces)

| Month | 1 - 3 | 4 - 6 | 7 - 9 | 10 - 12 | Total |
|---|---|---|---|---|---|
| KSR | 568 | 599 | 354 | 643 | 2,155 |

Weight: 2,155,000 x 0.035 kg/piece = 75 t/a

3) Raw material consumption

1. Corrugated board and containers (tonne)

| | 1991 | | 1997 | |
|---|---|---|---|---|
| Testliner | 10,016 | 30.4% | 550 | 20.0% |
| Schrenz | 9,351 | 28.4% | 1,032 | 37.6% |
| Fluting | 15,534 | 41.2% | 1,162 | 42.4% |
| Total | 32,910 | 100.0% | 2,744 | 100.0% |
| Loss | 1,370 | 4.2% | 158 | 5.8% |

2. Sacks (tonne)

| | 1991 | | 1997 | |
|---|---|---|---|---|
| Sacks | 34,924 | 97.1% | 2,336 | 96.9% |
| Sacks with handle | 1,033 | 2.9% | 75 | 3.1% |
| Total | 35,957 | 100.0% | 2,411 | 100.0% |

(4) Equipment list

1) Corrugated board and container

1. Corrugated board production facility

a) Corrugator — 1 unit

| | |
|---|---|
| Installation | 1960 |
| Width | 1,600 mm |
| Speed | 100 m/min |

b) Corrugator — 1 unit

| | |
|---|---|
| Installation | 1990 |
| Width | 2,100 mm |
| Speed | 300 m/min |
| Restoration work in progress. Scheduled to complete June, 1998 | |

c) Starch adhesive preparation system — 1 unit

| | |
|---|---|
| Installation | 1991 |
| Method | Hot starch adhesive method |

2. Container production equipment

a) Printer slotter — 1 unit

| | |
|---|---|
| Installation | 1976 |
| Width | 3.6 m |
| Printer | two color, oil base dye |
| Speed | 90 rpm |

b) Printer slotter — 1 unit

| | |
|---|---|
| Installation | 1981 |
| Width | 2.7 m |
| Printer | two color, water base dye |
| Speed | 120 rpm |

c) Flexographic printer folder gluer — 1 unit

| | |
|---|---|
| Installation | 1978 |
| Width | 2.2 m |
| Printer | two color, water base dye |
| Speed | 150 rpm |

d) Die cutter (Victoria) — 1 unit

| | |
|---|---|
| Installation | 1976 |
| Width x Length | 740 x 1200 |
| Speed | 25 - 30 rpm |

e) Wire stitchers

| | |
|---|---|
| Manual stitcher | 3 units |
| Semi-automatic stitcher | 1 unit |

f) Others

Slitter

Slotter

3. Common Equipment

| | | |
|---|---|---|
| a) | Battery operated 3.2 m high, 3 ton Folk Lift | 2 units |
| b) | 2 m diameter Cyclone | 2 units |
| c) | Baler | 1 unit |
| d) | Shredder (chipper) | 1 unit |

4. Equipment lost by war

| | | | |
|---|---|---|---|
| a) | 1800 and 2100 mm Printer-slotter | | 2 units |
| b) | Die cutter (Platten) | | 1 unit |
| c) | Gluer | | 1 unit |
| d) | Wire stitcher | Automatic | 1 unit |
| | | Manual | Several |
| e) | Compartment assembler | | 1 unit |

2) Paper bag

1. Sacks

| | | |
|---|---|---|
| a) | Sacks making machine | 5 units |
| b) | Bottoms gluer | 7 units |
| c) | Bottoms stitcher | 6 units |

2. Sack with handle

| | | |
|---|---|---|
| a) | Sack machine | 3 units |

(5) Corrugated board and container

Production capacity calculation and production balance

1) Corrugated board production capacity

When the new machine is restored in June 1998

Width 2100mm, Speed 200 m/min, Three shift, 22 day a month operation,

Efficiency 75%

2.1m x 200m/min x 60min/h x 24h/d x 22d/mo x 12mo/a x 0.75

$= 119,750,000\ m^2/a$

$119,750,000\ m^2/a \times 0.6kg/m^2 = 71,850\ t/a$

2) Corrugated container production capacity

a) Flexographic printer slotter

Width 2200mm, Speed 150 rpm, Three shift, 22 day a month operation,

Average area $0.5m^2$, Efficiency 70%

0.5m2/r x 150 r/min x 60min/h x 24h/d x 22d/mo x 12mo/a x 0.7

= 19,958,000 $m^2$/a

19,958 $m^2$/a x 0.6 kg/$m^2$ = 11,975 t/a

b) Flexographic printer slotter

Width 2700mm, Speed 120rpm, Two shift, 22 day a month operation, Average area 0.7m2, Efficiency 60%

0.7m2/r x 120r/m x 60min/h x 16h/d x 22d/mo x 12mo/a x 0.6

= 12,773,000$m^2$/a

12,773,000 $m^2$/a x 0.6kg/m2 = 7,664 tonne/y

c) Printer-slotter

Width 3,600mm, Speed 90rpm, Two shift, 22day a month operation, Average area 1.0m2, Efficiency 50%

1.0m2 x 90r/m x 60min/h x 16h/d x 22d/mo x 0.5 x 12 mo/a

= 11,405,000$m^2$/a

11,405,000 x 0.6 kg/$m^2$ = 6,843 t/a

d) Total production capacity

By area (19,958 + 12,773 + 11,405) x 1,000 = 44,136,000 $m^2$/a

By weight (11,975 + 7,664 + 6,843) x 1,000 = 26,483 t/a

3) Corrugated board and container production balance

| | |
|---|---|
| Corrugated board production capacity | 71,850 t/a (119,750,000 $m^2$/a) |
| Corrugated container production capacity | 26,482 t/a ( 44,136,000 $m^2$/a) |
| Difference | 45,368 t/a ( 75,614,000 $m^2$/a) |

1. Production increase plan

a) Installation of (1) additional Flexo folder-gluer

Width 2,100mm, Speed 200 r/min, Three shift, 22 day/month

Average area 0.5 $m^2$, Efficiency 70%

0.5m2 x 200 r/min x 60min/h x 24 h/d x 22d/mo x 12mo/a x 0.7

= 26,611,000 $m^2$/a

26,611 t/a x 0.5kg/$m^2$ . = 15,967 t/a

Sales as sheet (40%) 29,401 t/a (49,000,000 $m^2$/a)

b) Installation of (1) additional Flexo folder-gluer

| | |
|---|---|
| Production | 15,967 t/a (26,612,000 $m^2$/a) |
| Affiliated container plant | |
| Production | 14,400 t/a (24,000,000 $m^2$/a) |
| Sheet sales (20%) | 15,001 t/a (25,000,000 $m^2$/a) |

(6) Bags Production capacity calculation

1) Sacks production capacity

Number of machine 5, three shift, 22day/mo, speed 100 r.p.m.

Efficiency 70%

100r.p.m. x 60min/h x 24h/d x 22d/mo x 12mo/a x 5 x 0.7

= 133,056,000 pieces/a

133,056,000 pieces/a x 0.275 kg/piece = 36,590 t/a

2) Sack with handle production capacity

Number of machine 3, three shift, 22day/mo, speed 70 r.p.m.

Efficiency 70%

70r.p.m. x 60min/h x 24h/d x 22d/mo x 12mo/a x 3 x 0.7

= 55,883,000 pieces/a

55,883,000 pieces/a x 0.035 kg/piece = 1,956 t/a

(7) Quality and Quality control

1) Raw material standard

1. Test liner

| Basis Weight | Burst strength | Bond test | | Moisture content | Water absorption |
|---|---|---|---|---|---|
| g/m² | kPa | mJ | | % | g/m² |
| ISO 536 | ISO 2758 | IBT | | ISO 287 | ISO 535 |
| | | u | p | | |
| 140 ± 5% | > 320 | >90 | >90 | 7 ± 1 | < 50 |
| 150 ± 5% | >350 | >90 | >90 | 7 ± 1 | < 50 |

2. Schrenz

| Basis Weight | Burst strength | Moisture content | Water absorption |
|---|---|---|---|
| g/m² | kPa | % | g/m² |
| ISO 536 | ISO 2758 | ISO 287 | ISO 535 |
| 120 ± 5% | > 320 | 7 ± 1 | < 50 |
| 130 ± 5% | >350 | 7 ± 1 | < 50 |

3. Fluting

| Basis Weight | Compression strength | Moisture content | Water absorption |
|---|---|---|---|
| g/m² | N | % | sec |
| ISO 536 | ISO 7263 | ISO 287 | TAPPI SU-72 |
| 112 ± 5% | > 160 | 7 ± 1 | 10 - 300 |
| 127 ± 5% | >180 | 7 ± 1 | 10 - 300 |

4. Paper bag paper

| Basis Weight | Tensile strength | Tensile index | Breaking length | Stretch | Water absorption | Air absorption | Moisture absorption |
|---|---|---|---|---|---|---|---|
| $g/m^2$ | kN/m | Nm/g | m | % | $g/m^2$ | s | % |
| ISO 536 | ISO 1924 | ISO 1924 | ISO 1924 | ISO 1924 | ISO 535 | ISO 3687 | ISO 287 |
| 90 ± 5% | (T) 3.0<br>(Y) 1.5 | (T) 33.5<br>(Y) 17.0 | (T) 3400<br>(Y) 1750 | (T) 1.8<br>(Y) 3.2 | 40 | 15 | 7 ± 1 |

2) Production standard

1. Corrugated board and containers: Nil
2. Sacks: Nil
3. Quality Control: Nil

(8) Technical Condition

The corrugated board and box plant and its store house was badly damaged in the war. There was a new corrugator installed some years before the war and this one is already being repaired with state money. There is also a big need for a new die cutter line to be purchased.

The sack mill is producing sacks today. Its immediate needs is to get the process more automated i.e. to run with less staff.

6.3.4. Steam, Water and Power supply.

Please refer Appendix for technical description, block diagram and specification.

(1) Power Plant

The power plant is partly running today. The two small coal boilers of 25 tons of steam/ hour and the 8 mw generator generate the energy for the present production. This equipment is in a bad technical shape after 35 years of running without a proper maintenance. The remaining life will not be more than 2-3 years. The boilers are running at maximum risk. The other two boilers, of 80 and 100 tons/ hour have yet not been restarted. The big 100 ton/hour boiler is in good shape and its tube material has also been tested with positive results. The two remaining generators of 18 and 25 mw have not yet been run. They can both be restarted after proper servicing. One problem to investigate further is where to get spare parts. While the old Jugo turbine company does not exist any more, it can probably be solved through ABB who have taken over the company. Production must be much more energy efficient in the future - to get the coal usage reduced to European standards for pulp and paper production. With a future bark boiler, the energy balance should be well taken care of, even without the two small boilers.

(2) Fresh Water Treatment

Only the old fresh water treatment plant has been restarted, because it is sufficient for the present water needs. Restarting the new water treatment plant is mostly a matter of maintenance and should not meet with great difficulties. Then the old plant will not be necessary taking into consideration lover water usage for production.

The chemical water production plant for the boiler water needs some maintenance and the ion exchange gel needs to be changed. This is a rather heavy restart-up cost.

6.3.5 Electrical and Instrumentation

(1) Electrical Power System

The 35 kV utility connections used to be made from two networks, one from Zenica, the other from Doboj, each with 10 MVA capacity. However, the Doboj now belongs to "Serb Republic" and, due to the political situation, the power from this direction became unavailable. Now, the system is rearranged to 20 MVA capacity connected to Zenica network only. The Zenica power system is dependable. Moreover, with the extensive mill co-generation system with condensing turbines, power is virtually self sufficient and, except for the plant start up, the mill can be run independent of the network, if necessary. The mill power distribution voltage is 6kV.

Motors with power 150 kW and over are high voltage motors (6kV) which totall approximately 150 in the entire mill. The rest of the motors are 380V.

1) Paper Machine Drives

PM1 Thyristor controlled DC motor sectional drive. The system is supplied by ANSALDO (Italy) 16 DC motors involved. The restoration is complete and the machine is in operation now.

PM2 Line shaft drive with Ward-Leonard variable speed drive. Rather antiquated system.

PM3 Line shaft drive.

PM4 Thyristor controlled DC motor sectional drive The system is supplied by ANSALDO (Italy). The system is damaged mostly by weather, some by grenades bombing.

2) Power Factor

There is no power factor compensation device in the mill; no power capacitor nor large synchronous motor. The power factor is poor; pre-war power factor was approximately 0.8.

3) Electrical Maintenance Facilities

The mill maintenance facilities are good. Motors can be hooked up in the maintenance shop test bench and tested for the motor characteristics.

The maintenance shop can re-wind motor windings of upto 50 kW. The larger motors can be rewound in a shop in Tuzla, 80 km away.

4) Damage Assessment

War damage in electrical systems is limited.

- Overhead 6kV cable interconnecting between station TS2/2 and TS13 snapped by direct hit grenade.
- Underground 6kV cable to PM4 machine and stock prep. is broken.
- PM4 drive control panels have some damage.
- A short length of Kamyr digester chip feed belt conveyer was burnt together with several low voltage cables.

Most of necessary repairs are due to weather damage. The damage does not appear serious. This is partly because almost all motors and transformers are installed indoors.

- One of two 10 MVA utility line transformer is known to be weather damaged.
- PM4 drive control system, thyrister control, was known to be weather damaged. Will require certain restoration work including some replacement parts and services by the original manufacturer ANSALDO in Italy.

(2) Instrumentation System

1) General Instruments

Through out the mill, the processes have pneumatic instruments. Foxboro is the most common manufacturer of the pneumatic instruments, next being Taylor.

The batch pulping processes and UKO-1, 2 boilers, the older section of the mill, are instrumented rather lightly. Newer areas are instrumented properly.

Control valves are all imported and there appears to be no standard selection. Control valves made by Taylor, Foxboro, Naf (Kamyr digester area), Fisher, Mason-neilan, Neles are commonly used.

2) Special Instrument

- Paper machine basis weight moisture scanner

  PM2 and PM4 are equipped with Accuray basis weight-moisture scanners. They control automatic machine direction basis weight and moisture. Also they display cross machine profiles of basis weight and moisture. However, they have no ability to control the cross direction control. Paper machines themselves are not equipped for cross machine control devise such as fine slice lip profiling, sectional steam shower.
- Batch digester auto-cooker

Accuray computerized automatic batch digester control system was introduced in 1987. It has never performed satisfactorily and the system was abandoned before the war.

3) Instrument maintenance facilities

Well organized warehouses maintain good store of spare parts.

The maintenance shop has a set of good quality test and calibration instruments sufficient to maintain the existing pneumatic instruments.

4) Damage Assessment

Kamyr line causticizer area was repeatedly hit directly by grenades. The building structure and some equipment and piping were damaged. The instruments in the control room were irrepairably damaged. The control panel has to be rebuilt, and the instruments have to be replaced for re-start of the mill.

Except the above, the damage to instrumentation system is minimal.

The special instrument, paper machine scanner is delicate electronic device. Although it is not possible to access the damage at this stage, it is anticipated that certain repair replacement work, including original supplier's (Italy) services will be necessary.

6.3.6. Environmental

(1) Effluent Treatment

1) Technical Description

The plant was started in 1986.

Waste water to be treated is classed into the two kinds: white waste water (acid) from the paper machines area and black waste water (alkaline) from the pulp production lines (batch and continuous).

White waste water is pumped into the mixing zone through a bar screen. It then goes to the coagulation and sedimentation to separate mud. The cleared water flows to the Bosna River. The mud is thickened for drainage. Black waste water is thrown into the primary sedimentation to separate mud, and then treated in the two accelerators for biological treatment. The treated water is discharged to the Bosna River. Surplus of the mud is dewatered with belt filters. Thickened mud is dumped at the deposit site.

The design criteria of the waste water treatment plant are shown in the following figures, which were effective in 1976, but confirmed to have been unchanged until the war.

Regulation values for Bosna River (3rd Category River)

| | | | |
|---|---|---|---|
| Suspended solid (SS): | 80 | mg/l | (Max.) |
| Total dissolved solid (TDS): | 1500 | mg/l | (Max.) |
| Dissolved oxygen (DO): | 4 | mg/l | (Min.) |
| BOD5: | 7 | mg/l | (Max.) |
| pH: | 6-9 | | |

| | | |
|---|---|---|
| Colour: | none | |
| Smell: | none | |
| Properties of Bosna River water (1976) | | |
| Suspended solid (SS): | 13 | mg/l |
| Total dissolved solid (TDS): | 354 | mg/l |
| Dissolved oxygen (DO): | 7.5 | mg/l |
| BOD5: | 2.5 | mg/l |
| COD: | 8.09 | mg/l |
| Total hardness: | 10.7 | D.H |
| pH: | 8.1 | |
| Minimum flow rate: | 9 $m^3$/sec | |

On the other hand, the wastewater treatment was designed as the following expected values of the treated water:

| | | |
|---|---|---|
| pH | 6-9 | |
| BOD5: | 30 | mg/l (Ave.) |
| Suspended solid: | 80 | mg/l (Ave.) |
| Colour: | As little as possible | |
| Smell: | As little as possible | |

The waste water treatment facilities have not been operated after the war. Water consumption and effluent flow is high compared with the production, 260 m3/t paper. All the effluent is discharged to the river without any treatment.

In addition to the effluent load originating from the waste paper treatment and paper machine, the coal ash from the power plant is discharged to the river with the effluent. According to the coal analysis the coal contains 14-40% ash, and the heat value is 10.5 GJ/t. The consumption of coal is around 1 t/t paper, and so the quantity of ash discharged is around 140-400 kg/ t paper. Such high pollution will not be allowed in normal operation.

2) Technical Condition

The effluent treatment departments are in poor shape. The settling basins are full of rain water, with grass growing inside. The lakes and their driving mechanisms have been seriously corroded. Corrosion and poor maintenance is visible everywhere. The building for sludge presses and chemical dosage system is badly war damaged as well as the machinery. This must be corrected immediately, otherwise no investor will show any interest in NATRON. None of the equipment has so far been restarted after the war, meaning that the present production is taking place without any environmental protection. The European standards for effluent treatment has developed a lot in recent years, so it is possible that further treatment will have to be implemented in the years to come. The total water usage for the pulp and paper production must be reduced to less than half of the usage before the war. With that in mind, the effluent treatment plant should be big enough even for the suggested increased future production level.

(2) Emissions to Air

To prevent air pollution and odor, the mill has (1) exhaust gas treatment and condensate stripping plant and (2) waste gas incinerator and (3) water scrubber and electrostatic precipitator for chemical recovery boilers.

1) Design criteria and technical specifications

Exhaust gas treatment and condensate stripping plant were designed as shown below.

Capacity:

Exhaust gas treatment

| | |
|---|---|
| For batch cooling line of pulp production of | 150 AD t/d |
| For continuous cooking line of pulp production of | 200 AD t/d |

Condensate stripping 150 $m^3$/h as feed waste water

Specification:

Stripping column Dimension 1900 mm dia. x 16475 mmH

The regulation against air pollution

Checks for discharge of exhaust gases and dusts in the mill were carried out in accordance with the following regulation values before the war.

a. The regulation inside the building JUS-U.BO.001/71 (Regulation for Yugoslavia Bosnia 001/1971)

| | | | |
|---|---|---|---|
| Dust: | 1,750 | pieces/$cm^3$ | (max.) |
| CaO: | 15 | mg/$m^3$ | (max.) |
| $H_2S$: | 7 | ppm | (max.) |
| Mercaphtane: | 0.5 | ppm | (max.) |
| CO: | 50 | ppm | (max.) |
| $CO_2$: | 5,000 | ppm | (max.) |
| $SO_2$: | 10 | mg/$m^3$ | (max.) |

b. In the chemical recovery boiler, the measurements were conducted in 1987. Dust and $SO_2$ emissions were then measured, calculated and analysed to check for the values in accordance with following standard values:

| | German standard | Maglaj standard | Other area standard |
|---|---|---|---|
| Dust: | 80 mg/$m^3$ | 50 mg/$m^3$ | 300 mg/$m^3$ |
| SO2: | 1.7 mg/$m^3$ | None | 3 mg/$m^3$ |

2) Technical Condition

The exhaust gas treatment and condensate stripping facilities have never been operated since the war, because no kraft pulp has been produced.

The waste gas incinerator has been stopped because of some operational problems.

Odour control was not required in the regulations before the war.

(3) Ash Dumping

The ash from the coal boilers is constantly generated when coal is burnt. The amount is estimated to be about 140 - 400 kg/t paper, based on the coal burning rate and its ash content. The ash has been earlier dumped to a deposit site 2 km from the mill. The piping and pumping system has been damaged during the war and cannot be used before repairing.

6.3.7. Common Facilities.

The vehicles are in a bad shape and require investment. The workshop for vehicles does not meet the standard necessary to do first class repair work. The work environment and safety standard is well below European standards. There is also a bad need for new equipment and new tools, both for mechanical and electrical maintenance.

Common areas like offices, laboratories, rest rooms, dressing rooms, are partly in a bad shape and will need some funds in the near future.

The tools and the machines in the mechanical departments are all there to secure the start up of the mill. The people need training to get a licence for welding pressure vessels and training for laser alignment of pumps and machines. For the coming years, the main crane in the mechanical workshop has to be complimented with a second bigger one. Some of the major workshop machinery also has to be replaced, especially if external services is going to be continued. Standards are below those in Germany - possibly a future requirement.

The test equipment and training seems to be sufficient on the electrical and instrument side.

The civil department people may have to be trained in using diamond drill and diamond saw equipment. Otherwise, they seem to have the sufficient training.

The maintenance management team also seems to have the skill and training for the big challenge of restarting the mill. They badly need a computer based planning system to handle the enormous scope of work and people needed for the restart of NATRON. There is also a need for a computer based spare parts system.

The technical situation in the mill is, that all equipment can be restored and that there is nothing on the technical side preventing the restart of NATRON.

The drawback of the restart program could be the large number of skilled people needed for maintenance. This has to be closely watched, and it may be necessary to start further maintenance training programs.

The internal transport does not belong to the maintenance organisation but to the commercial department. There are now 44 vehicles left of the 176 from before the war and another 27 are expected to be repaired shortly. This area will incur a lot of costs for new vehicles in the coming years. To keep such costs to a minimum it will mean the reorganisation of the whole department and changes in logistics. Less than half of the vehicles from before the war must be enough. Maybe part of these activities should be leased out to some external contractor company.

The fire- and security- department also belongs to the commercial department as one unit with one responsible chief. This is the same as before the war. The fire department consists today of four firemen on each shift. Added to that is one responsible for the fire protection equipment and one employed for co-ordination on day time. Before the war there were twelve firemen on each shift and five experts in the day time for preventive fire protection. The experts were, one fire chief, two responsible for the maintenance of the fire protection equipment, one teacher in fire protection and one responsible for the maintenance of the fire cars. There was and still is three cars for the fire protection. They are equipped to fire fight with, foam, chemicals and water. The fire brigade participated in the protection of Maglaj and played a superior roll in this task. The mill had before the war an automatic fire warning system based on sensors in each department, connected to a central alarm in the fire department, to alert the fire crew. For the future, this system must be restored and the warning central alarm should be placed in the security room at the main gate for the security officers and to alert the fire squad. The fire protection organisation had before the war 60 members. This can not be the case for the future. The shift maintenance crew must be trained to take over the responsibility for fire protection. Added to this there should be one fire chief, one responsible for maintenance of all equipment and one responsible for the cars, all on day time. There must be a radio system between the responsible persons for a quick communication to have a good working system.

The other leg of this organisation the security department today has four officers on each shift to guard two gates and to make some patrol duties. Before the war, there were twelve officers on each shift. There is one main gate and one side gate to guard. The side gate is only for personnel passing in and out by foot or by bicycle. This one could preferably be equipped with television cameras and monitored from the main gate. The employees should also be issued with identity cards and automatic reading at the gate. There should also be other cameras placed strategically along the fence. With this equipment, the television guarding system and the radio communication system, there should be enough with two guarding officers on each shift. To be able to do some patrolling within the mill area, the guards also need a small car, but there has always to be one guard at the main gate for safety reasons.

The safety department for personnel protection had a total staff of eleven people, co-ordinated by a safety engineer, before the war. The main role was preventive protection. The staff were all experts in different areas as, biological, social, mechanical, environmental, electrical and chemical safety protection. Added to this was a dispensary with doctors and nurses situated just outside the main gate, for the mill employees and their families. Today there is the safety engineer and a nurse left from the former organisation. Some of the main tasks before the war was 1) introduction and schooling in safety matters for new employees, 2) follow ups and written tests after a couple of months in personnel safety, 3) introduction seminars for visitors 4) checking and testing of safety devices 5) checking and training so that the employees are wearing the right personnel protection equipment for different tasks, 6) preparation of accident reports and suggestion of technical changes after accidents. In the event of major incidents together with the domestic accident inspection was also a big issue. Fires also required a great deal of investigation.

Also a lot of statistics have to be kept. As a measure of the scope of work which was done, here are some numbers from the accident statistics from 1991 and also from 1997. During 1991 the average employed was 4,502. The number of accidents was 149, of which 148 was minor and 1 severe. The maintenance department had the biggest number - 54 accidents. The mill has been fortune with fatal accidents. The last one was ten years ago. In 1997 there was a total average of 1697 employed and there were 21 accidents, 19 minor and 2 severe. The highest number was in the maintenance department. For the future, it might be necessary to add at least two overall experts for safety training and statistics.

The medical care has to be combined with the city hospital care of Maglaj.

## 6.4 Organisation and Personnel

### 6.4.1 Company Organisation

(1) Management Structure

The Supervisory Board of NATRON has seven members. Three of the members are nominated by the Federal Ministry of Energy, Mining and Industry as outsider members. Four members are nominated by the shareholders meeting from employees of Natron.

The members nominated by the Ministry are:

- Mujezinovic Aziz, Doctor of Technical Science, member of management team in steel factory in Zenica
- Backovic Enver, Doctor of Economic Science, Vice Governor of Narodna Banka (National Bank) Bosnia and Herzegovina
- Gotovusa Enes, Law Graduate Secretary in Ministry for Energetic of Bosnia

The members nominated by the individual shareholders assembly are

- Mustabasic Ismet, engineer of electrotechnics with more than 21 years of working experience as an assistant of general Manager for electrical and instrument maintenance
- Omerasevic Menaf, engineer of electrotechnics with more tan 13 years of experience as a leader of instrument maintenance
- Zachirovic Muhamed, economist with more than 15 years of working experience as a chief of economic Sector
- Duracivic Husein, engineer technologist with more than 15 years of experience as a chief of Production Sector

The supervisory board meets officially twice a year.

The General Manager is nominated by the Supervisory Board as contract basis, and he has the authority to nominate the Management team, consisting of seven members. They direct the main operational sectors of the company.

The Management team meets officially ones or twice a week., based on the need, without any regular schedule.

(2) Organisation

Currently the organisation is principally the same as before war, but because most of the mill departments are not operating and some of them are operating only intermittent or with low capacity, the function of the organisation does not correspond normal production conditions.

The organisation includes eight sectors. Organisation chart is attached, Fig. 6.2. Company Organisation, Present.

Marketing, purchasing and transport have been combined to the Marketing and Commercial Sector. The production sector includes two main departments: paper production (wood handling, pulp production paper production) and converting (sack, bag, corrugated board production). Energy and maintenance functions have been combined to one sector. The administrative functions are divided to four sectors including economy, development/ investments, law/personnel and quality/social/standard functions.

Two of the paper production department (wood handling, pulp mill) are not in operation.

The third department, paper mill, includes three groups, consisting of Group 1 (PM1, PM2 and PM3), Group 2 ( PM4 and PM5) and Group 3 (recycled fibre handling). Only PM1 and the recycled fibre departments are in operation some 10 days every two months.

The converting plant is operated discontinuously.

(3) Manning

Before the war, when all the mill departments were operating normally and the production level was 120,000 tons of pulp and 150,000 tons of paper, of which 67,000 tons was converted to corrugated board, sacks and bags, the mill employed some 4,500 people.

Now, when only the recycled fibre line and PM1 are operating intermittent (only one or two weeks in every two months) and the converting plants are operated only 5 % of capacity, the total manning has been reduced to some 1,640 and the working force to 632 (situation in February 1998). The difference, 1,008, is waiting for work. A rotation system has been applied between working and waiting personnel.

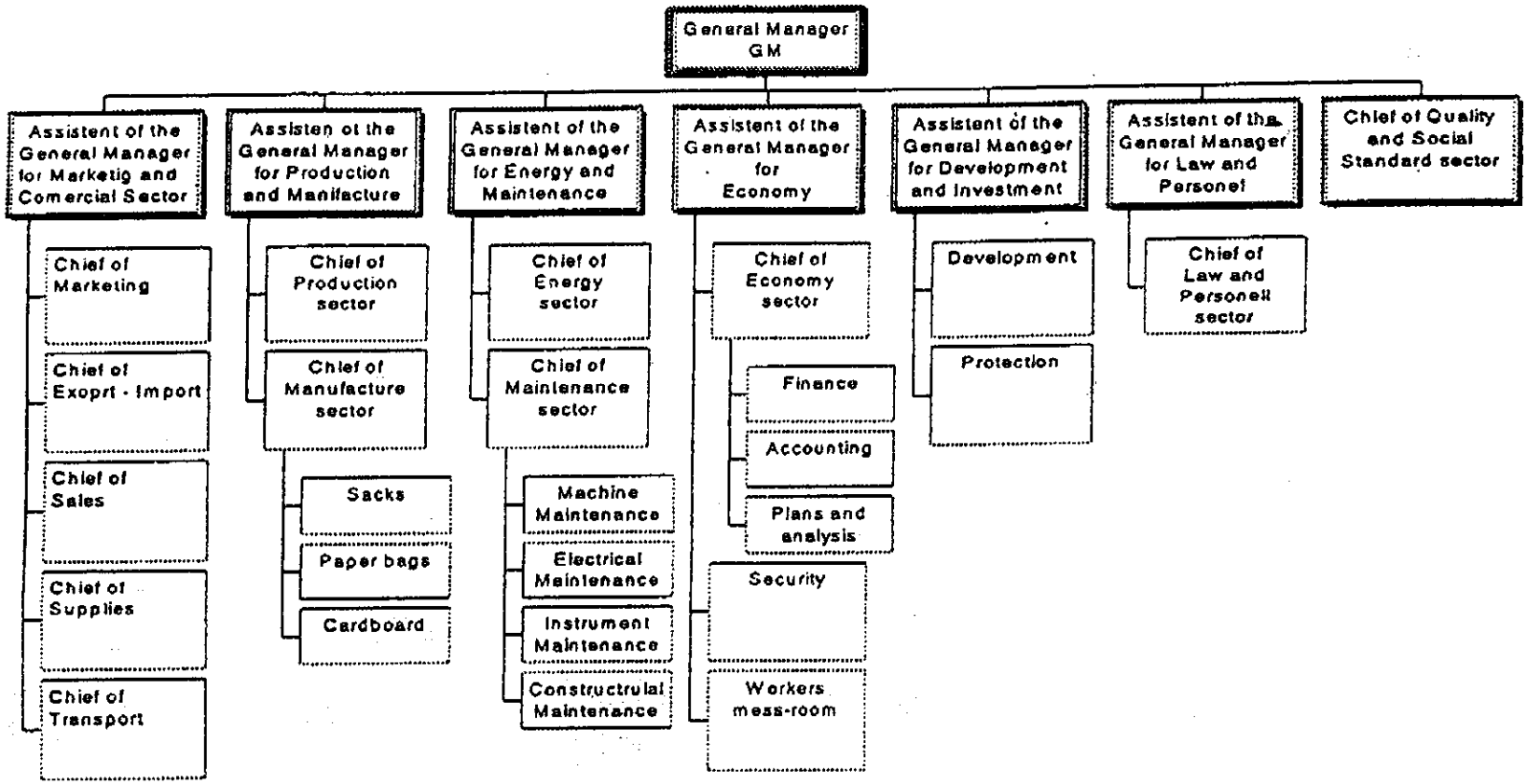
**TABLE 6-2**
**Manning by Organisation Sectors**

| | Working | Waiting | Total |
|---|---|---|---|
| Management | 8 | 3 | 11 |
| Marketing, commercial | 39 | 116 | 155 |
| Production | | | |
| paper | 118 | 156 | 274 |
| converting | 137 | 299 | 436 |
| Energy and maintenance | | | |
| energy | 79 | 38 | 117 |
| maintenance | 107 | 236 | 343 |
| Economy | 103 | 99 | 202 |
| Development, investments | 9 | 12 | 21 |
| Law and Personnel | 9 | 11 | 20 |
| Quality and Social | 26 | 1 | 27 |
| Total | 635 | 971 | 1606 |

The forestry sector, totalling 26 persons, has recently been cancelled.

**FIGURE 6.2**

**Company Organization, Present**



6.4.2 Paper mill Organisation.

The total manning of PM1, when operating, is 57 including superintendent, 1st operator and in shift one shift supervisor, two refiner operators, two wire operators, two dryer operators, four winder operators and four packing line operators. This manning is heavy taking into consideration the production level of the machine, but can be understood because of the low technical level and the local conditions.

The recycled fibre plant is operated simultaneously with PM1. The manning totals 37 including one engineer, in two-shift two truck drivers (who are during testliner production feeding the chemical pulp pulper as well) and in three shift six sorters and two operators.

Paper Mill and Waste Paper plant are organised as one unit with the Paper Mill manager as a common manager.
The unit consists of three groups all reporting to the Paper Mill manager.

The three groups are;

Group 1 Paper machine 1, 2 and 3.
Group 2 Paper machine 4 and 5.
Group 3 Waste Paper plant.

Three organisation groups are under the Paper Mill manager. Each group has one Superintendent as a group leader. Each Superintendent has a theoretical technical education. Each group has one Shift Supervisor which is responsible for the shift operation. All operators are reporting to the Shift Supervisor.

**TABLE 6-3**
**Paper Mill Organisation and Manning**

| | Super-intendent | Super-visor | Operator | Maintenance |
|---|---|---|---|---|
| Group 1 | 1 | 4 | | |
| PM1 | | | 58 | 12 |
| PM2 | | | 54 | 10 |
| PM3 | | | 30 | 10 |
| Group 2 | 1 | 4 | | |
| PM4 | | | 62 | 12 |
| PM5 | | | 54 | 10 |
| Group 3 | 1 | 4 | | |
| Waste paper | | | 36 | |
| Broke | | | 8 | |

Total employment in the paper mill, including maintenance and personnel waiting for work is 372.

### 6.4.3 Maintenance Organisation

The maintenance organisation today is similar to the one before the war. It is a centralised common organisation, which can be seen everywhere in the world in the pulp and paper business. There are five main departments under the supervision of the maintenance director.

- Mechanical department.
- Electrical department.
- Instrument department.
- Civil department.
- External services department.

The organisation chart is attached, Fig. 6/3, Maintenance Organisation, Present.

Three different targets have been set for the maintenance department and its future standards:

- Development of preventive maintenance.
- Quality development in workshops and repair activities.
- Continue to develop capacity and quality for external services department.

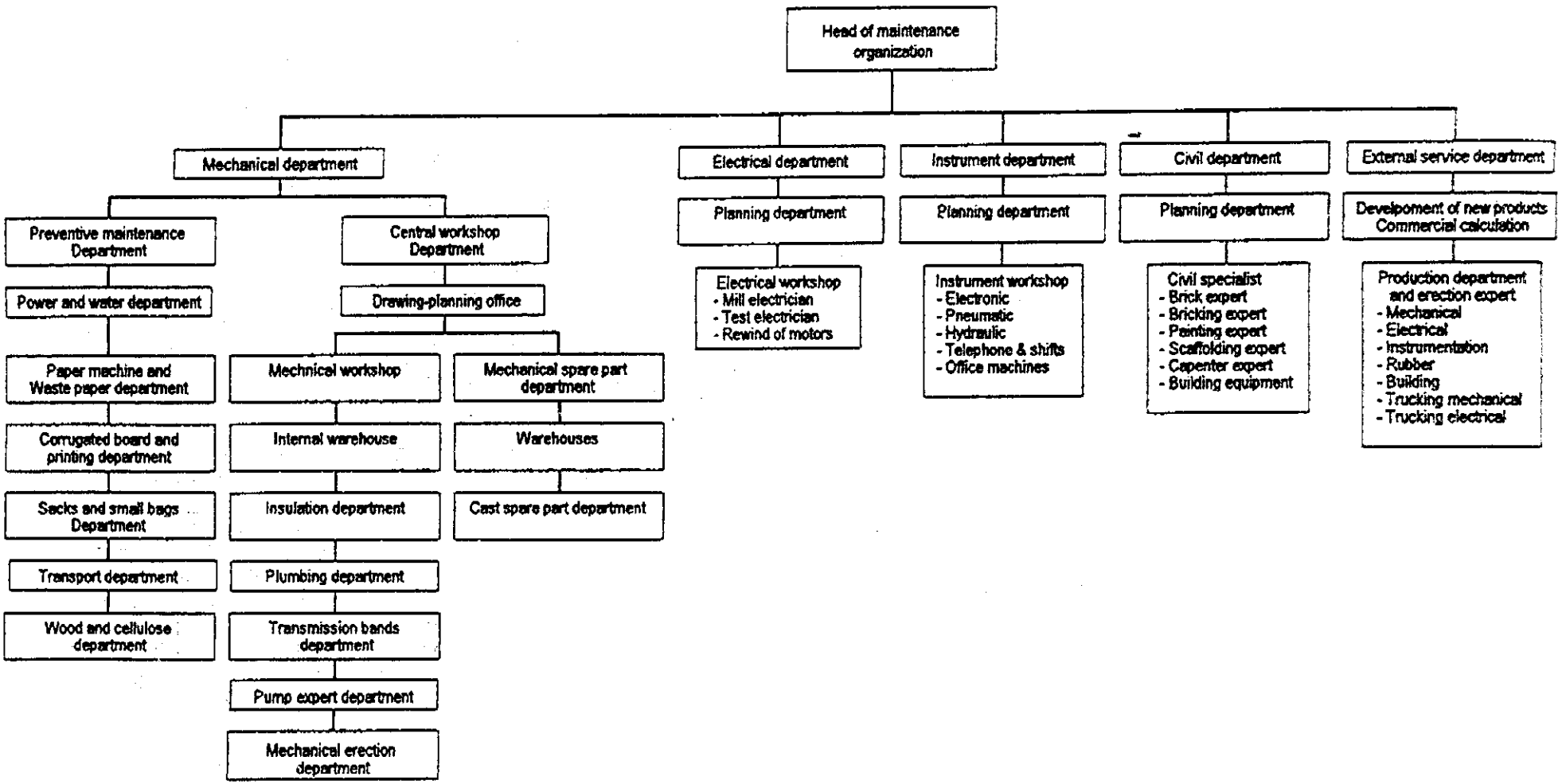
The preventive maintenance for the mechanical, electrical and instrument activities is key for the future success of NATRON. Therefore it has to be adapted as the first option to develop this system. Today activities with a daily, weekly and a monthly activity for lubrication and oil change is only a minor start of this future system.

The quality of spare parts coming from the workshops and the quality of the field repair is very critical for the availability of the process equipment and the difference between profit or loss for NATRON. There is no option to make any repair work twice in the future. It has to be correct the first time.

The external services department will mean very much for NATRON the first five years after start up of the mill. It will then be more specialists employed than necessary for the mill, because the different skills are needed for special spare parts, who can not be found on the market. To have these employed fully occupied it means external activities. One option for these employees is to be privatised and helped from the mill to start their own workshops when the mill is commissioned.

FIGURE 6.3

Maintenance Organization
at NATRON Maglaj



(1) Mechanical Workshops

The mechanical department is divided in two main lines. The one is for the field activities with small local workshops out in the production departments. There is an own department for preventive maintenance with its own manager in charge. The wood and pulp departments has still not been reopened after the war. The field organisation are planning and preparing their daily activities as well as the two yearly shut downs. The planning is all manually done as well as the spare part warehouse system. This system was computerised before the war. The documentation and work order systems are still working properly.

The second part of the mechanical department is the central workshop and all the special workshops as, cast, rubber, insulation, spare parts ,and so on, according to the organisation chart. There is also the drawing office where all the purchased machines and details has been measured and drawn. There are about 40,000 drawings stored today. The warehouses also belongs to this organisation. There is central warehouse for daily needs including bearings, as well as separated warehouses for different production departments. There are also special warehouses for lubrication grease, oils cast iron, rubber details and so on. The cast warehouse has also 6,000 wooden models for the cast spare part production. There are also warehouses for vehicles spares as well as small local ones for the different production departments.

(2) Electrical and Instrument Workshops.

The electrical and instrument departments have their own planning department, planning both the yearly shut downs and also the normal daily activities as well as all break downs. They have all the documentation available and they are planning all activities manually. They also have their own spare parts warehouses close to the workshops. Both documentation and spares seems to be in a good physical order and the facilities for a restart of NATRON is there. The test equipment for pneumatic instrumentation is all there, maybe old fashioned but functional and the people have the skills to use it. For the electrical department, there is a test bench for motors and there is also equipment and skills to rewound motors up to 30 kW. For all bigger motors there is an external workshop in Tuzla some 30 kilometres away.

(3) Buildings and carpenter Workshops

The civil department has its carpenter workshop and small warehouses for bricks, paint, glass and so on. There is a lot going on in the building department workshops, as preparation of doors, windows and others for restoration of the mill owned houses after the war. The planning is also very much connected with the reconstruction of war damaged houses in- and out- side the mill area. One of the most important projects is to restart the environment department.

(4) External Services

The unusual part of the organisation is the department for external services. This part was developed long before the war when old Yugoslavia decided that all spare parts should be made within the country. So NATRON decided to be a strong domestic spare part producer. A lot of products has been developed such as:

- Oil tanks up to 100 cubic meter.
- Waste paper press for stores.
- Spare parts for NATRON mill including pump housing and other bigger constructions.
- Small oil tanks for family houses.
- Mechanical parts for mechanical construction.
- Rebuilding of houses.
- Windows.
- Mechanical erection work in other mills.

These are some of the services NATRON has been providing and still provides. The biggest advantage with this activities today is that workmen skills is being kept in the mill, as well as that the employees from before the war, has a meaningful occupation.

(5) Maintenance Manning

The maintenance department was a very big organisation before the war. There was an average of 830 people in the department in 1991. There were 499 mechanical fitters and experts, 100 electrical, 68 instrument, 68 civil, 45 garden and roads, and 50 people for external projects.

The present manning in the maintenance department equals the situation in 1997 and is as follows:

| | |
|---|---|
| Mechanical maintenance | 232 |
| Electric maintenance | 40 |
| Instrument maintenance | 34 |
| Civil maintenance | 36 |
| Gardening, road maintenance | 16 |
| Total | 358 |

From this total number 110 are disabled from the war, 84 are committed for external projects, 21 persons are on the stand by list and 143 persons are in working in the mill.

### 6.4.4 Employers Education and Training

About 64 % of the personnel is ranked to be at least qualified or over-qualified. 3 % or 52 has university level education. 80 % is in the age range of 30-50 years, which indicates considerable working experience. The qualification according to age structure is shown in Table 6-4. The total number of personnel has been reduced to 1,606 after defining the age and qualification structure, as shown in the Table 6-4.

**TABLE 6-4**
**Qualification and Age Structure of Present Personnel**

| | Age years | | | | | |
|---|---|---|---|---|---|---|
| Qualification | 25-30 | 30-40 | 40-50 | 50-60 | over 60 | total |
| Unqualified | 1 | 181 | 207 | 113 | - | 502 |
| Trainee | - | 6 | 37 | 9 | - | 52 |
| Low qualified | - | 10 | 17 | 2 | | 29 |
| Qualified | 15 | 262 | 97 | 41 | 3 | 418 |
| High qualified | 2 | 126 | 152 | 62 | 3 | 345 |
| Middle qualified | 8 | 92 | 71 | 24 | 1 | 196 |
| Advanced specialist | - | 5 | 22 | 16 | 1 | 44 |
| University degree | 1 | 21 | 23 | 1 | 1 | 47 |
| Master | - | 1 | 1 | 2 | - | 4 |
| Doctor | - | - | - | - | 1 | 1 |
| Total | 27 | 702 | 627 | 270 | 10 | 1,638 |

Before war the personnel were trained systematically. Now, when the mill is operating discontinuously, major part of the personnel is waiting for work and the company is making heavy losses, no training is conducted. Therefore, no progress has happened towards fulfilling the requirements of modern, export-oriented operations in market economy.

Regardless of the general, rather satisfactory qualification as shown in Table 6-4, the personnel is not able to meet the requirements of efficient and cost-effective operations. The management has not applied such an control and reporting system, which would allow the personnel to became familiar with the cost structure of the production. The cost reports concerning production is now inadequate and prepared afterwards, and not distributed to the operating personnel. Therefore they cannot optimise their day-to-day measures in production and maintenance.

Quality control is inadequate, partly because of equipment and facilities, partly because of lack of systematic procedures and know-how. The reporting and follow-up is completely unsatisfactory. In addition to the special technical know-how needed to operate pulp and paper mill satisfactory, extensive training in all organisation levels is required, concerning

- management, who have to introduce proper control, follow-up and reporting system, and start systematic training of the personnel

- operating personnel, who have to be made familiar with the cost structure of the operations and their possibilities to improve production efficiency, product quality and profitability
- quality control personnel, who shall in the future be capable to adapt sufficient control methods and reporting system
- power plant personnel, who have to be trained to optimise plant operations

Because of discontinuous operation and other current problems the motivation of the personnel is low. Some of the skilled operators have left the company and Maglaj town or were killed during the war.

## 6.5 Financial State

### 6.5.1 Finance

Financial problem is most crucial matter for current NATRON. Such a bad financial situation is common among almost every Bosnian company. Under 10% operation of capacity makes small money and NATRON cannot procure enough raw materials by cash. Barter transactions began last summer. In January 1998, barter transactions accounted for 33% of all transactions. Payment of salary is delayed by two months i.e. last December's salary was paid at the end of February, of which half was raised from local banks. It is getting difficult to pay waiting employees even though their salary is so small (DM45/month).

Financial measures are very limited because local banks have only small and short-term loan at 3%/month interest rate, and NATRON cannot borrow from foreign banks because the Bosnian Central Bank does not approve. All assistance from government at present is two credits as following table. General director asked Prime minister to provide additional government loan of DM12.5 million, DM5million for working capital and DM7.5million for repairs of fixed assets at the end of 1997.

Government Loans at March 1998

| Borrow Date | Amount | Interest Rate | Term | Usage |
|---|---|---|---|---|
| Dec. 1996 | DM1million | 5.8% | 3 years | Material |
| June 1997 | DM1million | 8.0% | 5 years | Assets Repair |

### 6.5.2 Cash Flow Control

Finance division prepares fund statement every day, and monthly fund plan is circulated to management team. When a customer does not pay a bill, Natron files a suit in a court for distrain upon the customer's credit, or switches the transaction to a barter trade in a hurry.

6.5.3 Payment Term

Payment should be made by 30 days after transaction. If a buyer didn't pay, the buyer's bank accounts are frozen in all banks. On the other hand, the corresponding vender should pay fine of 1%/day to government. NATRON paid DM150 thousand in fines in 1995. Barter transaction might be preferred partly in order to avoid this severe fine.

6.5.4 Barter Transaction

Barter transaction is a complicated system. For example, in order to procure coal, NATRON seeks a company which wants paper and has credit to the coal company. Market prices of paper and coal are valued at same day, and when whole party signs the contract, the transaction starts. Payment is completed by settlement of each bank account, and difference of the goods' market prices is settled by cash. Each party pays fee of 0.3% of sales amount to the bank. Sometimes the party is composed of 4 or 5 companies. When the bartered good is furniture, NATRON has to seek a customer for the furniture.

6.5.5 Accounting Period

Accounting period is from Jan. 1 to Dec. 31. Half annual and annual reports are prepared.

6.5.6 Accounting Standard

In 1995, accounting standard of Bosnia was changed in conformity with US standard. But format of financial statements is too simple and detailed schedules of accounting items are not prepared enough, so it is difficult to understand NATRON's financial situation by such financial statements. Business report (annual report) is usually completed around until the end of March of the next year. The report will be submitted to Supervisory board and Assembly of shareholders. Unit price of material used is calculated by average method and final inventory is valued at acquisition cost, partly because current market prices fluctuate rapidly. Definition of fixed asset is regulated only by one-year lifetime rule, and not by the amount. Fixed assets are depreciated by straight-line method with no scrap value in accordance with regulated life. Depreciation for idle facility is discontinued until operation is resumed.

6.5.7 Production and Sales

All products are produced based on customers' orders in principle. But production by small lot is inefficient, and they often produce more than the ordered quantity.

Minimum sales price is fixed at 5% up on the total costs of each order. Marketing department staff negotiates with customers based on the minimum price. Average gross margin is 20%. Accounts receivable are controlled by finance division, but delinquent receivables over one year are not separated on the balance sheet.

6.5.8 Costing Process

Product cost reports are prepared by orders monthly. Those costs are calculated by variable costs and fixed costs based on latest actual unit price and quantity. They don't adopt standard costing partly because of current continuous price fluctuation. They separate variable cost and fixed cost, but don't analyze break even point. All costs including administrative costs such as salary of General director, marketing & personnel departments, and depreciation cost of administrative building are allocated to costs of products. This costing method is suitable for sales-pricing purpose, but when a lot of products remain unsold, a fictitious profit can be recorded virtually by increased inventories.

6.5.9 Inventory

Materials are DM4.5 million and finished products are DM5.3 million at the end of 1997. About 90% of those inventories remain from before war, and almost all the obsolete goods cannot be used or sold. There are many spare parts for pulp production machines purchased over 35 years ago. Many old products like NATRON paper, sacks and bags cannot be utilized except for waste paper.

6.5.10 Foreign Exchange Rate

Trends of exchange rate of Bosnian currency against German Mark (DM) are as follows:

| Year | From | Till | din / DM |
|---|---|---|---|
| 1990 | | | 7 Yu.din |
| 1991 | | | 13 Yu.din |
| 1992 | Apr. 6 War broke out<br>May 1<br>Aug. 19 (Redenomination 1/10) | Apr. 30<br>Aug. 18<br>Dec. 31 | 450 Yu.din<br>3,500 din<br>350 din |
| 1993 | Jan. 1 | Dec.31 | 35,000 din |
| 1994 | Jan. 1<br>Jul. 16 (Redenomination 1/10,000)<br>Aug. 1 | Jul. 15<br>Jul. 31<br>Dec. 31 | 650,000 din<br>65 din<br>100 din |
| 1995, 1996 | Oct. 12, 1995 War ended | | 100 din |
| 1997 | Aug. 11 (Redenomination 1/100) | | 100 din = 1DM = 1 KM |

Note: Yu.din=Yugoslavian dinar, din=Bosnian dinar, KM=Bosnian Convertible Mark

6.5.11 Fixed Assets

All fixed assets owned by NATRON are registered. Fixed assets are classified into fixed assets in use, and those out of use. Book value of fixed assets out of use at the end of 1997 is DM58,387

thousand, which is around 30% of total fixed assets (58,387/195,315 = 30%). No depreciation for fixed assets out of use is charged.

Useful life is regulated by law as follows:

| Type of Asset | Useful Life |
|---|---|
| Transportation | 6 ~ 10 years |
| Machinery and Equipment | 10 ~ 15 years |
| Building | 40 years |

Every sale and purchase of fixed asset must be approved by Agency of Privatization beforehand, and 70% of the sold amount will be taken by government from March 1998 (30% is to NATRON). Agency of Privatization also plans to sell NATRON's surplus assets such as football stadium, farm, restaurants, hotel and transport equipment (trucks and buses) etc. Forest of 32 thousand $m^2$ is included in land account. After war, 85% of the forest is belonged to RS region, and it cannot be utilized partly because many mines are laid there. Book value for it of DM50 million was written off by deduction from retained earnings in 1997. In 1991, property was insured for DM4.5 million, but after war, the premium has not been paid because of funds shortage.

6.5.12 Revaluation of Fixed Assets

Fixed assets were revalued from 1991 owing to hyper inflation as follows:

| End of Years | Inflation Rate | Revalued Price |
|---|---|---|
| 1989 | - | **(Assumed) 100.00** |
| 1990 | 121.7 % | 221.70 |
| 1991 | 256.6 % | 790.58 |
| 1992 | 189,109.0 % | 1,495,848.51 |
| (Redenomination) | (1/10) | (149,584.85) |
| 1993 | 6,599.0 % | 10,020,689.10 |
| 1994 | 422.0 % | 52,307,997.10 |
| (Redenomination) | (1/10,000) | (5,230.80) |
| 1995 | 17.8 % | 6,161.88 |
| 1996, 1997 | under 10.0 % | 6,161.88 |
| (Redenomination) | (1/100) | **(61.62)** |

6.5.13 Debts

NATRON owes advanced countries i.e. Germany, UK, France, Italy etc. DM39 million at end of 1997 at 7~11% interest rate with government guarantee for facility construction. It was borrowed 20 years ago and half is already paid back. After war, NATRON doesn't pay both the principal and interest, and hopes that Bosnian government will negotiate with Paris and London club about cancellation of the long-term debt. NATRON received a deduction advice for 38.7373% of London Club loans in April 1998.

Loan conditions from local bank in Bosnia is hard, i.e. small amounts, short-term and high interest. The interest expense should be paid at every end of month. Two buildings are

mortgaged to the local banks.

6.5.14 Related Business

When paper machine operates, electricity is generated as a by-product of steam production, and sometimes surplus electricity is sold to public electric power company at market price of DM0.08 ~ 0.10/kwh. But even when the machine works, usually 5% of necessary power should be purchased from power company, and its generating cost is higher than market price because of current cutback in operations. As a result, power supply business is not so efficient for NATRON.

NATRON owns a restaurant. It earned DM143 thousand and the cost of material was DM111 thousand in the first half of 1997. NATRON also has in-house restaurant and serves employees free lunches of which cost was DM686 thousand in 1997.

NATRON has 940 apartments for employees, but about 200 in those are provided for refugees. The area of them is $35m^2$ ~ $100m^2$, average $64m^2$, and the rent/month is DM0.3 /$m^2$. An employee who worked over 10 years can permanently live in his apartment and can buy it at a deep discount from March 1998. 90% of the sold amount of the apartments will be taken to the Canton and will be appropriated for new houses building for refugees. 10% will be taken to NATRON (the owners). After war, NATRON has not maintained the apartments because of lack of funds. NATRON has a large seaside hotel in Croatia but it was destroyed by war and refugees live there, and it can not be utilized now. So, the acquisition cost was written off in 1997.

NATRON has no other welfare facilities such as school and hospital.

NATRON seeks to get external jobs actively such as maintenance and construction works by making use of its technical skill, and earned DM528 thousand including foreign works in the first half of 1997.

6.5.15 Audit

Supervisory board has strong authority to supervise and control General Director and management team. But every member has his own occupation and 4 employee representatives of the board are subordinates under management team. Supervisory board has authority of accounting audit too. In addition, 'financial police (governmental official)' comes to NATRON suddenly, and investigates finance, accounting and tax for usually 15 days. Before war they came every year but they haven't come since 1995.

6.5.16 Taxes

Corporate income tax rate is 36% in 1996, and 30% in 1997. Corporate tax rate is reduced to 15% for investment. Import duty rate is 12%, but negotiable with government. There is no fixed property tax in BiH. Value added tax (VAT) is imposed on final consumers. NATRON should pay VAT to government in 30 days after sale whether the customer pay NATRON's bill or not.

Types of VAT are shown in the following table.

| Types of VAT | Objects | Tax Rate |
|---|---|---|
| Tax on sold product | Printing | 20 % |
| | Forest | 15 % |
| | Cut wood for heating | 10 % |
| | Sack, Bag | 5 % |
| Tax on service | Transport, maintenance service etc. | 10 % |

6.5.17 Accounting Organization

Accounting organization is named Economy department in NATRON. The department is composed of three divisions as follows:

(1) Finance division consists of 12 employees, in-charge of cash management, and accounts receivable and payable etc.

(2) Accounting division consists of 14 employees, in-charge of book keeping, preparation of financial statement etc.

(3) Plans & analysis consists of 4employees, in-charge of business plan, management report, costing etc.

# 7. PROPOSED DEVELOPMENT PROGRAM

# 7 PROPOSED DEVELOPMENT PROGRAM

## 7.1 Outlines for Future Production Concept

The objectives of developing the future production concept is to

- find out a feasible balance between raw material supply, mill production potential and marketing opportunities, targeting full utilisation of the resources and mill facilities
- to get back to profits and gain cost competitiveness by improving the operating performance, effective maintenance measures and investments
- improve the value of the mill or of a part of it to a level where options for attracting a foreign investor partner are available or sale of the enterprise or part of it makes economic sense

When defining the future production of the NATRON mill, the main technical fundaments have been considered:

- raw material supply
- markets
- existing technical facilities of the mill

Export of markets semichemical fluting and sack paper have been discussed in Chapter 4 and raw material supply in Chapter 5. The main principles affecting the selection of the future production concept is summarised in the following.

(1) Raw Material Supply

The main raw materials available are recycled fibre and wood.

1) Recycled fibre

Domestic recycled fibre resources have been declined because of downturn of the economy and because of the political situation, which currently restricts the geographical area available for collecting recycled fibre. The domestic recycled fibre available and suitable for packaging grades in question is estimated currently at 12,000 tons annually, covering less than 10% of paper mill capacity. Minor quantities of recycled fibre can be imported, but anyhow recycled fibre will have only minor role in future raw material supply.

2) Wood

In 1991 the mill used some 650,000 $m^3$ softwood, of which half was imported. The usage of hardwood was minimal, because the cooking process used was not suitable for hardwood, taking into consideration the products in question.

Now due to political situation the domestic forest area available for wood supply has declined, and the import would be more expensive before having the transport facilities (railways, harbours) in normal conditions and available for NATRON. The annual quantity of domestic softwood, which is available for kraft pulp and sack paper, is estimated at 40,000-45,000 $m^3$sob/a, which is sufficient only for one of the two pulping lines.

Hardwood is available in similar quantities, up to 400,000 $m^3$ sob annually. Hardwood can be used for production of semichemical pulp, which is the best possible raw material for high-grade fluting and superior compared to recycled fibre. Utilising the hardwood resources, in addition to softwood, would allow to increase the production of fluting to full capacity utilisation of the paper machine and improve corrugated board quality.

3) Markets

After restarting the mill, the main products will be corrugated board, fluting (and schrenz if PM2 will be started), sacks and bags, sack paper and MG paper.

Corrugated board is typically home-market product because of low specific weight and high transport costs. The maximum transport distance is normally 200-300 km, but the political situation in the former Yugoslavia region prevents the capture of even this geographical area. Marketing possibilities of corrugated board are limited and the development depends on economical growth and changes in political situation.

Fluting and sacks can be exported more easily, providing that they are competitive in terms of quality and costs. Currently the transport via rail and harbours is not possible, which reduces - or even prevents - cost competitiveness in export markets.
Countries with softwood resources and kraft pulp mills (Scandinavian countries, Austria, Russia) have over-capacity in sack paper production. Italy, Middle East and North Africa might be the most promising market areas for sack paper.

With high-quality semichemical fluting the NATRON mill could enter into export markets, and at the same time improve cost-competitiveness of corrugated board.

4) Present technical facilities

The mill has been designed and is suitable to produce unbleached packaging materials, using recycled fibre and softwood as raw material. However, the technical standard and the capacity of pulp and paper production lines is low compared to international standard. This hampers the possibility to install modern process control equipment, which are normal in state-of-art mills and which assist the achievement of high and stable quality.

With current discontinuous operation the paper mill cannot reach required efficiency and cost competitiveness. In order to get the highest benefit of the existing facilities without excessive investments, the production concept shall be targeted to result in simple, streamlined production lines, full capacity utilisation, minimum grade changes and stable exportable quality. Product grades shall be suitable for the processes and facilities available in the mill.

Changing to other grades, such as printing and writing paper or other white grades would require completely new, different kind of departments and high investments, in order to be competitive regarding product quality, and cannot be recommended in near future. Main fibrous raw materials for bleached paper grades are bleached chemical pulp, mechanical pulp or deinked waste paper. NATRON mill do not have any bleaching plant, mechanical pulping plant or deinking plant. In addition, domestic raw material base would not be sufficient for a typical state-of-art production unit with output of 1000 tons per day with one production line. Changing the product grade to bleached papers would not bring any benefit to NATRON in this restarting phase.

The production lines of the mill allow simultaneously to produce two pulp grades, unbleached softwood kraft pulp and semichemical hardwood pulp. Both of the pulping processes can be combined to common chemical recovery with only minor process modifications.

Semichemical pulping combines a mild chemical pulping of chips prior to mechanical defibration and produces a fairly high yield, up to 82 %. Neural sulphite semichemical (NSSC) pulping was developed in the 1920s. Most semichemical mills now use continuos digesters of Pandia or Kamyr type. The processes are besides conventional NSSC, carbonate-base or green liquor semichemical pulping processes, which are simpler and less capital intensive.

Green liquor semichemical pulping uses kraft green liquor; therefore the process can only be used in combination with a kraft mill. Such cross-recovery reduces chemical processing and recovery and minimises capital costs. The green liquor process produces a semichemical pulp which is comparable in quality with NSSC but has a darker colour. Wetting agents, however, have to be added to the refined stock to control glue absorption in the corrugator.

The most important property of fluting is measured by the Concora Medium Test (CMT) and Concora Crush Test (CCT). In Europe most fluting is produced from waste paper and physical properties achieved by surface sizing. Surface sized OCC based fluting at lower basis weights have similar properties to semichemical fluting, while at higher basis weights, SC pulp is required to produce quality fluting.

In modern corrugated box production the most important property of the corrugated box is measured with the Box Compression Test (BCT) method which determines the stacking capability of the box. In this respect it is more cost effective to reduce liner basis weight and increase the basis weight of fluting. In this context high basis weight SC fluting has found a marketplace.

One of the paper machines (PM1) is suitable to be rebuilt for fluting, corresponding the output of the semichemical hardwood pulp from the Kamyr line. One of the paper machines (PM4) is equipped with high consistency refining and Clupak unit and is suitable for sack paper production, using unbleached softwood kraft pulp. These paper machines will produce only one paper grade each with full capacity, thus allowing to maximise the efficiency and production and minimise the costs. PM3 can be used in production of special MG paper, if this proves to be profitable.

Main part of the paper produced has to be exported. With sack paper, semichemical fluting and MG paper the export quality is expected to be achieved, using the raw materials and processes available.

The converting plant would be developed so that the product mix meets market requirements.

Based on the raw material base, market limitations and present technical facilities of the mill, the future production concept has been outlined as:

- softwood kraft pulp production with one pulping line (batch line)
- hardwood semichemical pulp production with one pulping line (continuous Kamyr line)
- combined chemicals recovery
- sack paper production with one paper machine (PM4), using kraft pulp
- fluting production with one paper machine (PM1), using hardwood semichemical pulp
- MG paper production with one paper machine (PM3)
- converting

In this concept no recycled fibre would be used in the future. Start-up of PM2, producing schrenz from recycled fibre has been considered, but this alternative has not been found profitable.

### 7.2 Production Development PROGRAM

Because many mill departments have not been operated during the last few years, considerable investments and other measures are required in arranging the raw material supply, developing the marketing and bringing the technical condition of the mill to normal. Therefore a stepwise

implementation, including Immediate PROGRAM, Short Term PROGRAM and Long Term PROGRAM, is recommended.

### 7.2.1 Immediate PROGRAM

The Immediate PROGRAM covers the second half of year 1998. The target of this PROGRAM is to improve the present operations of the mill and to prepare steps for further development . Because of limitations in raw material availability and marketing, the production will be principally discontinuous as before. Main raw materials will be recycled fibre and purchased sack paper, and main sales products corrugated board, corrugating materials and sacks.

The Immediate PROGRAM includes

- rehabilitation and start-up of the effluent treatment plant (to be done before the start-up of PM3)
- rehabilitation and start-up of the ash dumping system (to be done before the start-up of PM3)
- acquiring a compact boiler, intended to improve energy-efficiency (optional)
- reduction of production cost and improvement of product quality through know-how transfer (production, quality control, maintenance)
- improvements in cost control through development of accounting and reporting systems
- improvements in marketing through market research and customer services
- preparation of implementation plan for Short Term PROGRAM, including financing plan for investments and for working capital
- measures for preparing the restructuring (privatisation, selling, partnership)
- acquiring minor financing resources to implement the immediate program

The budgeted production for year 1998 are presented in Table 7-1.

TABLE 7-1
Production Budget 1998

| | | |
|---|---|---|
| Paper | t | 15,000 |
| Sacks and bags | t | 18,065 |
| Corrugated board and boxes | t | 8,500 |
| Other paper products | t | 88 |

No major capital expenditures for the immediate PROGRAM are required, but preparation of the Short Term PROGRAM should be started The total capital expenditures during the immediate

PROGRAM is estimated at DM 3.2 million, which includes an allocation for a compact boiler, DM 2 million. The investments are specified in Chapter 8.1.

(1) Paper Mill

In the paper mill only paper machine 1 and waste paper plant will be in operation primarily to supply the corrugated board plant with fluting, schrenz and testliner.
The capacity will be limited by the supply of waste paper and market pulp.

The waste paper plant will be operated to existing rules for classifying and usage of different waste paper grades

The hot dispersion of waste paper will not be in use due to the marginal improvement of the waste paper pulp compared to the high cost of energy used.

Paper machine no. 1 will be operated at existing capacity with existing equipment. The present paper properties can satisfy the existing domestic market.
Reporting systems will be introduced in order to support and record the future improvement in efficiency as well as improvements of paper properties. Implementation of modern technology will improve paper properties, for example chemical additives to paper stock and new machine clothing.

It is necessary to prepare a technology development program in order to improve paper quality and efficiency, including contacts between technical managers of NATRON and advanced western suppliers.

No investments are considered. Capacity is not a limiting factor.
Paper qualities are acceptable for domestic customers within Bosnia Herzegovina.

In the paper mill only paper machine 1 and waste paper plant will be in operation primary to supply the corrugated board plant with fluting, schrenz and testliner.

7.2.2 Short Term PROGRAM

The Short Term PROGRAM covers year 1999 and the first half of year 2000. During this period the production of PM1 and converting will be increased. PM3 will be started producing MG paper, using purchased kraft pulp as raw material. Mill operations will be improved further. The production is still discontinuous, restricted by the marketing possibilities and probably by the availability of recycled fibre. Extensive efforts in preparing the implementation plan for long term

PROGRAM are needed. Rehabilitation and start-up of the effluent treatment plant and the ash dumping system is essential during this period before any major production increase.

It is possible to achieve the production target as planned in this PROGRAM without having the partner or investor involved, provided that NATRON has the required human resources available for planning and capital available for investments and for increased demand of working capital. However, preparing to start the continuous production of the pulp and paper mill in the next development stage requires considerable investments and other measures and involvement of partner and financier.

The Short Term PROGRAM includes

- increase the production of corrugating board materials on PM1, mainly for own converting plant according to marketing possibilities
- start-up of PM3, producing MG paper mainly for export market and using purchased kraft pulp as raw material
- continuing the measures for operation improvements including production, quality control, accounting, cost control, reporting, marketing and customer service
- starting the implementation of the Long Term PROGRAM, including project planning, engineering, tendering and procurement
- acquiring financing for investments and working capital
- carrying out the required maintenance measures and new installations needed to start the wood handling, pulping lines and PM4

The sales production in the Short Term PROGRAM is presented in Table 7-2, and the raw material consumption and the production of various departments in Appendix 7-I, Production Scenarios and Fibre Balance.

TABLE 7-2
Sales Production in Tons, Short Term PROGRAM

| | Year 2 | Year 3, 1st half |
|---|---|---|
| Corrugated board | 10,000 | 5,323 |
| MG paper | 4,800 | 3,200 |
| Sacks and bags | 5,000 | 2,640 |
| Total sales | 19,800 | 11,163 |

The total capital expenditures for the Short Term PROGRAM is estimated at DM 27.7 million, of which DM 1.9 million is needed to start the production and DM 25.8 million for preparing to

start up the continuous operation of the pulp and paper mill in the next development stage. The investments are specified in Chapter 8.1.

(1) Pulp Mill

In this Short Term Program, kraft pulping lines will have not yet been started, but the maintenance measures and new installations needed to start the pulping lines (batch and continuous Kamyr) must be completed for the future Long Term Program.

(2) Paper Mill

In the paper mill paper machine 1 and the waste paper plant will be in operation for the supply of the corrugated board plant.

Paper machine 3 is taken into operation for the production of Machine Glazed paper (MG) for paper bags. The majority of the production will be sold on export markets and only minor volumes will be converted in the paper bag converting plant in Maglaj.

A comprehensive training program for all employees within the paper mill organisation has to be realised during the short term program. The program is urgently needed in order to raise the technical knowledge generally as well as for replacing employees lost during the war and for those who have moved away from Maglaj.

1) Paper machine 1

The first step in the investment program will be taken during this period. The investments will be done in order to improve paper sheet formation which will result in improved paper strength properties which are essential for packaging grade papers.

By the end of the short term program the paper machine will be stopped. Investments will be made in order to increase capacity to 76 000 t/a.

2) Waste paper plant.

No investments needed.

3) Paper machine 3

The pulp supply to the paper machine will be based on market pulp. No investments are needed but a restart cost including a reconditioning of the paper machine to a good operating standard is required.