2025

CHEMISTRY

PROJECT

STUDY OF MANUFACTURE OF CEMENT AND PAPER

TILOTTAMA SECONDARY SCHOOL

I Tilottama-6 I Rupandehi I

I Nikit Shrestha I 12 I H I

RECOMMENDATION

This is to certify that the report entitled "***STUDY OF MANUFACTURE ANDCEMENT AND PAPER***" has been carried out by ***NIKIT SHRESTHA*** for the partial fulfillment of practical examination of Chemistry of Grade XII. This document involves detailed study of manufacture of ***CEMENT*** and ***PAPER*** showcasing the student's throughout understanding of subject matter. This report has not been submitted elsewhere for any other academic practical examination. I therefore recommend this report work to be accepted for the practical fulfillment of degree of Grade XII.

SUPERVISOR
HIMAL ARYAL

Tilottama Secondary School

DECLARATION

I declare that the project work entitled " ***STUDY OF MANUFACTURE AND OF CEMENT AND PAPER***" submitted to the Department of Chemistry carried out under the supervision of Mr. ***Himal Aryal*** and all the rules followed are as follows:

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Name: Nikit Shrestha
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DEPARTMENT OF CHEMISTRY
TILOTTAMA SECONDARY SCHOOL
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CERTIFICATE OF APPROVAL

This is to certify that the report entitled "***STUDY OF MANUFACTURE OF CEMENT AND PAPER***" submitted by Mr./Mrs./Ms. ***NIKIT SHRESTHA*** has been accepted for the partial fulfillment of practical examination of Chemistry in Grade 12. This project work has not been submitted in any other school or institution previously for the award of Grade 12.

This certificate is issued upon the given project work.

Supervisor

Mr. Himal Adhikari

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CEMENT

LEARNING OUTCOMES

1. Introductuction to Cement
2. Manufacture of Cement in Industries
3. Types of Cement
4. Cement Industry in Nepal

INTRODUCTION

The basis of construction manufacturing lies in cement, with Joseph Aspdin of Leeds, Yorkshire, England playing a central role. He secured a revolutionary material derived from a synthetic blend of limestone and clay. However, the credit for initiation of modern Portland Cement goes to his son William Aspidin, who made advancements in 1840s.

Joseph

Cement is the binding material that is obtained by burning at about 1300-1450°C of calcareous, siliceous and argillaceous raw materials mixed in definite proportion and crushing and grinding the resulting clinkers to a fine powder. Cement is a product obtained by composing materials rich in CaO and clay which contain SiO_2 along with oxides of Al,Fe and Mg. The average composition of Portland Cement is CaO(50-60%), SiO_2(20-25%), Al_2O_3(5-10%), MgO(2-3%0, Fe_2O_3(1-2%), SO_3(1-2%) and K_2O.

For good quality cement, the ratio of % of silica and alumina should be 2.5 to 4 and ratio of % of lime to sum of % of silica, alumina & ferric oxide should be 1.9 to 2.2. Here, *the percentage composition of MgO shouldnot exceed than 6% otherwise the strength of the cement decreases slightly and the setting time is extented*.

Cement and water forms a paste that coats each particle of stone and sand as small aggregates through a chemical reaction called Hydration, the cement paste hardens and gains strength. Cement is used for production of ***Mortar*** & ***Concrete***. Mortar, utilized as a binding material in brick, tiles, block, and stone construction, comprises cement, fine sands, water & lime. Concrete, a strong structural building material consists of cement, air, sand, water and larger aggregates like gravel. It is a thick paste and hence has high bulk density.

Cement is essential in modern construction, used for building strong structures like houses, bridges, and roads. It plays a key role in infrastructure projects, ensuring durability and stability. With growing environmental concerns, eco-friendly cement alternatives are being developed to reduce carbon emissions while maintaining strength.

STUDY AREA

The Study Area for this project is **Hongshi-Shivam Cement Pvt. Ltd**. The cement plant is situated in Sardi, Nawalparasi District, approximately 12 kilometers southwest of ***Dumkibas in Nepal's Lumbini Province***. The facility spans an area of 66.7 hectares.

Hongshi-Shivam Cement Private Limited is a joint venture between China's Hongshi Cement and Nepal's Shivam Group. Established with a 70% stake held by Hongshi Cement and 30% by Shivam Holding Private Limited (a subsidiary of Shivam Cements Limited), the company operates ***Nepal's largest cement plant.***

Hongshi-Shivam Cement has significantly contributed to Nepal's economy by reducing reliance on imported cement and creating employment opportunities. The company employs over 400 local workers directly and has generated jobs for over 10,000 individuals, including peak construction employment and indirect employment.

Hongshi-Shivam Cement Pvt. Ltd.

RAW MATERIALS

Raw materials are obtained from limestone and clay mines, minor constituents like magnesia, sodium. potassium, sulphur, chlorine compounds, etc. may also present up to the limited extent without harming cement product. Typically, these raw materials are obtained from open-face quarries, but underground mines or dredging operations are also used. According to the 2004, Department of mines & geology report, Nepal has significant deposit of lime stone. Some of the major depositing area of limestone include Okhre (Makwanpur), Chovar (Kathmandu), Bhattedada (Lalitpur), Nirapani & Supakhola (Arghakhachi) Galtar (Udayapur), Diyarigad (Baitadi).The report showed that about 985 million tons of limestone deposit is available in Nepal.

Basic raw materials to manufacture cement are:

1. **Calcareous materials** (which supply lime):
For example, limestone, cement rock (a soft argillaceous limestone), chalk, clay/marl, or marine shales and, waste calcium carbonate from industrial process. It provides calcium oxide and contributes 85% of clinkers. Its excess amount cracks the cement on setting while its less amount than needed decreases the cement strength.

2. **Argillaceous materials** (which supply silica (SiO_2),aluminates (Al_2O_3), and iron oxides(Fe_2O_3)): For example, clay, shale, ashes, blast furnace slag, contribute <15% of clinker.

3. **Gypsum** ($CaSO_4.2H_2O$). It regulates the setting time of cement and is especially used for resulting receiving water content. It does not contribute in the clinker formation.

STEPS IN CEMENT PRODUCTION

1. **Mining and Extraction:**
Cement production starts with gathering raw materials like limestone, clay, shale, sand, and iron ore. These are dug out from quarries and crushed into smaller, manageable pieces. This step is crucial because the right mix of raw materials determines the quality of the final cement.

2. **Raw Material Preparation:**
After extraction, the crushed materials are carefully blended in specific proportions. This ensures consistency in the chemical composition, which is essential for strong and durable cement. Once mixed, they are ground into a fine powder known as **raw meal,** a crucial ingredient for the next stage.

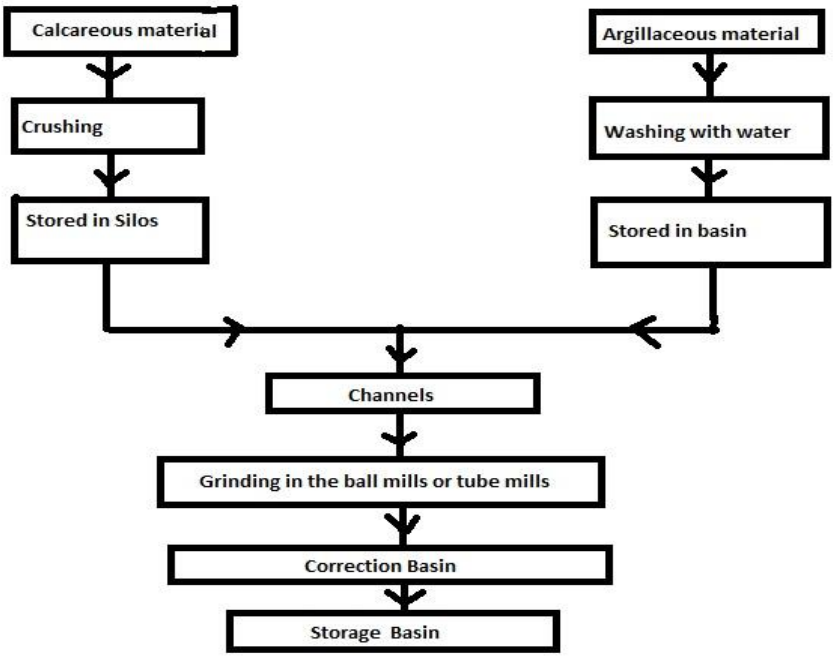
3. **Preheating and Precalcination:**
The raw meal is fed into a **preheater tower**, a series of tall, vertical cyclones where it is exposed to hot gases. As it moves downward through the tower, the temperature gradually increases, removing moisture and beginning the early chemical changes required for cement formation. This step is essential because it prepares the raw meal for the extreme heat of the kiln while also making the process more energy efficient. In some modern cement plants, a **precalciner** is also used at this stage, where additional fuel is burned to further assist in the decomposition of raw materials before they enter the kiln.

4. **Clinker Formation (Pyroprocessing)**:
Now comes the most critical and intense part of cement production. The preheated raw meal enters a **rotary kiln**, a massive, rotating, cylindrical furnace that can be over **60 meters long**. Inside, temperatures reach **1400-1500°C**, enough to completely transform the raw meal. At this heat, a complex series of chemical reactions take place, creating small, marble-sized gray nodules known as **clinker**. These nodules are the heart of cement. The extreme heat inside the kiln ensures the proper formation of minerals like alite, which give cement its strength. Once the clinker forms, it moves toward the cooler end of the kiln, ready for the next phase.

5. **Cooling and Storage:**
After being exposed to such high temperatures, the newly formed clinker needs to be cooled rapidly to preserve its quality and structure. This happens in a **cooling chamber**, where powerful air jets blow over the clinker, reducing its temperature from over 1400°C to around 100°C. Rapid cooling is essential because it prevents the formation of unwanted chemical compounds that could weaken the cement. Additionally, the heat extracted during this process is often recycled back into the system, improving energy efficiency. Once cooled, the clinker is transported via conveyors or bucket elevators to large silos or storage facilities. Here, it is kept until it is ready for the final grinding process.

6. **Grinding and Mixing:**
The clinker alone isn't cement yet—it still needs to be finely ground and mixed with other materials. It is sent through a grinding mill, where it is crushed into an extremely fine powder. At this stage, a small amount of **gypsum** (**5-7%**) is added. This might seem minor, but gypsum plays a key role in controlling how fast cement sets once mixed with water. Without it, cement would harden too quickly, making it difficult to work with. In addition to gypsum, other additives may be blended in, depending on the type of cement being produced.

7. **Packaging and Distribution:**
The final cement powder is packed in bags or transported in bulk to suppliers and construction sites. From here, it will be used to build roads, bridges, and buildings, forming the backbone of modern infrastructure



Flowchart for manufacture of Cement

TYPES OF CEMENT

Cement is categorized in terms of component, strength, heat generation, the percentage of several components, durability, grades, cost, eco-friendly nature, application, setting time, curing period etc.

1. Ordinary Portland Cement(OPC):
It is the most common cement used in the world because of its abundance, less time to set and harden and its low cost of production. A mixture of limestone and raw materials like argillaceous, gypsum is prepared then grinded to prepare OPC. The OPC cement is further classified into three grades.Some characteristics of OPC cement are:

i) It is less durable in aggressive whether.
ii) It has lower resistance against alkalis, sulphates and chlorides.
iii) The emmision of CO_2 occurs during manufacturing process.
iv) *The hydration process is fast resulting in the high heat of hydration and is unsuitable for mass concerning.*
v) It is suitable where fast construction is required but now suitable for mass concrete as more heat is generated in a hydration reaction.

The classification of OPC cement are as follows:
A) 33 grade:
A 33 grade OPC cement refers to a type of cement which can withstand 33N of force per unit 1mm2 of pressure after 28 days of curing. This cement is generally used for general constructions like plastering, flooring etc. It is not used for construction of bridges, road etc. since it is not quite strong and powerful.
B) 43 grade:
A 43 grade OPC cement refers to a type of cement which can withstand 43N force per unit 1mm2 of pressure after 28 days of curing. This cement is used in many constructions like bridge, house, residential buildings etc. It is more durable than 33 grade OPC cement.

C) 53 grade:
A 53 grade OPC cement refers to a type of cement which can withstand 53N force per unit 1mm2 of pressure after 28 days of curing. It is high quality cement which is used in constructive projects that require high-strength concrete. It is the most expensive cement among OPC cement.

2. Pozzolana Portland Cement(PPC):
It is a variant of ordinary portland cement obtained by adding gypsum, pozzolanic material such as fly ash, calcinated clay and volcanic ash to the OPC clinker. *Pozzolana materials are added to cement in ratio 15-35% by weight to improve the strength and durability of cement and even reduces the cost of concrete production and reduces the amount of OPC used in concrete*. Some characteristics of PPC are:

i) It is cheaper and has low setting time compared to PPC but hardens over period with proper curing.
ii) *It is available in one grade and its strength matches the strength of 33 grade OPC after curing.*
iii) It has slow hydration process & generates less heat than OPC resulting low heat of hydration.
iv) PPC uses natural and industrial wastes thus helps in reducing environmental pollution.

3. White Cement:
White cement is prepared from raw materials free from iron oxide and is similar to portland cement except for its white colour. It is more expensive and used for architectural purpose.

4. Hydraulic Cement:
It is the cement that hardens by the chemical reaction between anhydrous cement powder with water. Hydraulic cement is made of limestone, clay & gypsum. It is suitable to work with in any climatic conditions in modern day construction. The most widely used hydraulic cement is portland cement.It is used in numerous applications like concrete, mortar in masonry, swimming pools, marine construction, foundations etc.

5. Non-Hydraulic Cement:

It is the cement that hardens by carbonation reaaction with carbondioxide from air in dry condition. Nonhydraulic cement is composed of lime, gypsum plaster & oxychloride. Nonhydraulic cement should be kept dry to attain strength by reacting CaO with CO_2. Nonhydraulic cement is not used frequently due to the long duration time taken for setting of cement.

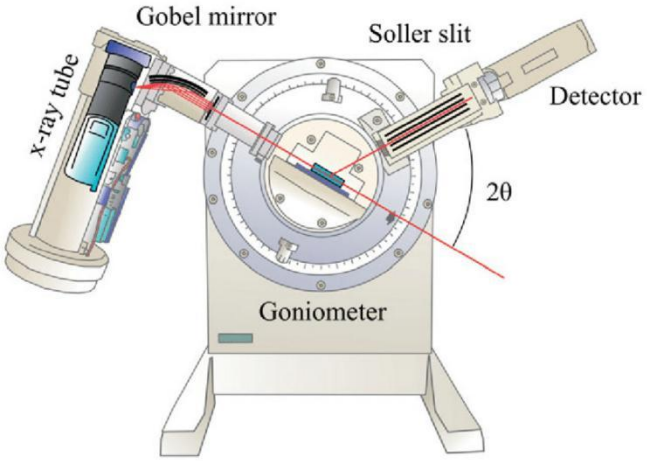
No.	Sources	OPC	PPC
1	Definition/ Components	A mixture of limestone and other raw materials like argillaceous, calcareous, gypsum is prepared and then ground to prepare OPC.	PPC is prepared by adding Pozzolanic materials to OPC. So, the main components are OPC clinker, gypsum, and pozzolanic materials (15~35%) which include calcined clay, volcanic ash, fly ash, or silica fumes.
2	Strength	Initial strength is higher than PPC.	PPC has higher strength than OPC over a longer period of time.
3	Heat of hydration	Generates more heat than PPC in hydration reaction which makes it less suitable for mass casting.	It has a slow hydration process and thus generates less heat than OPC.
4	Durability	Less durable in aggressive weather.	More durable in aggressive weather.
5	Cost	Costlier than PPC.	Cheaper than OPC.
6	Environmental Impact	Emits CO_2 during the manufacturing process.	It constitutes industrial and natural waste which makes it eco-friendly.
7	Application/ uses	It is suitable where fast construction is required but not suitable for mass concreting due to heat issues as mentioned above.	It is suitable for all types of construction work. For example RCC casting of buildings, mass concreting for bridges.
8	Setting Time	Lower than PPC. Its initial setting time is 30 minutes and the final setting time is 280 minutes. Its faster setting time helps faster construction.	The setting time of PPC is higher than OPC. Its initial setting time is 30 minutes and the final setting time is 600 minutes. Its slower setting time helps to get better finishing.
9	Fineness	OPC has finiteness of 225 sq.m/kg. It has lower fineness than PPC. So, it has higher permeability resulting in lower durability.	OPC has finiteness of 300 sq.m/kg. It has higher fineness than OPC. So, it has lower permeability resulting in higher durability.
10	Grades available	33 Grade, 43 Grade, and 53 Grade OPC cement are available.	No specified grade of PPC cement is available.
11	Workability	Lower than PPC.	Higher than OPC.
12	Resistance against chemical attack	It has lower resistance against alkalis, sulfates, chlorides, etc.	It has higher resistance against alkalis, sulfates, chlorides, etc.

Diffrences between OPC and PPC

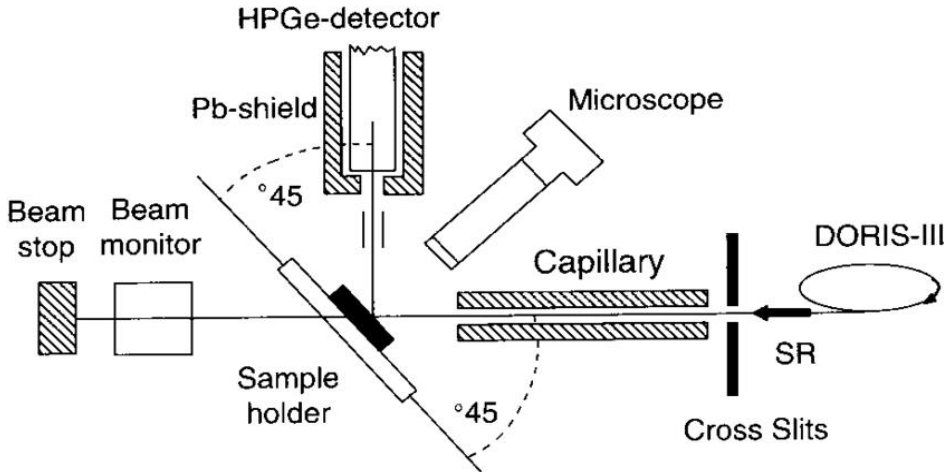
QUALITY OF CEMENT

In production of cement, the function of CaO is to provide high water retention in cement while Fe_2O_3 in cement is to increase the strength of cement and gives colour to the cement. Moreover, Al_2O_3 lowers the clinkering temprature and imparts quick setting property to the cement.

In order to maintain a constant product quality, each of the various step like analysis of revelant elements(silicon and calcium, iron and sulphur) in the raw materials, intermidiate process products and the final product are checked with analyzing tools and techniques. ***X-ray floroscence(XRF)*** spectrometer, flame photometer & ***X-ray diffraction(XRD)*** spectrometer instrumentation can provide complete quality control of clinker and cement. In curing cement plaster, water is sprinkled from time to time. It helps in devloping interlocking needle like crystals of hydrated silicas.



X-Ray Diffraction Spectrometer



X-Ray Floroscence Spectrometer

CEMENT INDUSTRY IN NEPAL

The cement industry is one of the most important industries for infrastructure development. In Nepal, cement was used in the 1950s. At that time, cement was imported from India, China, Korea & many other countries. The commercial import of cement was started from 1970s from China. Himal cement company Ltd. was the first cement plant established in 1975A.D. had a production rate of 160 tons per day but it was later shutdown in 2002 due to environmental cause. After this Heauda cement industry Ltd. & Udayapur cement industry Ltd. were established in 1976A.D. & 1987A.D. respectively. After the closure of Himal cement industry in 2002, only two government owned cement industries are currently in operation. Nepal's domestic cement productions are OPC & PPC, out of which OPC is widely used. Hongshi-Shivam Cement Private Limited, a Nepal-China joint venture company (2018A.D.) is the largest cement factory in Nepal with a daily production capacity of 6,000 tons. Recently, Nepal has more than 42 cement industries in operation, including 2 government owned industries. Among these, 15 industries are self-clinker producing and rests are based on imported clinkers.

Hongshi-Shivam Cement Pvt. Ltd.

PAPER AND PULP

LERNING OUTCOMES

1. Introduction to Paper
2. Manufacture of Paper in Industry
3. Quality of Paper
4. Paper Production in Nepal

INTRODUCTION

Paper was invented in China around 105 CE by Cai Lun, using materials like mulberry bark, hemp, and rags. It spread to the Middle East after the Battle of Talas (751 CE) and reached Europe by the 1100s through Spain. The printing press (1440 CE) boosted paper demand, and by the 19th century, wood pulp replaced rags, making paper production cheaper. Today, paper remains essential despite digital alternatives, with modern efforts focusing on sustainability and recycling.

Cai Lun

Paper is a thin sheet material obtained from the pulp of wood or other fibrous substances, used for writing, drawing, or printing on, or as wrapping material. It is made of cellulose and unwanted extractable forms like waxes, resins contained in wood are removed during pulping process but hemicellulose is required for fiber-to-fiber bonding in papermaking.

Pulp is commercial fibrous material obtained from raw materials like bamboo, wood and bagasse etc. used to manufacture paper by paper pulping process like mechanical and chemical method. The process of producing pulp from raw materials is called ***Pulping***. Pulp refers to a suspension of cellulose fibers In water and is the raw material for producing paper, board and other cellulose derivatives.

Paper and Pulp products have many uses, including writing, printing, filter paper, wall paper, currency, and security paper, conservation paper, laminated worktops, toilet tissues and manymore industrial and construction processes. Before the invention of paper, various materials like clay tablets, papyrus, parchment & vellum bamboo strips, wax tablets, birch bark & silk fabric were used for writing purpose.

Cai Lun invented paper around 105 CE by mixing mulberry bark, hemp, rags, and water into a pulp. He pressed, drained, and dried the mixture into thin sheets, creating a durable writing surface. This method improved earlier materials like papyrus and became the foundation of modern papermaking.

RAW MATERIALS

Papermaking process requires pulp as major raw material and other chemical to increase the brightness, stability as well as resistance property and some chemicals are added to remove impurities from paper. Broadly, raw materials required for paper are of two types:

1. **Fibrous Raw Materials:**

Wood & non-wood pulp are sources of fibres and is used in major quantity for papermaking. Hardwood trees(elm, khayar, poplar, maple, rubber plant wood, eucalyptus etc) and softwood coniferous and non-coniferous trees(pine, fir, cypress, hemlock, larch etc) are sources of fibrous raw materials.

A. Paper Pulp: Groundwood, bleached and unbleached pulp.
B. Reuse Pulp: Newspaper, paperbound, waxpaper, and plastic paper.
C. Cellulose Pulp: Straw from rice, what, barley, reeds, panni, bamboo, stalk, baggase, jute etc.
D. Speciality Pulp: Inorganic Fibres like glass and asbestos.

2. Non-fibrous Raw Materials:

Chemicals used for pulping, bleaching, filtering, sizing, fillering and coating of paper are involved in such raw materials.

A. Inorganic raw materials: Na_2S, NaOH, Na_2SO_3, ZnS, $Mg(OH)_2$, $CaCO_3$, TiO_2, H_2O_2 etc.
B. Organic raw materilas: wax, starch, dyes, glycerol, rosin etc.

Raw Materials for Paper Production

STAGES OF PAPER PRODUCTION

1.Timbering: The quality of paper is influenced by the quality of the timber used. Timber is sourced from well-managed forests where sustainable practices, such as replanting trees, are implemented.

2.De-barking: This process involves removing the bark from logs using methods like knives, drums, abrasion, or hydraulic barkers. The stripped bark can be repurposed as fuel or for soil enrichment.

3.Chipping: Once the logs have been de-barked, they are sent through chipping machines. These machines cut the logs into small, uniformly sized chips, typically around 20mm in length. The uniform size of the chips is crucial because it ensures even processing in the subsequent pulping stage. If the chips are too large, they may not break down properly, while overly small chips may be lost during the process. The chipping is done using rotating drum chippers or disc chippers, which use high-speed blades to slice the wood into precise sizes. The chipped wood is then stored in silos or bins before being sent for pulping.

4.Pulping: The chipping process prepares the wood for pulping, which is the most critical stage in paper production. Pulping involves breaking down the wood chips into a fibrous slurry, separating cellulose fibers from lignin and other unwanted components. There are three primary methods of pulping:

A. Mechanical Pulping: This method physically grinds the wood chips using rotating stones or steel discs. It is commonly used for producing newsprint and lower-grade paper since it retains most of the wood components, resulting in lower durability and yellowing over time.

B. Chemical Pulping: In this method, wood chips are cooked in chemical solutions to dissolve lignin while preserving cellulose fibers. Two major chemical pulping processes exist:

A.Kraft Process: Uses sodium hydroxide (NaOH) and sodium sulfide (Na_2S) to break down lignin. It produces strong, high-quality paper with minimal damage to cellulose fibers.

B.Sulfite Process: Uses sulfurous acid (H_2SO_3) and its salts to remove lignin. This process results in softer pulp and is often used for fine-quality writing paper.

C.Semi-Chemical Pulping: A combination of mechanical and chemical methods. The wood chips are first treated with chemicals to soften the fibers and then mechanically refined to produce pulp.

After pulping, the resulting mixture contains a combination of fibers, chemicals, and residual wood components, requiring further purification.

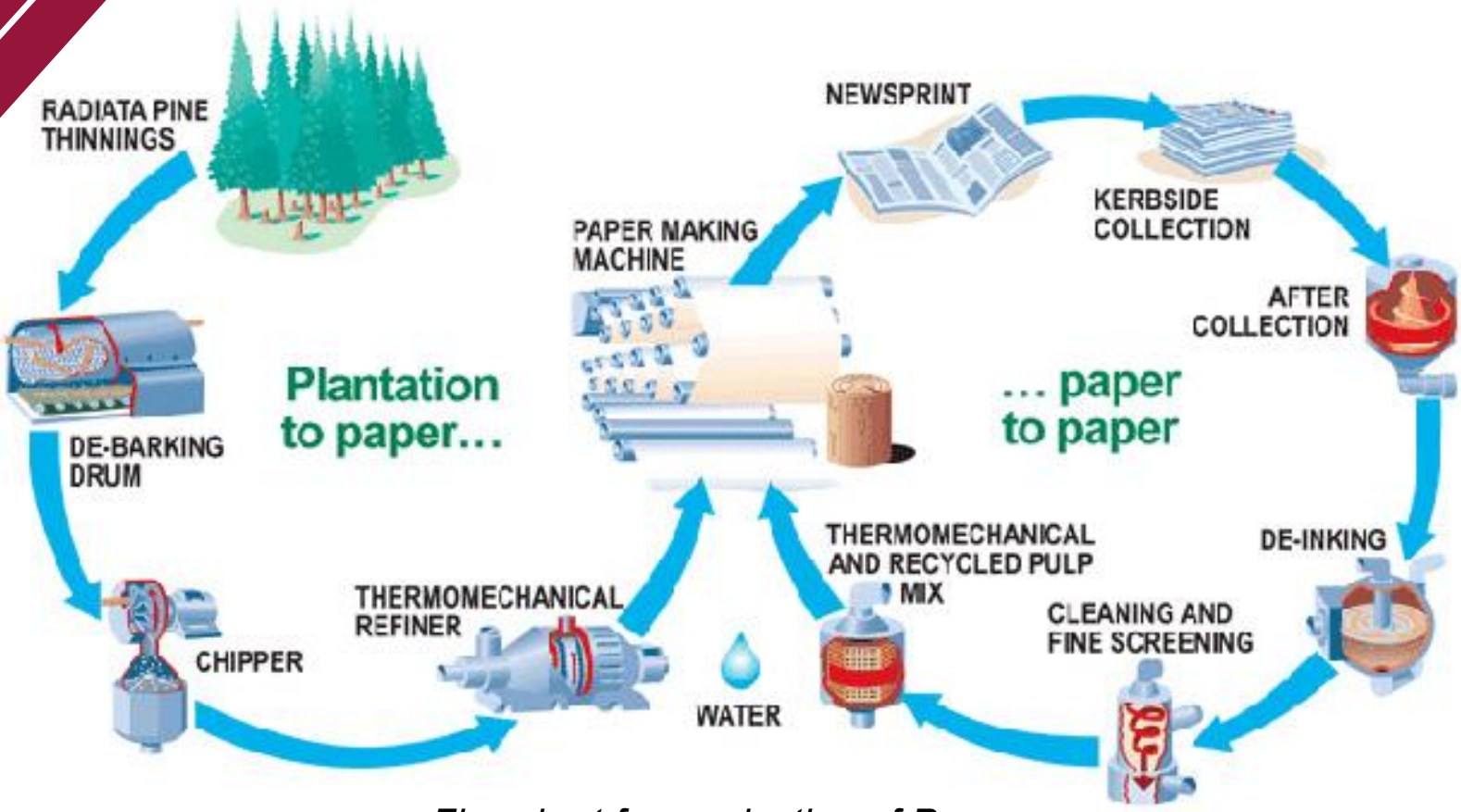
5.Screening and Cleaning:
After pulping, the fiber mixture is screened to remove oversized particles, knots, and undigested wood fragments. The pulp is then passed through fine mesh screens and centrifugal cleaners that use the difference in density to separate unwanted materials like dirt, sand, and residual bark. This ensures that only pure cellulose fibers remain in the mixture.

A.Screening: The pulp is passed through vibrating screens, pressure screens, and centrifugal screens to filter out large particles and clumps.

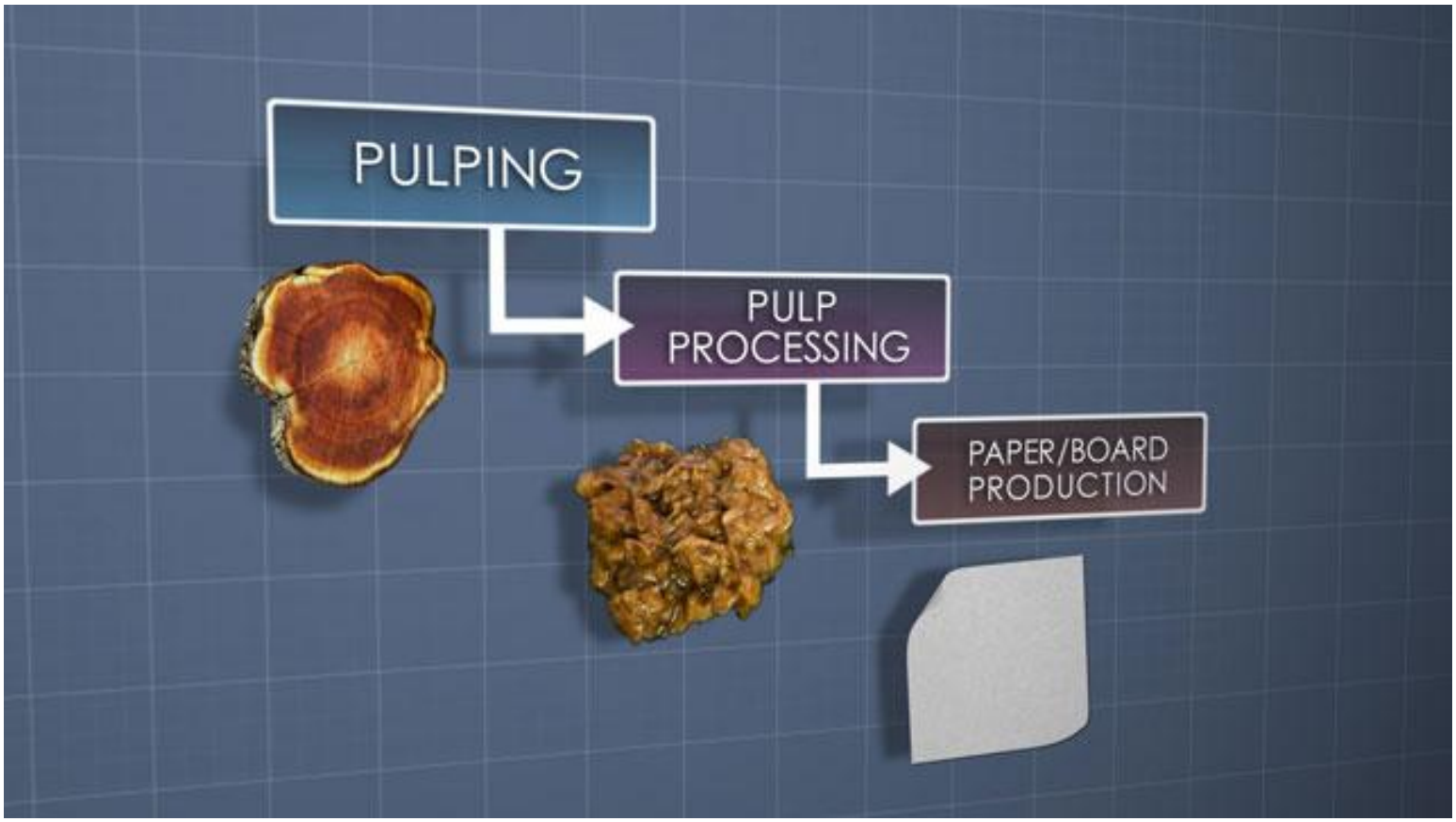
B.Cleaning: Centrifugal cleaners remove heavier impurities such as sand and metal fragments. The pulp is also washed thoroughly to remove chemical residues from the previous pulping process.

6.Refining:
The cleaned pulp is beaten and refined to improve fiber bonding, which enhances the paper's strength, flexibility, and overall quality. Refining also affects the paper's texture and surface properties.

7.Drying and Finishing:
After refining, the pulp is pressed, dried, and subjected to finishing processes such as sizing, coating, and calendering to produce paper suitable for various applications.



Flowchart for production of Paper



Basic Idea of Paper Production

QUALITY OF PAPER

The raw material & quality composition, nature of pulp and process of paper formation with finishing & converting process determines the quality of paper. Following are some paper charactertistics considered.

1. **Appearance:**
Appearance of Paper determines the quality of papers. Typically, coated papers have better appearance than uncoated paper. Papers can be coated in a variety of materials from, thick shining gloss to dull matte.

2. **Raw Material Composition:**
The raw materials composition determines to a large extent the quality of paper. Both appearance & strength of paper depend largely on the quality of the raw material used.

3. **Surface Finish:**
The surface chatracteristics of paper like glossy, matter determines the paper qulity.

4. **Sizing:**
Sizing is the process of adding material to the paper to render the sheet more resistance to penetration by fluids, particularly by water. Sizing is especially improtant for writing and drawing papers, but also for other paper grades.

5. **Clarity, Opacity & transparency:**
Clarity indicates whether the paper is coarsely ground or finely ground. On the one hand, opacity is related to paper thickness and a high filling agent content has a direct effect on paper characteristic. Transparency is an undesirable characteristic for many paper qualities, with the exception, however, of tracing paper or paper for detailed drawings.
The raw materials composition determines to a large extent the Clarity, Opacity and Transparency of Paper.

6. Weight & dimensions of paper:

The weight of paper is described in grammes per square metre (gsm), commonly called Grammages. Up to 200gsm are considered to be papers & >200 gsm are paperboard or low-quality board. For examples, 10gsm:tissue paper,75-90gsm:notebooks, photocopy paper, 90-100gsm:for printing, 120-140:posters, 150-170gsm:tickets,booklets,350-450 gsm: busines cards & invitation cards. Typical office paper is a typical A4 sheet used for printing and photocopy has weight of 80 g/m2.

Typically, a "paper weight" directly relates to the thickness and stiffness of the paper. More the weight of paper, better will be its quality. A paper is available in various size as A0,A1,A2,A3,A4,A5 and so on.A3 papers are used for charts and posters and A5 is used for planners and books, etc.

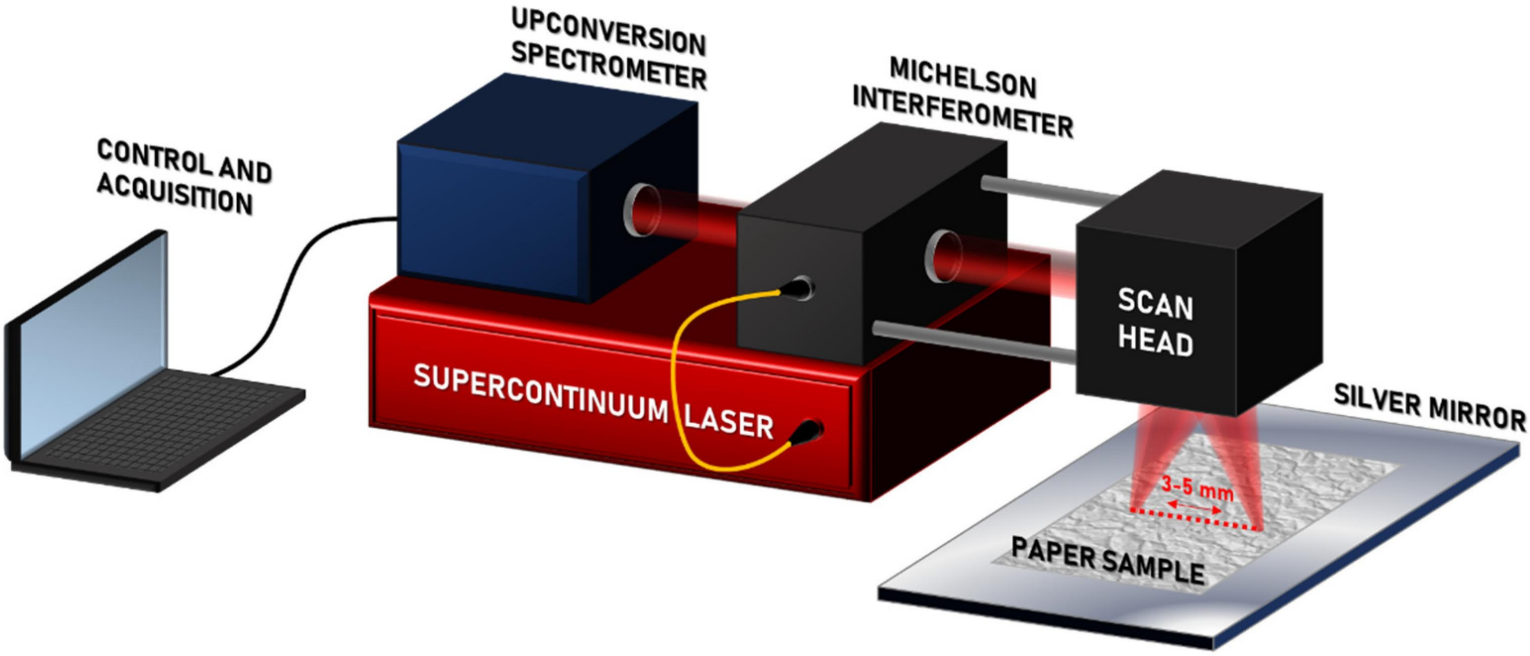
7. Strength and longevity:

Based up on the application of paper, different testing methods are used to determine its strength, such as breaking strength, tensile strength, breaking length, elongation, tearing strength, folding resistance, and stiffness.Nepali handmade lokta paper has high tensile strength and bending resistance. Hand made paper is stronger than machine made and are used for artistic purposes whereas later one are used for writing, newspaper etc.

Wood free paper have greater strength than wood containing paper and are preferred for greater longevity. These are the important properties of paper, but the requirements may vary based on the printing process. Paper stored in slightly humid conditions starts to smell musty due to microbes. Stains and holes are visible. This process has caused many books & works of art to become lost beyond repair.

QUALITY CONTROL OF PAPER

A frequently employed tool for paper quality control is the spectrophotometer, which assesses and analyzes the color & optical characteristics of paper, encompassing attributes such as brightness, whiteness, opacity, and color consistency. Additionally, industry-specific quality control purposes utilize instruments like densitometers, gloss meters, and roughness testers.



Quality Analysis of Paper

Glossmeter

Densitometer

PAPER INDUSTRY IN NEPAL

Paper and paper industry is the forest-based industry, and it has been completed its four decades of production in Nepal. The Cottage Industry Department of Nepal reports 377 registered handmade paper production industries. There are 46 paper and pulp industries operating in Nepal and majority of them are handmade units & 7 of them are mechanized pulp and paper mills. Bhrikuti pulp and paper Nepal limited was the first paper company in Nepal and was established in Gaidakot, Nawalparasi (in 1985) with support from the People's Republic of China. In 2011, Bhrikuti pulp and paper Nepal limited was closed permanently. Everest Paper Mills Pvt. Ltd. located in Janakpur (in 1982) is manufacturing various grades of writing and printing paper in Nepal. This industry is anD agricultural residue-based mill that uses various combinations of wheat straw, rice straw, bagasse, jute and wastepaper as raw material. As of now, the operating capacity of the plant is 30 metric tons per day. Reliance Paper Mills located in Bhairahawa has Nepal's biggest integrated paper manufacturing plant which produces crafts and papers. There is big market of paper in Nepal. However, most of the paper are imported from India, China, Indonesia, United Arab Emirates, Bangladesh etc. Paper is mainly used in making newspapers, books, cartons, bags, cards, etc. Mahaguthi Limited in Lalitpur has been producing paper albums, cards and notebooks since 1984 and exporting these items to several countries for more than 25 years.

Lokta paper (Nepali Kagaj) is a wild crafted, handmade artisan paper indigenous to Nepal Nepalese handmade lokta paper is made from the fibrous inner bark of wild shrub locally known as lokta (Daphne bholua & Daphne papyracea). Lokta bushes grow naturally in most coniferous forest in Nepal at an altitude of 2000 to 4,000m. Historically the handcrafting of lokta paper occurred in the rural areas of Nepal, most notably in the Baglung District. Today raw lokta paper is produced in more than 22 districts in Nepal but finished lokta paper products are produced only in Kathmandu Valley & Janakpur. Lokta paper's durability and resistance to tearing, humidity, insects and mildew have traditionally made lokta paper the preferred choice for the recording of official government records and sacred religious texts. Moreover, it is also used in book bindings, wrapping papers, and packaging. Lokta papermaking is cost effective, ecofriendly and resistance to humidity.

CONCLUSION

This project work on the study of "***STUDY OF MANUFACTURE OF CEMENT AND PAPER***" has been completed successfully. The overall study of manufacture of Cement and Paper in ***Hongshi-Shivam Cement Industry*** was very exciting and interesting. The proper management of those large equipment for cement was done perfectly by the employees in the factory.

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