Lecture No. (3)

Rubber Latex Processing Steps

Phases of Rubber Latex

The latex has two phases which includes:

1- The dispersed phase or discontinues phase consisting of small particles of polymers (particle size < 5 micrometer in diameter).
2- The continuous phase or (a dilute aqueous solution).

Gutta-Percha Rubber

The other source of natural rubber is gutta-percha. This type of rubber has all trans-1, 4- poly isoprene structure and has very different physical properties from natural rubber that obtained from hevea brasiliensis trees. Gutta-percha get off from plantations in Malaysia and used for golf balls, undersea cables, and this material choice for packing teeth in root.

Definition of Rubber Latex

In general the rubber latex consists of mixture of compounds make up from special structures called laticifers, which have many compositions for different types usually contains water, sugars, enzymes, etc.

In specially the latex is commonly defined as a stable colloidal dispersion of polymer in an aqueous medium (water) or in non-aqueous medium in which the polymer is insoluble in it. That is a white, milky fluid that is held in cells that found in the inner layers of the trees.

Classification of Rubber Latex

The latices can be classified into many types which include:

1- Natural latex obtains from the trees in plantations.
2- Synthetic latex produced from emulsion polymerization process.
3- Artificial latex produced by dispersing the appropriate bulk polymer in an aqueous dispersion medium.
4- Modified latex produced by modification of existing type of latex by (grafting, cross linking, etc).

Rubber Latex Properties

Natural rubber latex concentrates are highly specified materials and characterize by many properties that are includes:

1- Dry Rubber Content (DRC).

2- Total Solid Content (TSC).

3- Alkalinity.

4- Potassium Hydroxide (KOH) Content.

5- Mechanical Stability Time (MST).

6- Sludge Content.

The properties of the latex are of interest because of:

1- To gain understanding of the physical and chemical nature of the latex.

2- To determine the fitness of the latex for a particular applications.

3- To assure the general quality of the latex.

Rubber Latex Processing Steps

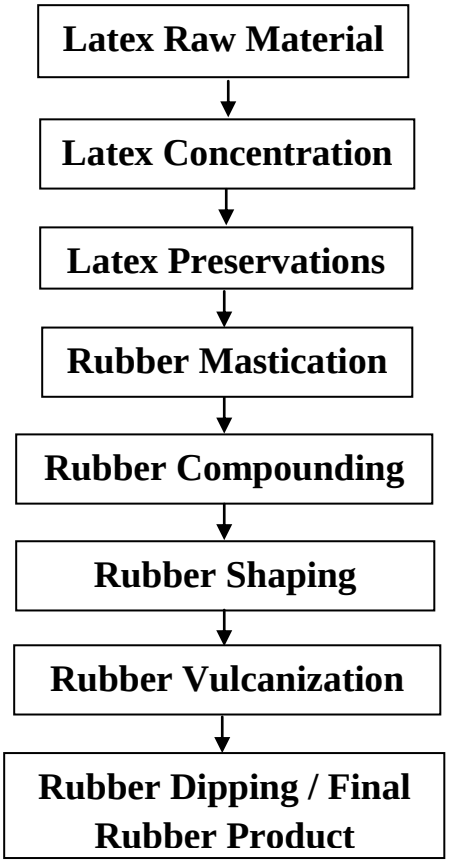

Figure (1): Rubber Latex Processing Diagram

Rubber Latex Tests

The test methods required to evaluate the latex properties includes:

1- Tests related to chemical composition.

2- Tests related to colloidal stability.

3- Tests related to physical properties.

Rubber Latex Concentration

The natural rubber (NR) latex obtained from the plantation is called fresh latex or field latex. The field latex contains about 33% NR, thus it is not economical to be used to make a latex products. The rubber content in the field latex need to be increased before it is used in making latex products. This is achieved by doing concentration process to the field latex. At result, that the natural rubber is sold as latex concentrate, when water is removed by many process to give stable latex concentrate and contains 60% or more of dry rubber. There are few methods that can be used to concentrate natural rubber latex:

1- Concentration by creaming.

2- Concentration by centrifugation.

3- Concentration by evaporation.

In this process, separate small pieces of rubber and collects in the form of large pieces, then being washed it with water, dried and rubber that we get it this way. The rubber latex large influenced by heat and technology processes such as (hardening to turn it into a proper shape).

Rubber Latex Preservations

Sometime the rubber latex susceptibility to bacterial attack, for this cases where rubber latex sensitive to bacterial activity, can be added disinfectant such as anti-rot and during filtration and storage the rubber latex in factories.

Therefore the preservation of latex is necessary to prevent micro-organism (bacterial) from attacking the non-rubber components of latex concentrated, because when the concentrated latex has lower colloidal stability and bad odor, when attacked by bacterial. After latex preservation can be uses

the latex in many applications such as (foam, carpet packing, thread and adhesives).

Concentrated latex is preserved for long-term storage. The most popular preservative is ammonia (NH_3) or sodium sulfide. There are two types' of ammonia preservation systems:

1- Low ammonia latex (LA latex): Added 0.2 % ammonia for short term preservation suitable for certain applications such as latex foam, that requires low ammonia content in order to gel properly,

2- High ammonia latex (HA latex): Added 0.6 - 0.8 % of ammonia, this process called secondary preservatives are added to low ammonia latex for long term preservation (storage).

Rubber Latex Compounding

Compounded latex is defining the process of addition chemical materials to the raw latex. Most chemical materials added to the latex in solid form, therefore these materials need to be dispersed in water first before added to the latex. The elastic properties are produced by mixing rubber latex with specific additives during rubber compounding.

The chemicals materials prepared by grinding them together and it is dispersing in water. The chemicals materials used in latex compounding can be divided into three general classifications:

1. Surface active agents (surfactants).
2. Liquid phase modifier.
3. Elastomer or rubber phase modifier.

Latex Compounding Formulation

General latex compounding formulation from:

Elastomer/ Raw latex	100
KOH	0.3
Sulphur	0.5
Zinc Oxide	0.25

Accelerator	0.75
Antioxidant	0.5
Fillers	15
Total	**117.3**

Note: Parts per hundred rubbers (pphr), all the ingredients used in a compound formulation are given in amounts based on a total of 100 parts of the rubber.

Rubber Latex Curing

Curing of latex define the process of introducing cross-links in the rubber molecules. The term vulcanization used to describe cross-linking process involving sulfur as cross-linking agent. Two types of vulcanization in latex:

1- Pre-vulcanization: when the vulcanization is done while the latex is still in liquid state.
2- Post-vulcanization: when the vulcanization is done on latex film.

Latex that has been pre-vulcanized latex (PVL) that referred to the pre-vulcanized natural rubber (PVNR). Appearance of PVNR is very similar to un-vulcanized natural rubber. Because of maintained fluidity, cross-linking only takes place in each individual particle and particles in PVNR have the same shape, size and size distribution as those in un-vulcanized latex.

Rubber Latex Dipping Process

Dipping process is used to make thin and hollow latex products such as gloves, catheters and toys, these products are called dipped products. In principle the dipping process involves dipping cleaned formers into the compounded latex. Latex film will be formed around the former and latex film product obtained by drying and curing (pre-vulcanized or post-vulcanized compound) the films. Latex dipping process can be classified into three methods:

1- Straight or simple dipping: when no stabilize agency is used to form the latex films.

2- Coagulant dipping: when colloid-rich viscous liquid phase that may separate from a colloidal solution by addition of a third component, that is used to promote latex film formation.

3- Heat-sensitized dipping: when a heat sensitizer is used to promote latex film formation.

Rubber Requirements

1- High molecular weight: rubber elasticity is due to the coiling/uncoiling of molecular chains.

2- Use temperature must be above glass transition temperature (Tg): to allow for molecular chains motion.

3- Amorphous in its un-stretched state: the crystals would hinder coiling/uncoiling of molecular chains.

4- Molecular chains tied together: to prevent flow of molecular chains, traditionally occur through crosslinking (hard domains) and entanglements (soft domains).