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THE COMPANY

Packages Limited was established in 1957 as a joint venture between the Ali Group of Pakistan and Akerlund & Rausing of Sweden, to convert paper and paperboard into packaging for consumer industry.

Over the years, the Company continued to enhance its facilities to meet the growing demand of packaging products. Additional capital was raised from sponsors, International Finance Corporation and from the public in 1965.

Packages commissioned its own paper mill in 1968 having production capacity of 24,000 tonnes of paper and paperboard based on waste paper and agricultural by-products i.e. wheat straw and river grass. With growing demand the capacity was increased periodically and in January 2003 was nearly 100,000 tonnes per year

Since 1982, Packages Limited has a joint venture with Tetra Pak International in Tetra Pak Pakistan limited to manufacture paperboard for liquid food packaging and to market Tetra Pak packaging equipment.

In 1993, a joint venture agreement was signed with Mitsubishi Corporation of Japan for the manufacture of Polypropylene films at the Industrial Estate in Hattar, NWFP. This project, Tri-Pack Films Limited, commenced production in June, 1995 with equity participation by Packages Limited, Mitsubishi Corporation, Altawfeek Company for Investment Funds, Saudi Arabia and general public. Packages Limited owns 33% of Tri-Pack Films Limited's equity.

In July, 1994, Coates Lorilleux Pakistan Limited, in which Packages Limited has 55% ownership, commenced production and sale of printing inks.

In 1996, a joint venture agreement was signed with Printcare (Ceylon) Limited for the production of flexible packaging materials in Sri Lanka. This project Packages Lanka (Private) Limited commenced production in 1998. Packages Limited now owns 77% of this company.

In 1999-2000 Packages Limited has successfully completed the expansion of the flexible packaging line by installation of new rotogravure printing machine and the expansion of the carton line by a new Lemanic rotogravure inline printing and cutting creasing machine. In addition a new 8 color flexo graphic printing machine was also installed in flexible packaging line in 2001.

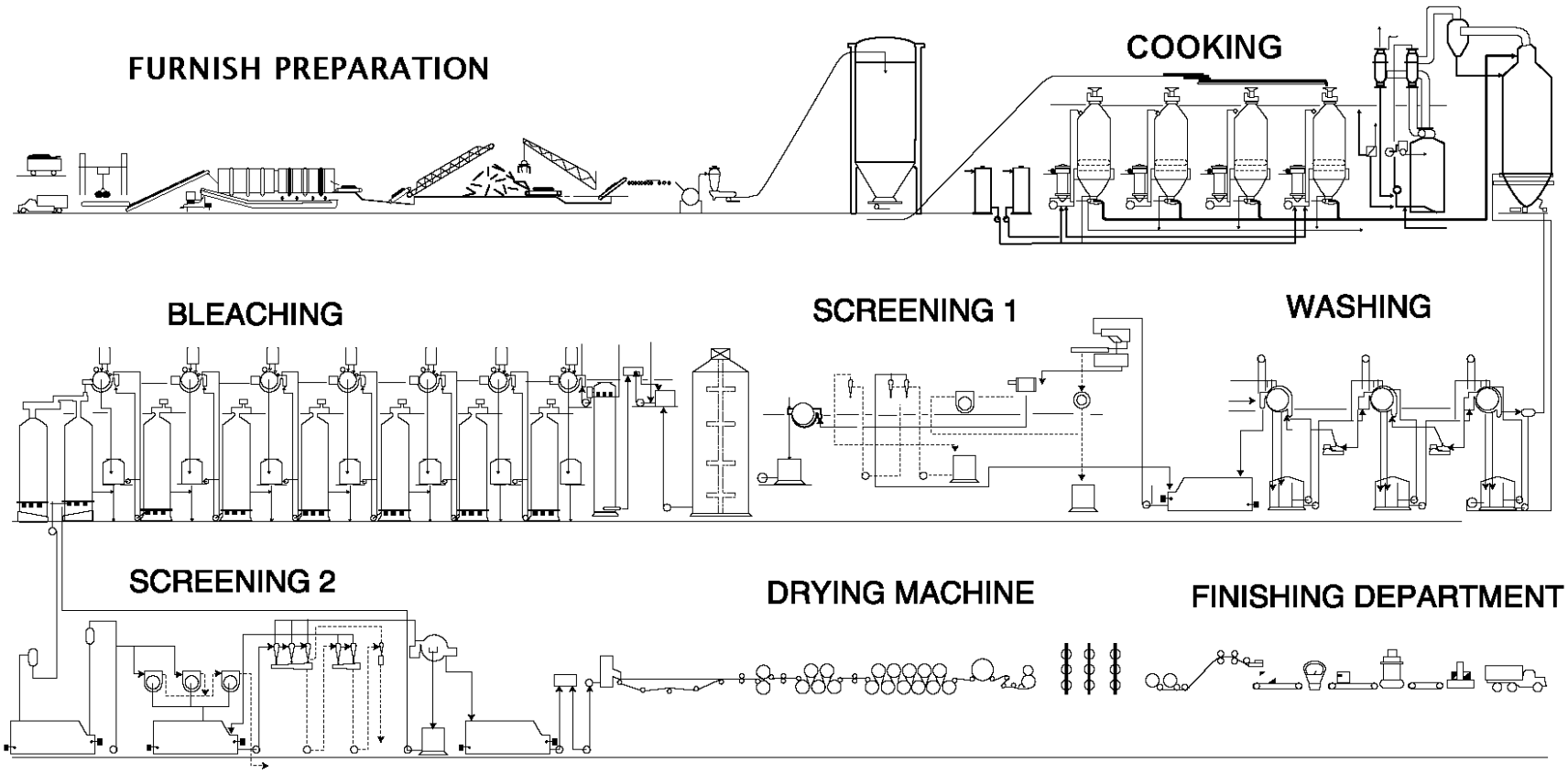
Packages Limited has also started producing corrugated boxes from its plant in Karachi from 2002. The company has

1). Paper and Board Division
2). Packaging division
3). Consumer products Division

INTRODUCTION

Processes in the manufacture of paper and paperboard can, in general terms, be split into three steps: pulp making, pulp processing, and paper/paperboard production. Paperboard sheets are thicker than paper sheets; paperboard is thicker than 0.3 mm. In general, however, paper and paperboard production processes are identical. First, a stock pulp mixture is produced by digesting a material into its fibrous constituents via chemical, mechanical, or a combination of chemical and mechanical means. In the case of wood, the most common pulping material, chemical pulping actions release cellulose fibers by selectively destroying the chemical bonds in the glue-like substance (lignin) that binds the fibers together. After the fibers are separated and impurities have been removed, the pulp may be bleached to improve brightness and processed to a form suitable for paper-making equipment. At the paper-making stage, the pulp can be combined with dyes, strength building resins, or texture adding filler materials, depending on the intended end product. Afterwards, the mixture is dewatered, leaving the fibrous constituents and pulp additives on a wire or wire-mesh conveyor. Additional additives may be applied after the sheet-making step. The fibers bond together as they are carried through a series of presses and heated rollers. The final paper product is usually spooled on large rolls for storage.

Pulping process Category	**Fiber Separation Method**	**Fiber Quality**	**Examples**
Mechanical	Mechanical Energy	Short, weak, unstable, impure fibers	Stone ground wood, refiner mechanical pulp
Semi-chemical	Combination of chemical and mechanical	Intermediate pulp properties (some unique properties)	High-yield Kraft, high-yield sulfite
Chemical	Chemicals and heat	Long, strong, stable fibers	Kraft, sulfite, soda



Source: Smook, 1992.

NEW FIBER LINE (NFL)

Process sequence	Description
Fiber Furnish Preparation and Handling	Wheat straw dry and wet cleaning and transportation
Pulping	Chemical, semi-chemical, or mechanical breakdown of pulping material into fibers
Pulp Processing	Removal of pulp impurities, cleaning and thickening of pulp fiber mixture
Bleaching	Addition of chemicals in a staged process of reaction and washing increases whiteness and brightness of pulp, if necessary
Stock preparation	Mixing, refining, and addition of wet additives to add strength, gloss, texture to paper product, if necessary

FURNISH PREPARATION

Dry Cleaning

Wheat Straw is collected from stock and then it is sent for dry cleaning, here dry cleaning is divided into two stages.
Wheat Grains are separated from lumps, dust and sand particles are removed. Dry cleaned material is sent to Dry Silo, a storage cell room.

Wet Cleaning

Straw coming from dry silo is ready for wet cleaning, for the removal of remaining dust particles adhere to the fiber as well as water soluble compounds are being dissolved in water. Waste White Water coming from machine hose, is used for wet cleaning process, before using it for cleaning this white water is passed through screens, to recover useful fibers before using this water into the circuit. Dry cleaned material in which white water from machine house is added. Heavy particles such as stones, pebbles etc. are settled down and purged out periodically. Wet cleaning is done in a conical tank commonly called as Scrap Separator; here heavy particles are separated using sedimentation technique. A scraper is present at the bottom of the settler / sedimentation tank, which rotates at a very low speed, and scrap out all the agglomerated particles or sand dust in the form of thick slurry.
From scrap separator, material is over flowed to the Hydro Pulper where severe agitation takes place, then material is pumped to inclined screen drainers, the muddy water passes through holes of sieve of drains. The material is then passed through a press called DKP press, in which material is pressed hardly. The outlet consistency of the material is reduced to around 30%, this material is then sent to Wet Silo.

From wet silo material is conveyed to a metering unit by means of various conveying screens, after metering a measured and known quantity of material is processed. This is the first step of mathematical calculation in material balance of the process. The known quantity of raw material is then passed through a unit called Poly Screw Feeder, which increases the consistency of material up to 40 %, and then it is fed to the three tube continuous digesters. Steam and Chemicals are injected simultaneously, as the raw material enters into the digester Na_2SO_3 is the main cooking chemical. The cooked material is at the temperature of 175 – 185°C, at the chemical charge, which is Sodium Carbonate Na_2CO_3, of 14% + 1, 30 bar steam is used by Boilers, made by DESCON, The pressure in digester is 10.5 – 10.8 bar, The cooked material from digester is blown into a blown tank then pumped to a centrifugal screen, for the separation of cooked and un cooked material.

Un cooked material is sent back to the cooking section for re-cooking, The size of screen is 3 mm, Cooked material is then washed on two pulp washers, and one displacement press. Normally, cooked material is in slightly basic pH range around 8.The pulp is passed through high pressure screens, for fine screening actions, and then through centrifugal cleaners battery for the removal of shives and fine sand particles. Pulp is then washed, thickened and finally stored in high-density storage tower. This pulp is ready for brown varieties of paper and board, or for the bleaching unit.

PULP PREPARATION

After pulp production, pulp processing removes impurities, such as uncooked wheat straw, and recycles any residual cooking liquor via the washing process. Some pulp processing steps that remove pulp impurities include screening, defibering, and deknotting. Removing a portion of the water may also thicken pulp. At additional cost, pulp may be blended to ensure product uniformity.

Residual spent cooking liquor from chemical pulping is washed from the pulp using brown stock washers. Efficient washing is critical to maximize return of cooking liquor to chemical recovery and to minimize carryover of cooking liquor (known as brown stock washing loss) into the bleach plant, because excess cooking liquor increases consumption of bleaching chemicals. Specifically, the dissolved organic compounds (lignins and hemicelluloses) contained in the liquor will bind to bleaching chemicals and thus increase bleach chemical consumption. In addition, these organic compounds function as precursors to chlorinated organic compounds (e.g., dioxins, furans), increasing the probability of their formation. The rotary vacuum washing is carried out sequentially in two or four washing units.

Pulp screening, removes remaining oversized particles. In open screen rooms, wastewater from the screening process goes to wastewater treatment prior to discharge. Centrifugal cleaning (also known as liquid cyclone, hydrocyclone, or centricleaning) is used after screening to remove relatively dense contaminants such as sand and dirt. Rejects from the screening process are either repulped or disposed of as solid waste.

Kappa Number

Kappa number measures the amount of lignin present in pulp
Kappa Number x 0.15% = % lignin in pulp

BLEACHING HOUSE

Bleaching is defined as any process that chemically alters pulp to increase its brightness. Bleached pulps create papers that are whiter, brighter, softer, and more absorbent than unbleached pulps. Bleached pulps are used for products where high purity is required and yellowing (or color reversion) is not desired (e.g. printing and wrapping papers, food contact papers). Unbleached pulp is typically used to produce boxboard, linerboard, and grocery bags.

Any type of pulp may be bleached, but the type(s) of fiber furnish and pulping processes used, as well as the desired qualities and end use of the final product, greatly affect the type and degree of pulp bleaching possible. Printing and writing papers comprise approximately 60 percent of bleached paper production. The lignin content of a pulp is the major determinant of its bleaching potential. Pulps with high lignin content (e.g., semi-chemical) are difficult to bleach fully and require heavy chemical inputs. Excessive bleaching of semi-chemical pulps results in loss of pulp yield due to fiber destruction.

Pulp from NFL is sent to the battery of three stage centrifugal cleaners , in which in first stage centri cleaner the accept is sent to the washing filter , where as the reject is sent to the second centri cleaner. The accept of second centri cleaner is sent back to the first centri cleaner and the reject of second centri cleaner is sent to the third centri cleaner , where as the accpe tof third centri cleaner is sent to the Fibrizer , where as its accept is sent to the first sent to the first centri cleaner and reject of Fibrizer is rejected. The accept of centri cleaner no 1 is sent to the washing filter.

The capacity of washing filter is 120 tons. After passing through washing filter, the consistency of pulp becomes 8 – 10 % . This pulp then pumped to the un bleached tower of 300 m^3 capacity using TSP pump, via 18 in dia pipe . The pulp from un bleached tower is pumped to the Buffer Chest. Where its certain

chemical characteristics are attained such as pH , consistency , etc. After buffer chest the pulp is passed through second stage washing tower, then hypo is added for bleaching purpose after that TSP 2 pump is used to pump pulp in hypo tower, plus water is also added. The capacity of hypo tower is $75m^3$, then after hypo tower , pulp is pumped to the high density tank 2, then after high density tank , pulp is pumped to the battery of centri cleaners for the removal of heavier particles , and after processing through bleached pulp is stored in Chest of capacity 20 m^3.

S. Parameter	Chlorine stage	Alkali stage	Hypo stage
Pulp consistency(%)	2.75-4.5	9-11	5-11
Bleaching time(min)	45-60	120-240	120-240
pH	2-4	9-11	6-9

STOCK PREPARATION

At this final stage, the pulp is processed into the stock used for paper manufacture. It includes pulp blending specific to the desired paper product i.e.; dispersion in water, beating and refining to add density and strength, and addition of any necessary wet additives. Wet additives are used to create paper products with special properties or to facilitate the papermaking process. Wet additives include resins and waxes for water repellency, fillers such as clays, silicas, talc, inorganic/organic dyes for coloring, and certain inorganic chemicals (calcium sulfate, zinc sulfide, and titanium dioxide) for improved texture, print quality, opacity, and brightness.

Stock Preparation Plant is basically , mixing and blending sort of plant, in which according to job requirements , various types of pulps are blended together. To get the desired results. There is total thirty six number of chests and two type of refiners are used, i.e. Conical Refiners, and Double Disk Refiners.

Chests Division

12 Chests for PM1
8 Chests for PM2
4 Chests for PM3
5 Chests for PM5

There are six sources of pulp for this plant

1. Un Bleached pulp from NFL
2. Un Bleached Pulp from CTMP
3. Imported bleached pulp
4. Un bleached pulp from WPP 1
5. Un bleached Pulp from WPP 3
6. Bleached pulp from bleaching house

The purpose of refiners is the proper mixing and size reduction as well as size uniformity of the fiber.

CTMP PLANT

Chemi-thermomechanical process (CTMP):
Mechanical–chemical methods usually involve agitating the pulp material with chemicals, thus providing a mild chemical digestion combined with mechanical disintegration. A development of the thermomechanical process involves the inclusion of chemicals with the wheat straw at the time of steaming. This chemi-thermomechanical process (CTMP) developed in the 1970s produces long, clean, bleachable fibers approaching the quality of wood-free pulps.
After washing and screening the wheat straw is first impregnated in an impregnation tower where the straw are immersed in an alkaline chemical solution Na_2SO_3. After chemical impregnation the pulp is pre-warmed and their temperature increases further in the 1-2 stages refining machines (rotating refining plates) resulting in softening of lignin bonds and fibers are released. The manufactured CTMP is mixed with recycled process water, which is used also for disintegration of fibers and transportation to the next process stages.
A further development of the CTMP process is the CMP process. With stronger chemical treatment and refining at atmospheric pressure pulps with high strength properties can be produced from both softwood and hardwood. After chemical impregnation the chips are cooked in a temperature ranging from 70-170 °C. The cooking time depends from the process and can vary between 15 minutes to a couple of hours. Different kinds of treatment are used for different wood species. Optical properties are drastically reduced and the yield can fall below 90%.
Both the increase in the refining temperature and the use of chemicals (alkaline treatment) increase the generation of pollutants as a consequence of the yield loss in refiner mechanical pulping. In most cases chemical pre-treatment increases the energy consumption. Optical properties are drastically reduced and CMP can only form a minor part of the furnish for printing papers. CTMP is often produced in connection to a paper or board mill due to the possibility of reuse the heat from refiners for production of steam and better energy efficiency. However, CTMP is sometimes manufactured as market pulp and dried with a flash dryer up to 90 % dry solids content.
The production capacity of CTMP plant is 80 tpd, plant efficiency is 80%, and where as feeding capacity of plant is 100 tpd. This is unique plant of its own type, based on wheat straw as raw material. Plant is completely DCS except the feeding plant.

- 4.5 % NaOH, 60 gm/ liter
- 8 bar Steam, at 155- 160°C
- Residence time is 18 mins.

Mechanical Action includes defiberator as equipment. Caustic is added in thermal action just to soften the fibers.

DEINKING PLANT / PM4

Prepare tissue from imported primary and secondary fiber source as per customer's requirement

CPD Marketing
There are two sections of marketing

1. Industrial Marketing
2. Consumer Marketing

In the industrial marketing the industry related products are marketed and there is no interaction of the local consumer with the CPD. CPD marketing department is mainly concerned, with those products of the packages with which the local consumer is concerned. There are 3 products, with which the CPD department is concerned,

1. Rose Petal Tissue
2. Tulip Tissue
3. Feminex

The selling of these products to the consumer has been organized by the distribution control system, in the distribution control system, in every city , distributors are present to the market the products.

Process Description (CPD production)

The whole tissue division is divided into two departments, one is tissue paper manufacturing and other one is consumer product conversion department, further tissue paper making department is divided into two sub division, i.e. De inking plant, and PM4 Machine.
De inking plant is also known as Stock Preparation Plant, and is installed for pulp preparation for tissue making, On PM4, tissue papers are made, the raw material which are used for manufacturing includes

1. Soft wood; imported bleached pulp of long fiber
2. Eucalyptus imported bleached pulp of short fiber
3. Bleached hard wood pulp of soft fiber, this is little bit low in quality as compared to eucalyptus pulp.
4. Linter Bleached pulp (local pulp)
5. Local eucalyptus pulp

CPD Conversion

In the CPD production different consumer related products are made for example, disposal coffee cups, paper plates, table napkins kitchen rolls, toilet rolls etc. The tissues rolls that are formed on PM4 are taken here for making rolls of very required sizes. The inner cones of these tissue rolls are

supplied by K.V Dept. then sealing of these rolls is done by passing the wrapper at the temperature of 120°C. Similarly the adjustment of the machine is done for the production of double horse tissue (exported to Afghanistan) Tulip tissues, Rose Petal Supreme, and Rose Patel multicolor.

At de inking plant; the following wastes material is used to make pulp

a. Un printed News paper
b. CPD tissue Broke
c. Tissue Cuttings waste (1st Quality waste paper)

De inking Plant Process Description

Conveyer belt is used to transfer paper and board from Pulper to chest then after H.D. cleaner, screener which is stored in chest where pulp consistency is 3.5 Percent. After that pulp is sent to kinetic cell of floatation in which froth is produced to remove ink, the pulp is passed through centri cleaners, and then it is passed through high pressure and then pulp is sent to washing filter thickener screen, here its consistency is 4 %, after that it is sent for storage and then to the machine house

Different dyes are used to give various coloration to the tissue paper, e.g. pink, blue, white and peach.

To increase the wetting strength of tissue, a chemical commonly known as Kymene is used.

CHEMICAL RECOVERY PLANT

Chemical recovery plant recovers the chemicals that were previously wasted. It was realised by the authorities that the chemicals going in the effluent are hazardous for the environment. The plant was installed to save the environment from these hazardous chemicals. The capacity of CRP is 80 tons/day.

The plant was imported from Italy and was installed in 1997. Many feature of the plant were modified by Packages Engineers to make the process economical and smooth such as use of Na_2CO_3 instead of NaOH to make process economical and self priming as sodium is recovered in the form of Na_2CO_3.

Recovery of black liquor has several advantages. Incineration of conc. Black liquor releases energy that is used in the generation of steam. This steam is enough for the internal needs of CRP. Development of new equipment and increase in mill size made it more economical to process black liquor than to buy new chemicals. Recovery plant consists of following sections.

1-Evaporation section
2-Combustion section
3-Conversion section

Evaporation Section

The black liquor received from pulping is termed as weak black liquor, it is stored in WBL storages at CRP. It contains used chemicals from pulping and organic compounds such as lignin and

cellulose to some extent. The aim of evaporation is to produce black liquor to sufficiently high concentration with minimum losses. The black liquor contains 9 to 10% solids .The evaporation of black liquor has two principle units.

1. Separation of water from black liquor to generate concentrated black liquor.
2. Processing of that black liquor to segregate clean and fouled condensate fractions.
3. Evaporation of black liquor uses direct or indirect heating. For this purpose multiple effect evaporators.

Five stage multiple effect falling film type evaporation plant has been installed. The black liquor obtained from fibber line contains 8-10 % D.S.(dissolved solids). In the evaporation section Black liquor is concentrated up to 50% on the principle of counter flow. This black liquor is now termed as Thick liquor and is stored in thick liquor storage from where it is sent to DCE. Hot flue gas from the recovery boiler heats a film spray of black liquor and 50% D.S black liquor is further concentrated to 60% DS in DCE(direct contact evaporator). This concentrated liquor is feed to recovery boiler.

Combustion section

Chemical recovery boiler

The black liquor with (58-60% D.S.) is then fired in the boiler which serves two purpose. First for reduction of sulphur compounds and second for steam generation. During combustion organic material is burnt into gases which are called flue gases. Here high pressure steam is also produced which is used in the process. Inorganic material settled down in the form of molten smelt which flows into the dissolving tank and then fed to clarifier where through settling mud is separated and clear green liquor is obtained.

Recovery boiler chemistry

In the recovery boiler furnace a number of entirely separate physiochemical processes takes place simultaneously.

-Air injection and mixing with the furnace gases.
-Black liquor spraying and droplet formation.
-Drying of the black liquor droplets.
-Pyrolysis of the black liquor and combustion of the pyrolysis gases.
-Gasification and combustion of the char residue.
-Reduction of the sulfur compounds to sulfide.
-Tapping of the molten salt mixture of sodium sulfide and sodium carbonate from the furnace bottom.

An undesired side effect during combustion is the vaporization or fuming of sodium and sulfur compounds (and to a lesser extent of chlorine and potassium compounds). The vapours and fumes escape with flue gases.

Sodium and Sulfur Chemistry

In the recovery boiler the sulfur occurs in the molten salt as both sulfide and sulfates . A substantial part of sodium and sulfur is carried by the combustion gases into the boiler flue, mainly in the form of sodium sulfate dust and sulfur containing gases . These compounds cause fouling of heat transfer surfaces and corrosion .
Most of the sodium and sulfur dust falls out of the flue gases into dust hopper. Roughly 10% of the sodium contained in black liquor is typically in this circulating load . The part of the sulfur carried by the combustion gases and fume ranges from 20 to 40 %. A small portion of both sodium & sulfur leaves the process as flue gas emission . The emission components are Na2SO4 , H2S, SO2 and CH3SH(methyl mercaptans) , COS(specially at low bed temperature) , Na OH and metallic sodium. The flue gases are washed with Na2CO3 in scrubber where most of the SO2 is absorbed in it.

Equilibrium composition in the lower bed
Two of the conditions in the lower furnace have major impact on sodium and sulfur distribution are the temperature of lower furnace and temperature of the char bed. These temperatures are chiefly influenced by liquor spraying technique and the introduction of combustion air into the furnace . Also the black liquor properties , particularly its dry solid contents , affects the tempertaure in the furnace .
Solid compounds begin to form in the bed when the temperature drops below apporximately 800 C (1475 F) .

Reaction rate char bed reduction
In principle , the sulfate contained in a partially burned black liquor droplet entering the bed may be reduced by either of the reducing gases (CO or H2) or solid Carbon (char) in the bed.
One comparision shows that the reduction of sulfate by means of char is about two order of magnitude faster than the corresponding reduction with reduction gases. Gas reaction become dominant in the reduction process only after 99% of the char in the smelt bed has been consumed . At this stage , however, the whole reduction process is very slow , essentially insignificant for practical purposes .
So a per-requisite for efficient smelt reduction is a sufficient amount of char continously on the bed surface . This means that black liquor should sprayed in such a way that a significant fraction of the droplets hit the bed surface while char burning is still incomplete.
The limit would naturally be the capacity of the bed to burn the char . An excessive flow of char onto the bed would result in unwanted growth of the bed .
Another important factor for efficient smelt reduction is temperature , so as to provide activation energy .The reduction rate roughly doubles whenever the temperature increases by 50 to 60 C.

The reduction of the smelt is to some extent is counter acted by re-oxidation of fine smelt droplets in flight , and re-oxidation of exposed smelt near the furnace walls and smelt spouts . In normal practice , however, such re-oxidation is insignificant.

Conversion section

Conversion tower consists of following four parts.

a) Carbonation
b) Stripping
c) Scrubber
d) i)Washing (ii) Cooling

In conversion tower main chemical reaction of conversion of green liquor containing Na_2S into Na_2SO_3 takes place.

Carbonation

CO2 is introduced from the top which is formed in the sulfitation and stored in CO_2 accumulator. Green liquor is introduced from the top of the carbonator at the rate of 3 to 4 cubic meter /hour. The temperature is 65 to 75 C. Here Na2S is converted to NaHS by reacting with CO2. Na_2CO_3 is also produced as a by-product.

$$H_2O + 2Na_2S + CO_2 \longrightarrow 2NaHS + Na_2CO_3$$

Na2CO3 produced in the above reaction and Na_2CO_3 which is already present in green liquor reacts with CO2 to produce NaHCO3.

$$Na_2CO_3 + H_2O + CO_2 \longrightarrow 2\,NaHCO_3$$

Stripping

The sodium bi sulfide and sodium bi carbonate produced in the above reactions reacts with each other to form sodium carbonate and hydrogen sulfide.

$$NaHS + NaHCO3 \longrightarrow Na_2CO_3 + H_2S\uparrow$$

The sodium carbonate produced in this reaction is sent to sodium carbonate storage. In the storage the amount of Na2CO3 is kept 200 g/l. If the recovered Na2CO3 concentration is less than the addition soda ash is carried out to meet the required concentration.

Stripping is carried out in stripper at 60 to 65 C. The flow of green liquor is maintained at 2.5 to 3.5 m3. The purpose of stripping is to remove the H2S present in green liquor. This has to done by reducing the pressure and passing the steam through green liquor after carbonation. The steam is introduced from the bottom and liquor is fed from the top of the tower. The stripper is made internally such that it has slits to facilitate the reaction. Steam at high pressure ejects H2S from liquor as much as possible.

Absorption

Absorption is carried out in absorption tower. In absorption SO2 reacts with Na2SO3 to form NaHSO3. The SO2 is produced by the oxidation of H2S recovered from stripping with Oxygen at high temperature and oxidation of molten sulfur If the amount of recovered H2S is not according to requirement then the Sulfur is added to meet the requirement.

$2H_2S + 3O_2 \longrightarrow 2H_2O + 2SO_2$

$S + O_2 \longrightarrow SO_2$

In absorption chamber the reaction of Na2SO3 and SO2 takes place

$SO2 + H2O + Na2SO3 \longrightarrow NaHSO3$

Sulfitation

In sulfitation chamber the reaction between Na2CO3 and NaHSO3 takes place and Na2SO3 is produced .

$Na2CO3 + NaHSO3 \longrightarrow Na2SO3 + CO2 + H2O$

The sodium sulfite produced in the above reaction is fed to the mixing tank where it is mixed with buffering agent (Na2CO3) carried from storage.
After mixing the material is now termed as white liquor which is sent to New Fiber Line(NFL) for cooking the raw material .
Cooling Section:
Cool water is used in the cooling section , where gases are cooled and sent to the chimney where gases are exhausted to the environment.

Scrubbing Section:
Lower part of conversion tower is scrubbing unit, where gases are scrubbed. It is basically a packed column , where pal rings are used usually they are made from two materials. One is from steel and second is from plastic and depending of temperature zones these rings are used.

WASTE PAPER PLANT

One of the raw materials for pulp making is waste material such as newsprint, white duplex board etc. Packages also use imported waste material for its waste paper plant. The over all waste paper stock is categorized into two classes, one of them is first quality which is used for PM and this first quality waste material is processed at waste paper plant # 3, and the other grade is second quality, which is processed at waste paper plant # 2, and it is used for PM2.Waste Paper Plant # 2 is only for tissue making at PM4.

Waste Paper Plant # 3, is totally DCS based, and automatic plant, and its capacity is 100 tons per day, where, waste paper plant is manually operated, having capacity 50 tons per day,

Waste Treatment Process at WPP

The feeding capacity of this plant is 130-140tpd, and production capacity is 100tpd. Waste treatment process starts from the removal of contaminations, present in the waste stock. The major contamination includes, sand, mud , iron pieces such as staple pins, common pins, paper clips, etc. mainly this process consists of extensive screening of the raw material , it is just a chain of various separation techniques , in which special equipments such as , high pressure screens, sand cleaners, coarse screens, and centrifugal cleaners.

First of all, the raw material is sent to the main pulper , through conveyer belts. In which water is added, and the consistency of the solution becomes 4.5 – 5 %. Pulper is just like a chest in which impeller is installed, which produce whirling action inside the chest , also , a screen is installed, through which , accept i.e. 70 % of the total, is pumped to the high speed centrifugal cleaners, and the reject of main pulper is sent to the tam trap , where it is again passed through a sieve of 8 mm dia, and the accept of this tam trap is sent to the high speed centrifugal cleaners. The reject of tam trap is sent to the drum screens, where extra water is added, and the mix is diluted, the reject of drum screens is mainly plastic waste, and the accept of drum screen is sent back to the main pulper.

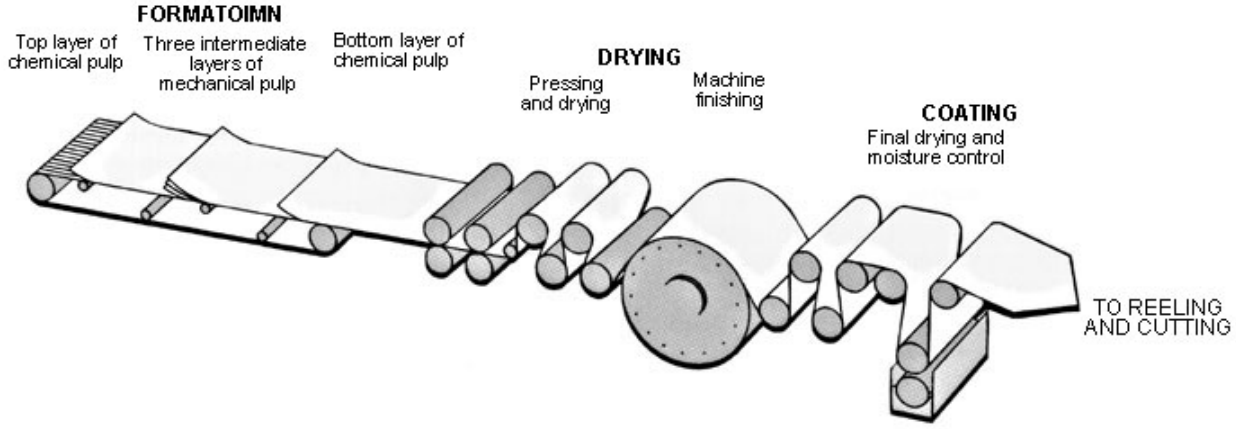
So the accept of main pulper and tam trap comes inside high speed centrifugal cleaners. Where over sizes are again separated and the reject is sent to the effluent treatment plant, and the accept is sent to the pulper dump tank. It is a sort of storage tank. As well as sedimentation tank. Heavy particles are rejected from the bottom of this tank time to time. and the accept of pulper dump tank is sent to the High Pressure Screens , where the fine particles reject of high pressure screens is sent back to the Reject Chest. In reject chest , water is added and sent to the fiber sector, , where light reject is sent back to the pulper dump tank. And the medium reject is sent to the vibratory screens, and the heavy reject is drained to waste treatment plant.

The accept of high pressure screen is sent to the coarse screens. The accept from coarse screen is stored in a tank ,from where it is pumped at the mass flow rate of 1600 lb/ min. to the battery of centrifugal cleaners, centrifugal cleaners are 3 stage battery , the accept of centrifugal cleaners is sent to the high pressure screen. The accept of this high pressure screen is sent to the thickener. And the reject is sent to the pressure screens, where after screening through 0.15 mm screens , material is again sent to the thickener. Finally the accept of thickener is sent to storage tank for stock preparation plant and the Water is sent back to the filter tank.

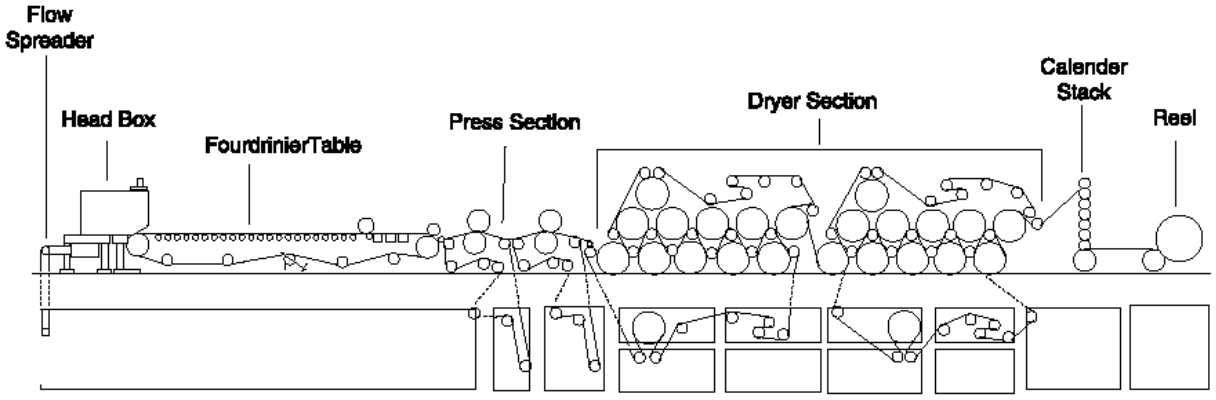
MACHINE HOUSE

There are four machines in machine house, named as

Machine	Board type produced	Capacity (tons / day)
PM1	3 layers	120
PM2	2 layers	70
PM3	1 layer	10
PM5	1 layer	50



MULTI LAYER PAPER MACHINE



SINGLE LAYER PAPER MACHINE

Wet-end

Headbox and slice

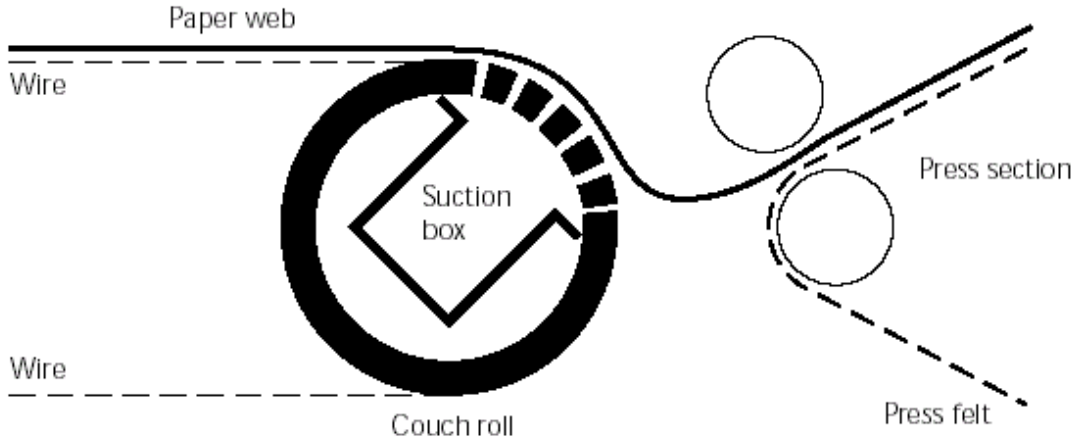
The prepared stock is delivered to the headbox (or flowbox) at a consistency of 1% fiber in water. The headbox is effectively a reservoir extending across the width of the paperforming wire, with a slice at the bottom to control the quantity of pulp directed onto the wire. By adjusting the aperture of the slice, more or less pulp is allowed to pass, thus allowing the caliper and grammage of the paper to be varied. The slice lip is adjustable at several places across the machine so that the grammage profile across the web may be controlled to improve cross-machine uniformity. Two factors are of particular importance at this stage of the process. First, paper fibers demonstrate a strong tendency to gather into clumps or flocs. These result in nonuniformity in the paper because the later

calendering process compresses the fibers, forming regions of higher density than the uniform surround. This in turn results in nonuniformity of ink absorption which manifests itself as mottling in solidprinted areas of the sheet. Flocculation may be reduced by adding dispersants to the pulp but these may cause foaming which is equally undesirable because air bubbles also cause nonuniformity in the finished sheet

Wire section

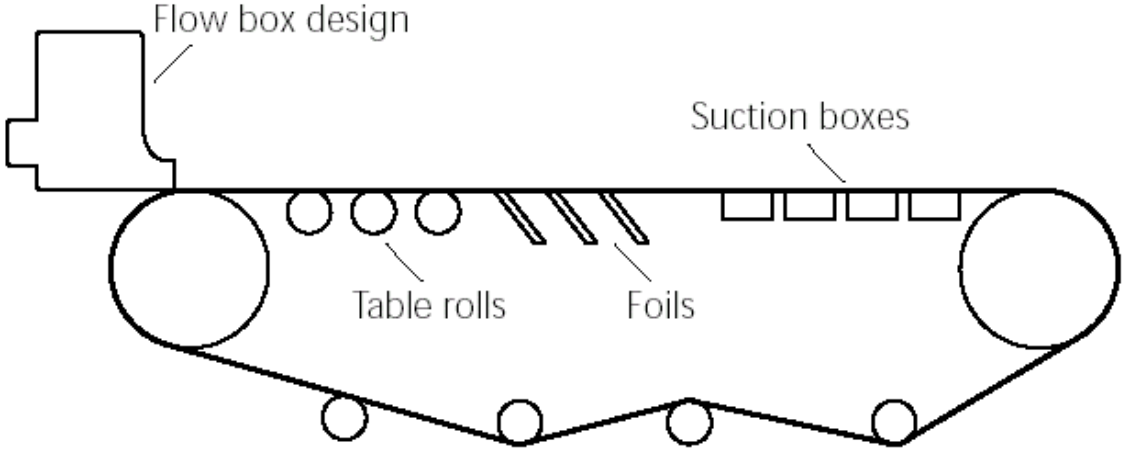
The wire section is a continuous belt of wire mesh onto which the stock is projected. The size of the perforations depend upon the type and amount of stock, and nature of the paper being produced. Highly refined wet stocks require larger mesh openings to encourage rapid drainage. The function of the wire is to form a mat of paper fiber and then to drain off as much water as quickly as possible. It is necessary to assist the natural gravitational drainage of water. In addition, the underside of the wire through which drainage is occurring is passed over a series of foils. These are blades usually made of high density polythene which run across the width of the wire making a small bevelled angle with it. The foils are fitted into slots which enable a variable number to be used and their position on the wire to be chosen to control water removal. The function of the foils is twofold: first, they assist the removal of water; second, they promote a smooth flow from the underside of the wire. Flow that breaks up into turbulent motion disturbs the fiber formation on the topside of the wire. In addition to ordinary foils, the last two or three in the arrangement are vacuum assisted (vacuum foils).

After the vacuum foils several vacuum boxes apply a higher suction to remove further water and over these is sited the dandy roll. The dandy roll is a lightweight wire mesh roller which applies pressure to the topside of the web, closing up the open textured paper mat and giving a smoother finish. In the days of hand papermaking, the coucher was the papermakers assistant who placed the wet sheet on a felt for pressing. Today, the couch roll, placed at the very end of the wet-end wire, performs a similar function and is the final stage in formation of the sheet, before it crosses from the wet-end to the press section. The couch roll comprises a perforated stainless steel shell which rotates around a suction box sucking water through the perforations. The couch roll also drives the forming wire by gripping it as it rotates. The paper web then passes across a gap onto the rolls and felts of the press section.

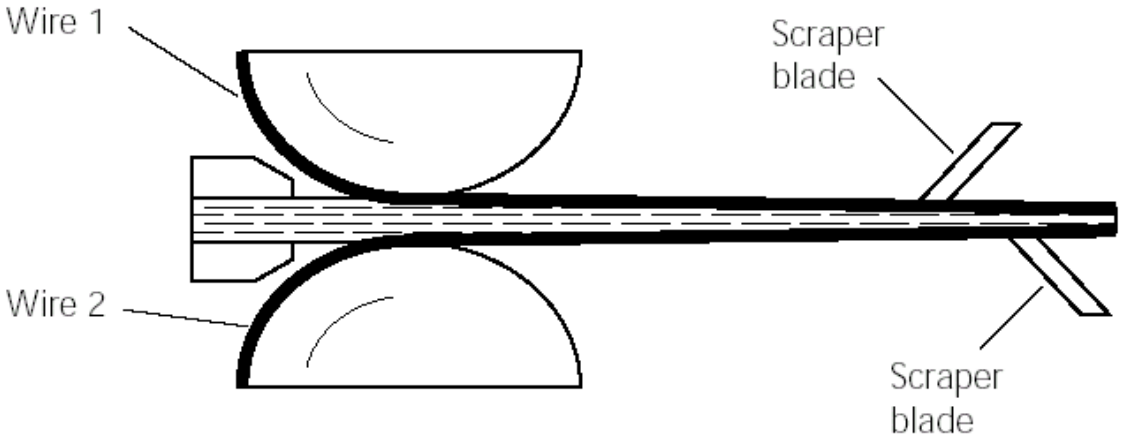


Forming wires

Before moving to the press section, mention must be made of different papermaking wire configurations. The simple single-wire system supported and aided by foils and suction boxes as previously discussed is the Fourdrinier wet-end, first devised by the Fourdrinier brothers. The disadvantage of the Fourdrinier wire table is that it produces paper that is two sided. The reason is that water drainage through the paper web to the underside of the wire, carries with it fillers and small fines.



The suction boxes emphasize this gravitational action with the result that paper in contact with the wire side contains less filler and small fibers than the top side. Thus, the wire side characteristically comprises more long fibers and is therefore more open than the densely packed top side, leading to differences in smoothness, absorbency and dimensional stability in the presence of moisture. The principle of twin forming has been introduced to improve dewatering on fast machines and to reduce two-sidedness. The principle of twin forming differs from that of twin wire (next section) in that an additional wire is added to the Fourdrinier wire table such that the paper web must pass between them.



Water is thus removed equally from each side of the paper, eliminating twosidedness. There are various possible configurations for twin forming and the simplest is the top or over wire addition to the Fourdrinier wire table.
Press and drier sections

Press and drier sections

On leaving the Fourdrinier wire table, the paper web is still very wet and the purpose of the press section is to remove as much water as possible before reaching the drying section where expensive heat energy is required to drive off residual water. Modern press sections may bring the water content down to less than 60% but this is still a great deal of water to remove in heat energy terms and explains why at least two-thirds of the length of a papermaking machine comprises the drier section. Since it is generally considered that a 1% reduction in the amount of water to be removed requires 4% less steam heating energy to dry the web, the efficiency of the press section is very important and research is ongoing to improve it. The general principle of pressing is to press the paper web against a porous felt and between rollers assisted by suction. The press sections are often heated to raise the temperature of the web. It is claimed that heating lowers the viscosity of water, increasing ease of removal through the felts.

Perhaps more importantly, a preheated web entering the drier section appears to reduce the required drier energy by 1% for every 10°C of temperature rise. In spite of this, the drier section remains the most energy expensive, comprising a two-tier arrangement of steam-heated drying cylinders over which the paper web passes in a figure-of-eight configuration designed to dry both sides of the paper at the same rate. In order not to shock the paper the web is introduced to a temperature gradient which rises from entry to a maximum at the middle of the section and then falls away towards the exit.

On-machine coatings such as sizes and mineral coatings may be applied in the drier section, although the latter is often performed as an additional, off-machine operation. On leaving the

drier section the moisture content of the paper is between 6% and 9%. The paper is then calendered to impart smoothness before being reeled into standard weights. These are wrapped and warehoused or despatched for web printing. Alternatively, reels may be sheeted to standard sizes to suit the requirements of sheet fed printing presses. In modern paper mills the entire operation of reeling, warehousing and despatch is computer controlled using robots to handle and warehouse reels and then to locate, retrieve and despatch them to customer requisition.

Calendering and finishing

The term finishing signifies to the application of the required surface finish to the paper and usually refers to the smoothness, gloss, and in some cases special textures such as crepe paper finishes.

Calendering

Some machines are equipped with calender rolls between the drier and reeling sections; there may even be intermediate calenders in the drier section. Papers that have been finished by machine calenders only are called machine finished or MF papers. Calenders may also be located between coaters or off-machine. The objectives of calendering are to ensure that the final print quality is correct by imparting smoothness and gloss, and to improve sheet uniformity in thickness, particularly in the crossmachine direction of the web. This is achieved by passing the web through banks of heated (chill) rollers (rolls) which apply compression and thus smooth the paper. The rolls were, until recently, arranged in a vertical stack of five or seven, the paper passing from top to bottom under increasing pressure. Modern developments such as the introduction of swimming or Kuster rolls have reduced this number to two for many applications. The smoothness and thickness of the paper depends upon the speed of travel (dwell time in the nip) the nip pressure, the moisture content of the paper and the temperature of the rolls. A well-beaten paper containing a high loading gives the best calendering result because the fibers are more bruised and flexible and easier to roll flat.

Calendering variables

The degree of calendering is affected by speed of passage through the nip, the pressure applied within the nip, and the temperature applied by the chill rolls. Relevant paper properties include the base weight, degree of beating and moisture content. As the temperature of calendering is increased, the smoothness for a particular thickness increases. The improvement in smoothness is even more pronounced with increases in moisture
content and the more highly beaten the paper the greater the smoothness attained (as exhibited in glassine paper which is highly beaten). However, as the speed of calendering increases, the gloss imparted decreases because

the dwell time, that is the time the paper spends between nips, is insufficient for heat to penetrate the paper and plasticize it. Increasing the pressure is undesirable because this will reduce the thickness of the paper sheet which in turn lowers stiffness and stiffness is a very important property of paper (tensile stiffness).
Paper / Board Products:

Machine	**Products**
PM1	White Duplex Board
	Tetra Duplex Board
	White Card Board
	Un line Grey Board
PM2	CMP (Corrugated Medium Paper)
	KLP (Kraft Liner Paper)
PM3	White Poster Paper
PM5	Writing / Printing Paper, CMP, KLB

Quality Control (P / B)
Quality Control is the back bone of production, Machine house has also its own quality control department to ensure the quality of the product , whatever , either it is board, or paper.
Following tests are carried out in this laboratory

Test	Units	Test	Units
Bulk	cm^3/ gm	Grammage	Gm/m^2
% Moisture	%	Cob Test	Gm/m^2
pH	Nil	Wax Pick Test	Nil
Porosity	ml / min	Roughness	Ml / min
Brightness	%	Ash Content	%
Bursting Strength	Kpa	Burst Index	KPa , m^2/ gm
Tensile Strength	KN/ m	Tensile Index	Nm/ gm
Elongation	%	Tearing Strength	mN
Tearing Index	mNm^2/ gm	Stiffness	mN
Ring Crush	KN/m	Curl Test	Mm
Internal Bond Strength	J/m^2	Top liner	Gm/m^2
Back liner	Gm / m^2		

POWER HOUSE

Power House is the backbone of every industry, Packages also has a power house, which is producing steams at three pressures, i.e. 4, 8 & 13 bar. Power House has three boilers
Two Boilers are used to generate electric power, and third boiler manufactured by DESCON Engineering Works is used to produce steam only, at 13 bar pressure which is normally supplied to NFL (New Fiber Line) Plant. The bleeding steams from Allburg, and MAN boilers after running turbines, come at pressure, 8 bars and 4 bars, respectively.

1. Allburg Boiler 10 MWatts.
2. MAN Boiler 6 MWatts.
3. Descon Boiler 13 bar saturated steam to NFL

Boiler	Power Generated	Steam Capacity
Allburg	10 MW	60 tph
MAN	6 MW	30- 32 tph
Diesel Engine	10 MW	N.A.

Two Turbines are run from Allbrg and MAN Boilers.Package's total power consumption is 26.4 MW on the average, out of which 26 MW is generated with in Power House, through boilers and one diesel engine, and some of the power is bought from WAPDA.

Objectives & Operations

1. Power Generation
2. Provide Water to the cooling towers
3. To Provide Water to the Diesel Plant
4. To Provide 4 & 8 bar steams where ever required
5. Pumps of the effluent treatment plant are operated from Power House.

WATER TREATMENT PLANT

Power House, in every industry plays a role of backbone, Packages also has a powerhouse. In which two boilers are operating. So in order to generate steam from these boilers treated water, which is free from all sort of solids, usually called as de-mineralized water is used, for the demineralization of water we need water treatment plants, in which certain resins are used for the removal of solids from water, and these resins are regenerated after treating a particular volume of water, in Packages water treatment plant three de mineralization and one reverse osmosis unit is working.
The conductivity of raw water is between 600 - 800 µs/cm, after

Name	Capacity	Water regeneration volume
HOH 1	12 m^3/ hr.	250 m^3
HOH 2	17m^3/ hr.	200 m^3
B& L	20m^3/ hr.	180 m^3

demineralization conductivity becomes less than 10 µs/cm

Chemical Reactions Involved are as follows

$CaCO_3 + HR \longrightarrow CaR + H_2CO_3$

$H_2CO_3 \longrightarrow H_2O + CO_2$

RUBBER DEPARTMENT

Introduction

Pakcages is not directly involved in Rubber Business so this department can't be considered as one of the production departments. Rubber plant in Packages is basically a service department which give production according to the in house demand plus outside the Packages. Few outside customers of Packages includes Flying Paper Mills, Nishat Textile, Zamindar Paper Mills, & Leather Industries etc.

Products

The main product of this department is Roll which are used in paper mills as well as in textile mills frequently. Here rolls are covered with rubber for various positions & jobs, in mills and for various job, various varieties of rubber are formed for example ebonite rolls.

Rubber Products

1. Rubber Rolls
2. Rubber linning
3. Conveyer Belts
4. Rubber Parts/ Moulds

But the key job of this department is to provide services to the Flexible Packaging , Board Mills, inside Packages in the form of rubber rolls.

Type of Rollers

1. Offset rollers
2. Felt rollers
3. Flexo rollers
4. Yankee Touch roll
5. Dip rollers

Capacity

The average annual capacity of this plant is 700- 800 rolls per year.

Raw Materials

1. Rubber Polymer — Poly isoprene,NitrileButadiene Rubber
2. Plasticizer
3. Curing Agents — (Sulphur , Per oxides)
4. Fillers — (Sillica)

Process Description

First raw rubber is mixed with fillers, plasticizers , remain according to developed formulation in mixer machine, then it is heated in second stage for homogenization of all ingredients. The residence time in mixer is round about 2 -3 hrs.Thetemperature in the first stage mixer is maintained between 60- 70°C , and pressure is customized according to the product management , From second hand mixer / heater the material is transferred into Calendar, which converts the rubber into sheets of 2- 3 mm thickness or any other required dimension of internal customer, then this sheet is rolled on the roller, over this rubber roller, range a cotton , straps are wound then wire is tighten uniformly and to give it a shape of a mould, then this roll is sent for autoclaving in vulcanization where usually a temperature of 120°C is maintained and pressure is round about 0.5 – 4 kg_f / cm^2 here residence time is about 8 hrs. After autoclaving followed by cooking roll is re opened , wire and cotton strips are removed , so Roll is ready to be installed at the Mill.

Raw Material varies from job to job, but few of them are necessary, e.g. Natural Rubber, or Synthetic Rubber, These raw materials are imported under following names

1. SBR (Styerene Buta diene Rubber)
2. EPDM (Ethylene Propylene Di Monomer)
3. NBR (Nitrile Buta diene Rubber)

With these basic raw materials , some other chemicals are also used in making the required composition of the product, such as

1. Plasticizers
2. Resins
3. Fillers
4. Curing Agents
5. Accelarators (Promoters) } Catalysts
6. De Accelarators (Inhibitors) }

Plasticizers are added to improve the properties of the final product, e.g. they softens the rubber, or they act as lubricant , commonly DOP (Di octa thalate) is used for synthetic rubber, and Tellus Oil is used for Natural Rubber.

Resins are also an important constituent of rubber manufacturing , usually phenolic resins such as Phenol Formaldehyde is used , to make rubber more harder as well as resins are added for Tech Purpose i.e. to improve linkage between two rubber sheets/ layers.

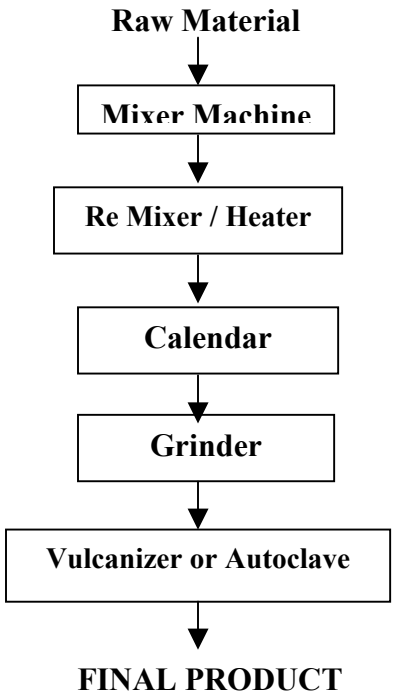
Silica is used at rubber plant as Filler, the purpose of its addition is to enhance the viscosity of rubber product and to handle this increase in viscosity , plasticizers are also in appropriate ratio to get optimized characteristics in the final product.

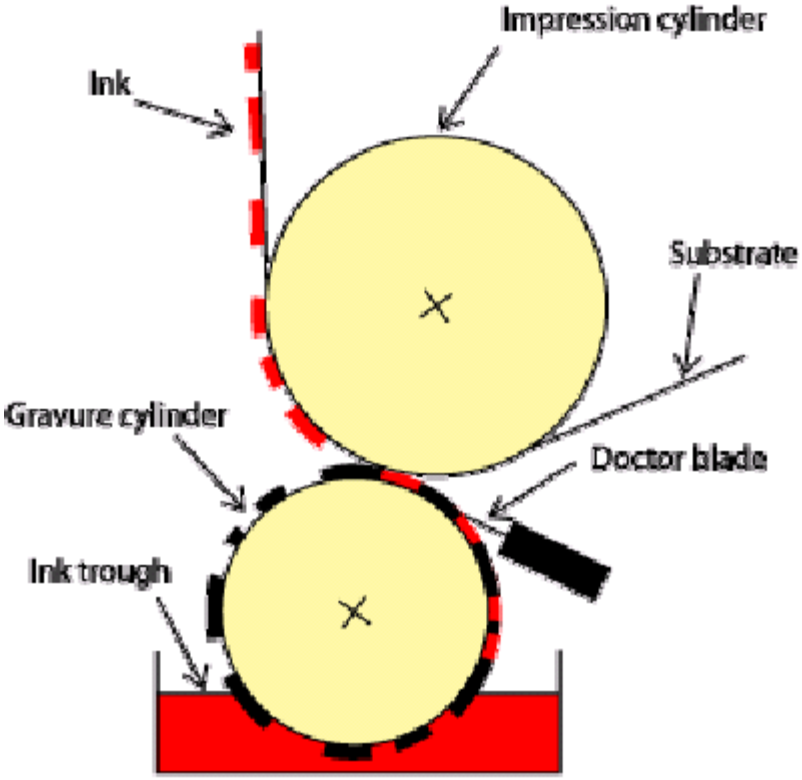
Curing Agent such as Sulfur is used in rubber processing to increase the linkage between Carbon to Carbon , this is also commonly known as Vulcanization.
Some Accelerators such as MBT's , TMT etc. are used to improve hardness of the product , and they act as catalysts, where as some times, when it is required to slow down the process , De Accelerators such as CDS, HBS are also added , they act as inhibitors.

Rubber Testing Lab
Resilience Test
Resilience means, bouncing back , so this test is carried out to determine the bouncing back effect of rubber , which is rolled around a spindle , over all known as roll, this is important , because , when paper is subjected to the rollers for printing purpose, if it (rubber at roll)doesn't have required resilience , probably paper/board will stick to the roll, and it may spoil the printing job. It is usually determine in percentages. Say , 40% resilience , means , this rubber material has 40% bouncing back effect.
Following other tests are performed in Rubber Department Laboratory to make the product according to the both external as well as internal customer requirements.

1. Rapid Plasti meter Test
2. Abrasion Test
3. Tensile Strength Test
4. Modulus of Elasticity Test.
5. Resilience Test

Block Diagram of Rubber Plant





OFFSET PRINTING

Inputs for Offset Printing

1. Board from Paper store
2. Plates from Re production
3. Inks from Coates

Production Statistics

Average Production Per Day	300,000	Sheets
Average Production Per Month	9,000,000	Sheets
Production Capacity Per Month	125,000,000	Sheets

FLEXIBLE PACKAGING

In flexible packaging different kind of raw materials are used. They include PVC, Polyester , OPP (Oriented Poly Propylene), BOPP & Paper except poster paper all the other raw materials is imported , where as the poster paper is made in board mill.

In the packaging of flexible material initially printing is carried out. There are two machines installed for printing. They are called as

1. Cerruti Machine
2. Rota Mach Machine

On both these machines roto gravoure printing is carried out. The Cerruti machine is 8 color machine, which has got max speed of 250 m/min. on these machines printing of PVC , OPP, & BOPP is carried out. According to the no. of colors required, for printing rollers are installed and printing of each color and

design is carried out in different sections and after each section the material is passed through air dryer at temp. of 60 – 70°C . for inking at each stage , inks are obtained , from coats laurilleux. These inks are diluted with different solvents ,and contiuous mixing of the inks is carried out , continuously. The solvents includes

1. Ethyl acetate
2. Ethyl alcohol
3. Propanol
4. Propyl acetate

On the rotomach Machine normally paper jobs are done. It is six color machine, and paper used on it , are of two types. One type is imported paper , which is used for making wrappers of toffees, and bubble gums ,and the second type includes poster paper, which is made in board mill and is used for printing wrapping of Gold Leafs etc.

The roto mach is operated at speed of 100- 120 m/min. Although it has got maximum speed of 180 m/ min. the printing phenomenon is same as in Cerruti machine. After the printing in the printing section the printed material is laminated in lamination section. In the lamination section , there are four laminators. Out of which two are solvent based , and other two are solvent free. In the solvent based , lamination the two layers of packing are laminated, by use of Glue. A solvent usually iso cyanides is added to it to maintain its viscosity . in the lamination process of solvent base lamination , after primary , un winding , coating is done, and glue is applied on it.

Now this material is passed through drier to give pasty / rubbery behavior to glue. It is then pass through nip station, from where the other layer to be laminated on it , is passed and thus lamination is done. where as in solvent free lamination , the insulating material which is normally polyethylene , etc. is preheated at 50°C and then coating is carried out.

After coating , curing time of 24 – 48 hrs. is given , the amount of lamination in solvent free coating is 1.5 - 2.5 gm /m^2 . and for solvent based , it is 2- 3 gm/ m^2. Also different test are performed , to test the ready material which includes grammage , peal strength , and solvent retention etc. The capacity of solvent free lamination is 9000 m/hr. where as for solvent based it is 5000 m/hr.

The normal job sequence for the flexible packaging is

1. Rota Printing
2. Lamination
3. Slitting / Sleeve Cutting

Coating & Extrusion Department

To enhance the printability of board, it is coated and extruded, Mainly china clay is used for coating purposes.

Composition of Coating

China Clay 20%

Filler (Marble Stone)	80%

Other Additives

Binder	Rubber Latex 13 %
Antifoaming Agent	0.2%
Brightening Agent	BSF Poly Salts
Dispersion Agent	

After coating the following qualities of the board increases mainly
Gloss increases from 10 % to 50 %
Brightness increases from 70% to 84 %
Roughness decreases from 300 to less than 50

Inputs for Coating Department
White Duplex board , which is further used in Offset Printing
Bleach Duplex board, which is used for lemanic / Rotogravure Printing
Card Board
Tetra board for Tetra Pack.

Coating is usually done in two steps , first stage is called, Bar flex Coating, where as second stage is called Blade Coating , after the name of the function carried out in coating equipment.

CORRUGATION DEPARTMENT

Corrugation department , is a separate , in which containers and corrugated boxes are prepared, Depending on the job, various types of boards are used, e.g. KLP, White duplex, the internal suppliers of corrugation department are , PM2 PM5 machines, PM2 provides KLP where as , PM5 supplies CMP "corrugated medium paper" .
Corrugation department is divided into the following sub divisions

1. Planning Division
2. Fluting Division
3. Printing Division

Objectives

1. 100 % Quality
2. In time Delivery
3. Customer Satisfaction

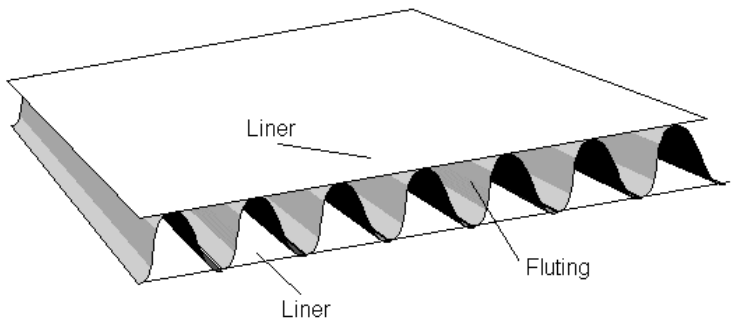
First of all , when a job , comes to the market division through sales or may be through directly customer, then marketing department contacts the planning department in corrugation division, then planning department prepares Production order according to ISO i.e. internal sales order, (issued by marketing), and in response to this production order, a sample is produced, which goes back to customer or sales division for approval, after approval , pre press planning is done, then

finally bulk production starts and in the end, the prepared product is stocked in the store, from where, stock is delivered to the customer.
For example if entirely a new job , comes, to the marketing department, then marketing department contacts RD& C, to develop the new product and do all other tests to get best quality as required by the customer.

Flutes
There are four main types of flute forms, designated A, B, C and E, each with a defined size as indicated in the table below. There is also a very small micro flute or carton flute (eg F and N flute).

Flute Form	Corrugation per metre	Height of corrugations (mm)
A	105 to 125	4.5 to 4.7
C	120 to 145	3.5 to 3.7
B	150 to 185	2.1 to 2.9
E	290 to 320	1.1 to 1.2

Number of walls
There are four types
Single face - One sheet of fluting glued to one liner, used for wrapping interior fitments, cushion pads or as "lamp wraps"
Single wall - One sheet of fluting sandwiched between two liners, the most common material.
Double wall - Two sheets of fluting, an outer liner and inner liner, and a middle liner which separates the inner and outer flutings, used where greater compresion strength is required.
Triple wall - Three sheets of fluting separated by two middle liners plus one outer liner and one inner, used for pallet boxes and other heavy duty applications.
The strength of the board and ultimately the case increases with grammage, fiber length, flute size and number of walls. Hence, all other things being equal, double wall is stronger than single wall. A flute is slighty stronger than C flute which is stronger than B flute where the same grammage of liners and fluting is used. A 150 gsm liner is stronger than a 125 gsm liner and Kraft is stronger than Test.



Research, Development & Control Department

R D& C department is one of the major departments of the Packages, Here new techniques in pulp and paper development as well as certain important tests are carried out. There are following labs, in RD& C

PULP LABORATORY

Objective

Following objectives of this lab are given

a. Quality assurance of the job, before going to massive production in paper mill
b. Research work in pulp development
c. To check the fault / draw backs in the product if customer makes any complaint.

In pulp laboratory the following tests are performed on daily basis

1. Pulp Consistency
2. ^{0}SR
3. Percentage Ash Content

In pulp lab, various samples from different sections of the industry are being tested before running the production , for example , the pulp from CTMP, Bleach , Linter, Wood , and SPP "Stock Preparation Plant " is being tested here,

Generally pulp can be categorized as follows :

1. CTMP (Chemithermomechanical pulp)
2. Un bleached straw pulp
3. Bleached straw pulp
4. Semi bleached pulp
5. Bleached linter pulp
6. Bleached wood pulp (Imported)
7. Waste paper pulp

Pilot plant , in pulp lab consists of the following units

a. Digester / Cooker
b. Washer
c. Disintegrator
d. Strainer
e. Refiner (Mechanical)
f. Plate & Frame Press
g. Dryer

Digester is the starting unit of the pulp manufacturing , it is electrically operated.

Chemicals that are used in the digester includes Wheat Straw or other fibrous material

Digestion liquor (Na_2SO3 , Na_2CO_3), 165- 195^oC temperature is maintained in the digester for 2 – 3 hrs. under an operating pressure of 7 bar, where as the pH in digester is maintained at value 8 .

Purpose of addition of cooking liquor is to separate liquor from fiber , Almost 14 % of the total wheat straw , sodium sulphite is added and $1/4^{th}$ of sodium sulphite , sodium carbonate is added as buffer to maintain the pH parameter.

After digestion , cooking liquor and pulp is subjected to washer , where raw pulp and un digested wheat straw is separated , where a screen of 80 mesh size is used for the separation of pulp.
After washer , pulp is subjected to the disintegrator . It is just like a centrifuge machine , which reduces the size of fiber, and thus increase the quality of pulp.
As fiber size decreases, water drain ability increases and thus $^{\circ}$SR reduces. And after checking the value of $^{\circ}$SR apparatus , pulp is sent finally to the pulp refiner and then it is pressed and moisture is removed , after then it is dried & pre weighed , before final drying , to calculate consistency of the paper formed at the end.

CHEMICAL LABORATORY

Objectives

a. Calibration of the various equipments/ machines , in various departments as well as in the chemical lab. At frequent intervals to ensure the quality testing.
b. Water treatment is carried out in this lab. Certain tests and procedures are followed to accomplish the task and get the desired result . The details of these tasks & procedures is beyond the scope of this orientation as it requires more time than just a single working day.
c. Monitoring of waste water treatment of Tetra Pack is also done.
d. Quality assurance of incoming non fibrous raw material is carried out here to reduce the production losses as well as to get a quality product to satisfy customer and get competitive advantage in the market.
e. Prime objective of all laboratories , particularly , chemical lab is to develop and then follow the procedures to optimize the process to get better , economical , customized product , according to the customer requirement.

In Chemical laboratory , the test of the following non – fibrous materials are carried out

1. Sodium Silicate
2. Caustic Soda
3. Sealalcole 5720
4. Glow 2770
5. China Clay
6. Witophene
7. Aluminum hydroxide
8. Soda Ash
9. Hydrogen Per Oxide
10. Soap Stone

11. Fortified Rosin
12. Alum

PHYSICAL LABORATORY

Objective

Labs are always an important tool behind the development & quality assurance issues , These labs are back bone of RD& C department . The significance of physical laboratory is that it assures the quality of pulp, which is going to be converted into paper , It tells us completely about the properties attained by the paper to be formed in Machine House.

Following tests are carried out in the physical laboratory which includes its own significance in the product development.

1. Brightness test
2. Opacity
3. % Moisture
4. Tearing test
5. Pealing test
6. Stiffness test
7. Bursting Strength
8. Oil Absorption Strength
9. Thickness test
10. Grammage test
11. Internal Bond Strength
12. Smoothness test
13. Speed / Load test for machine
14. Yellow & Brightness test
15. Porosity test
16. Box comparison test

Brightness test

A paper sheet appears brighter if it reflects (diffused) preferentially blue colour (wave length=457nm).Pulp is bleached before making cultural paper, so that the resulting sheet formed is bright. This is because a sheet formed of unbleached pulp looks pale and hence is not pleasing in appearance.The degree of bleaching is measured by the extent of blue colour reflectance . Due to these reasons , brightness of a sheet is measured as the diffused reflectance of blue colour from an opaque pad of such sheets.

Brightness differs from whiteness in the sense that whiteness refers to the uniformity of reflectance of different colours (wavelength). Most white papers have total reflectance ranging from 50-90%.Brightness is affected by the addition of dyestuff. A small amount of blue dyestuff is often added in furnish for making white paper. However,it does not increase brightness.

Opacity test

This property refers to see through characteristic of a paper sheet. Consider a paper printed on both the sides , when you read one side of this paper, you dread the impression of the text printed on the other side. The quality of printing might be good but look through characteristic makes overall bad printing. This is due to less opacity of paper and is attributed to larger degree of diffused transmission. Thus a perfectly opaque paper is one which is absolutely impervious to all visible light (zero diffused transmission). Black paper used to wrap photographic films is nearest to perfect opaque paper. However, normal book paper have opacity of approximately 90%.Opacity increases with increase in grammage of sheet. Addition of fillers , dyestuff or pigment also increases opacity of paper. However , effect of beating ,pressing or calendering decreases the opacity. Highly bleached pulp also have less opacity.

Gloss test

Gloss is the attribute of surfaces which is responsible for their shiny appearance. Thus a glossy surface will be shiny. It is associated with specular reflection from the given surface. Thus in some surfaces , the amount of light reflected in different directions will be same but in some ,the reflecttion along 90° (i = 0°) will be more than those along other directions. The latter surfaces are termed as 'Glossy' and the former , at the other extreme , are termed 'matt'. So in glossy surface, there is selective reflection along a particular direction (angle 0°) over others.

Gloss is related to 'luster' , the sudden selective reflection a light and to 'glare' , the desirable reflection (again in a particular direction) of excessive bright light. It is a property which is characteristic of surfaces (unlike diffuse reflection which depends upon nature of material bulk).

(i) if we don't change the furnish used in paper making , a smooth paper will be glossier than a rough paper,

(ii) if a paper surface has chemical whose specular reflection factor is more , the surface will have higher gloss.

All these three important features of the paper are tested on a single instrument called as Photo Volt meter. This test is carried out usually in less than 10 mins

Moisture Test

Because cellulose fibers are tubular with central canals or lumens, they can absorb water through the fiber walls. Moreover, the cellulose molecule contains hydroxy groups, which attract water by hydrogen bonding so that, overall, cellulose fibers are hygroscopic. In fact, a high affinity for water is necessary to make the physical bonds between fibers during papermaking. Narrow thick-walled fibers, such as linen, are less porous than broad thin-walled fibers such as softwoods, which are more absorptive. Whereas water is absorbed into the paper fibers ink vehicles tend to adsorb onto the surface of the fibers, although some

penetration of certain solvents, for example alcohols, is possible. The absorbency of paper towards ink is its ability to absorb ink into its bulk rather than into individual fibers. Sizing the paper throughout its bulk controls absorbency towards aqueous-based inks.

This test has its own significance because moisture percentage in paper plays a vital role in determining its properties, such as tensile strength, bursting strength, etc. Moisture up to an appropriate amount is sufficient for paper manufacturing , say usually up to 5- 8% , moisture content is carried out in paper. But if the moisture exceeds this limit it will create two major problems

1. Paper will loose its strength
2. More energy will be consumed during paper manufacturing.

This test is performed on an instrument called as TMI Hart, this instrument excellently reduced the time for determining moisture content .

Tearing Test

Tearing strength is measured in two directions , i.e. Machine Direction (MD) , Cross Direction (CD) , A sample of known dimensions is fixed inside the machine and then it is subjected for tearing. The machine directly gives us value if "gram force " then this value is changed into milli Newton mN .

Skip Peel Test

This test is performed to determine the coefficient of friction , between the two films , of the paper in machine as well as in cross direction . This test is must for printing job papers or boards.

Paper Stiffness Test

Stiffness is an important characteristic of paper / board . The unit of stiffness is mN, from the instrument it is measured in gram cm then converted into mN.

The small of size is 1.5x 2.75 in^2 is taken , is subjected inside the machine , the 15° angle is rotated , and machine will directly give the value of stiffness.

Conversion factor: 1gm cm = 9.870 mN.

Bursting Strength

This test is carried out to find out the bursting strength of paper / board. It is carried out in Mullen Tester , Two different Mullen Testers are used for board and paper separately, the principle of this machine is based on hydraulic system ,Glycerin is used as working fluid in hydraulic system , Bursting strength is measured in lb/in^2.

Conversion factor: 6.896 KPa = 1 lb/in^2

Oil Absorption Test

This test is very simple , here liquid paraffin is used as a source to perform test, a simple apparatus is designed to perform the test, in which a drop of oil is dropped on a metal drum , which is rolled on piece of paper / board, and the moment when oil starts touching board/ paper is started noting , and when 75% of the oil is absorbed by the paper/board, the stop watch is stopped. This gives the relative absorption ability of paper/board to absorb the oil.

Thickness Measurement

Since thickness of paper is affected by its moisture content, due care is to be taken regard to conditioning of paper.
Thickness of paper / board is measured by the Thickness Micrometer , and thickness is usually called as Caliper or in mm or micro.

Grammage Test

This parameter relates available surface area of paper or its weight. It is important due to several reasons:
(i) it is the surface of paper that is used in nearly all its applications- be it a writing, printing paper or a packaging paper or tissue paper.
(ii) paper is sold on weight basis and the daily turn over of a mill is also indicated in units of weight.
This test is done for measuring the Grammage of paper , i.e. how much weight is carried by paper in one square meter. This test is performed on an equipment called Sartarous Balance and gives value in lb_f.

Internal Bond Tester

The Strength of paper or board to withstand layer-to-layer separation. It is the force with which a coating or film adheres to the surface of a sheet.
This test is conducted to find out the bonding strength between the two or three layers of the paper sheets , which are joined together to make duplex/ triplex board.

Smoothness Test

To reproduce half tones, the paper surface must be smooth. Smoothness may be imparted by calendering (i.e. rolling) the paper surface or by coating it with a mineral such as china clay, and then calendering. To obtain the required smoothness, a greater percentage of short-fibred stock may be incorporated into the pulp furnish.
This test is performed on L&W Bond Strength Tester , the units of smoothness are ml/ min.

IGT Test

This test is used to determine the speed or load of the machine, i.e. what max load / speed at which machine can be run , in

packaging department for printing jobs. It is measured in cm/ sec.

Melt Flow rate Test
This test is performed to measure the melt flow in flexible packaging.

Techi, Bright MICRO TB-1C Test
This test is again used to measure yellowness , brightness and whitness of the paper/board.

Box Compression Test
This test is carried out to determine the over all stiffness of the board.