CHM 215

Paint Production

Paint production is the process of combining raw materials like pigments, resins (binders), solvents, and additives to create a finished coating. This is a material transformation process involving steps such as premixing, grinding pigments, and blending, with the goal of achieving a specific color, texture, and performance property. The final product can be broadly categorized into two main types: oil-based and water-based paints.

Key components of paint

- **Resin (Binder):**

  Acts as the "glue" that holds the paint together and adheres it to a surface.

- **Pigments:**

  Provide color and can also regulate gloss and provide opacity.

- **Solvents:**

  Act as a carrier to keep the other components in a liquid state, which then evaporate as the paint dries.

- **Additives:**
  Modify the paint's properties, such as its drying time, durability, and resistance to cracking or scuffing.

The production process

Premixing:

Raw materials like pigments, resins, and solvents are combined in the initial stages.

Pigment Grinding/Dispersion:

A critical step where pigments are broken down into smaller particles and evenly dispersed throughout the mixture. This process is essential for achieving the correct color and finish.

Blending:

After grinding, the dispersed pigments are combined with the rest of the components (resin, solvent, additives) to form the final paint solution.

Finishing:

The paint is thinned, tinted, and blended to achieve the final specifications. Quality control checks are performed, and the fineness of the pigment is measured.

Filling and Packaging:

The finished paint is sieved and filled into containers, labeled, and prepared for shipping.

Paper pulp manufacturers separate fibers and clean them, which leads to refining, dilution, fiber formation, and other steps. Paper and pulp, thus, get created from plant materials such as cellulosic fibers. Sometimes, a few synthetic materials are incorporated into the final product to impart some unique qualities.

Raw material preparation

Wood reaches to a pulp manufacturing factory in many forms. The source of raw materials and its pulping process changes. Sometimes, the raw material contains short round wood logs attached to the bark. Other times, factories receive small chips in large quantities.

Depending on the condition of the raw material, professionals prepare it for pulping. Round-wood logs get debarked with the use of huge tumbling steel drums. Then, they get turned into small-sized chips, which get cleaned and stored for a while.

Fiber separation

This stage involves a number of pulping technologies. High-temperature steam is used for fiber separation. This is called the digestion of chips. A digester or huge pressure cooker is used with appropriate chemicals to complete the process of chemical pulping. The digestion process allows wood chips to dissolve partially into various extractives including lignin.

After this, the pulp is transferred to a specially designed pressure vessel, where all the volatile materials and steam get separated. Then, the cooked pulp reaches the cycle of chemical recovery once again.

There is a mechanical procedure of separating fibers as well. The debarked logs go through a rotating wheel made of stone that grinds the wood. The pulp goes through thermos-mechanical refining, screening, cleaning, and water removal.

Bleaching

After fiber separation, the pulp contains several discoloration materials. Hence, bleaching is necessary to acquire the white, clean appeal. This process involves oxidation and chlorination of cellulose. The chemicals used in bleaching include chlorine gas, chlorine dioxide, hydrogen peroxide, sodium hypochlorite, and oxygen as well.

Sodium hydroxide is a pretty strong alkali chemical compound that helps in the dissolution of lignin discoloration from the surface of fibers. The type of bleaching agents used and their sequence in the process depend on various factors like the cost of chemicals, type of pulp and discoloration condition.

Mechanical pulp requires a different type of bleaching than chemical pulp. The bleaching process used for mechanical pulp ensures lignin removal minimization that would decrease fiber yields.

Chemicals are selectively used in the bleaching process of mechanical pulps. That way, the chemicals selectively remove coloring impurities without impacting the presence of cellulosic materials and lignin. Such chemicals include zinc or sodium hydrosulfite, sodium bisulfite, sodium or hydrogen peroxide, sodium or calcium hypochlorite, as well as Sulfur Dioxide-Borol method.

Papermaking

Pulp and paper are made from cellulosic fibers and other plant materials. Some synthetic materials may be used to impart special qualities to the finished product. Paper is made from wood fibers, but rags, flax, cotton linters, and bagasse (sugar cane residues) are also used in some papers. Used paper is also recycled, and after purifying and sometimes deinking, it is often blended with virgin fibers and reformed again into paper. Products such as cellulose acetate, rayon, cellulose esters that are made from cellulose will be used for packaging films, explosives.

The unbleached or bleached pulp goes through more refining procedures to attain roughness on the surface of cellulosic fibers and cut them further. This process encourages bonding between fibers and improves the formation of collective structures. The process takes place in a papermaking machine.

A thin mix of pulp is created by adding water, which brings fiber concentration to one or lesser percentage. The slurry gets diluted, then, the cleaning process begins in the presence of cyclone cleaners. With that, the

cleaned slurry goes to the centrifugal screens for screening. This prepares the material for the wet-end of paper-forming machinery. The diluted, cleaned and screened stock goes through the head-box of the machine, which evenly and uniformly distributes the slurry as per the desired paper sheet size.

The pulping process is aimed at removing lignin without loosing fiber strength, thereby freeing the fibers and removing impurities that cause discoloration and possible future disintegration of the paper.

The procedure might differ here and there depending on the type of product required. For instance, the construction process of the **paper packaging board** might not need bleaching.
Hemicellulose plays an important role in fiber-to-fiber bonding in papermaking. It is similar to cellulose in composition and function. Several extractives such as waxes, oleoresins are contained in wood but they do not contribute to its strength properties; these too are removed during the pulping process.

The fiber extracted from any plant can be used for paper. However, the strength and quality of fiber, and other factors complicate the pulping process. In general, the softwoods (e.g., pines, firs, and spruces) yield long and strong fibers that contribute strength to paper and they are used for boxes and packaging.

Hardwoods produce a weaker paper as they contain shorter fibers. Softwoods are smoother, transparent, and better suited for printing. Softwoods and hardwoods are used for paper-making and are sometimes mixed to provide both strength and print ability to the finished product.

Paper is made through the following processes:

- Pulping procedure will be done to separate and clean the fibers
- Refining procedure will be followed after pulping processes
- Dilution process to form a thin fiber mixture
- Formation of fibers on a thin screened
- Pressurization to enhance the materials density
- Drying to eliminate the density of materials
- Finishing procedure to provide a suitable surface for usage

Steps involved in the Pulp and Papermaking Procedure:

Preparation of raw Material

Wood that has been received at a pulp mill can be in different forms. It depends on the pulping process and the origin of the raw material. It may be received as bolts (short logs) of round-wood with the bark still attached, as chips about the size of a half-dollar that may have been produced from sawmill from debarked round wood elsewhere.

If round wood is used, it is first debarked, usually by tumbling in large steel drums where wash water may be applied. Those debarked wood bolts are then chipped in a chipper if the pulping process calls for chemical digestion. Chips are then screened for size, cleaned, and temporarily stored for further processing.

Separation of Fiber

In the fiber separation stage, several pulping technologies will be diverged. The chips are kept into a large pressure cooker (digester), into which is added the appropriate chemicals in kraft chemical pulping.

The chips are then digested with steam at specific temperatures to separate the fibers and partially dissolve the lignin and other extractives. Some digesters operate continuously with a constant feed of chips (furnish) and liquor are charged intermittently and treat a batch at a time.

After the digestion process, the cooked pulp is discharged into a pressure vessel. Here the steam and volatile materials are tubed off. After that, this cooked pulp is returned to the chemical recovery cycle. Fiber separation in mechanical pulping is less dramatic.

Debarked logs are forced against rotating stone grinding wheels in the stone ground-wood procedure. Refiner pulp and thermo-mechanical pulp are produced by chips. These chips are ground by passing them through rapidly rotating in both processes.

In the second stage after refining, the pulp is screened, cleaned, and most of the process water is removed in preparation for paper making.

Bleaching Process

Raw pulp contains an appreciable amount of lignin and other discoloration, it must be bleached to produce light colored or white papers preferred for many products. The fibers are further delignified by solubilizing additional lignin from the cellulose through chlorination and oxidation. These include chlorine dioxide, chlorine gas, sodium hypochlorite, hydrogen perioxide, and oxygen.

Sodium Hydroxide, a strong alkali is used to extract the dissolved lignin from fibers surface. The bleaching agents and the sequence in which they are used depend on a number of factors, such as the relative cost of the bleaching chemicals, type and condition of the pulp.

Mechanical pulp bleaching varies from chemical pulp bleaching. Bleaching of mechanical pulp is designed to minimize the removal of the lignin that would reduce fiber yields.

Chemicals used for bleaching mechanical pulps selectively destroy coloring impurities but leave the lignin and cellulosic materials intact, These include sodium bisulfite, sodium or zinc hydrosulfite (no longer used in the United States), calcium or sodium hypochlorite, hydrogen or sodium peroxide, and the Sulfur Dioxide-Borol Process (a variation of the sodium hydrosulfite method).

Papermaking Procedure

Bleached or unbleached pulp may be further refined to cut the fibers and roughen the surface of the fibers to enhance formation and bonding of the fibers as they enter the paper machine.

Water is added to the pulp slurry to make a thin mixture normally containing less than 1 percent fiber. The dilute slurry is then cleaned in cyclone cleaners and screened in centrifugal screens before being fed into the ‘wet end’ of the paper-forming machine. The dilute stock passes through a head-box that distributes the fiber slurry uniformly over the width of the paper sheet to be formed.