Industrial Internship Report

School of Chemistry

MIT World Peace University, Pune

For the

Degree in

M. Sc. Chemistry (Industrial Polymer Chemistry)

By

NUMADEVI MAROTRAO FALKE

S1132200693

Mentors

Mr. Biswajit Pal (External)

Mr. Biswanath Guria (External)

Dr. Vandana Mooss (Internal)

Trimester VI, 2022

ACKNOWLEDGEMENT

The Induction Trainee opportunity, I had with **ORIENTAL RUBBER INDUSTRIES PVT. LTD**. was a great chance for learning and professional development. Therefore, I consider myself as a very lucky individualas I was provided with an opportunity to be a part of it. I am also grateful for having a chance to meet so many wonderful people and professionals who led methough this induction period.

We would like to extend our sincere thanks to **MR. VIKRAM MAKAR**(CMD), **MR. VISHAL MAKAR** (MD) for giving us an opportunity to learn and carry out the trainee in **ORIENTAL RUBBER INDUSTRIES PVT. LTD**.

We are highly grateful to **MR. H. SINGH** (VP Works & Plant Head) & MR.**CHINMOY RAY** (Vice President: Technical & R&D) Ms. **AVANTIKA MARKAR** (HR Head & commercial), **MR. SOUMEN GHOSH** (Manager: QAD),**MR. BISWAJIT PAL** (Deputy Manager: QAD) for providing us this opportunity to carry out this induction training & to arrange our settlement and for taking care during the training period.

We would also like to thank for our QAD team members, for helpingme during this training period. And I would like to thank the entire team of ORIENTAL RUBBER.

I also thank those who have helped me directly or indirectly for the successful completion of this induction program.

CERTIFICATE

ORIENTAL RUBBER INDUSTRIES PVT. LTD.

QUALITY SYSTEM CERTIFICATION DNV·GL ISO 9001

ORIPL/PER/INTERN/2022-2023 **Date: March 15, 2022**

Ms. Numadevi Falke
Hudco Colony, Ward No 14,
Plot 260/261, Near Shiv Mandir,
Kalmeshwar, Nagpur.
Pin: 441 501.

Subject: Offer Letter for Internship

Dear Ma'am,

This refers to your application for Internship and the subsequent interviews which you had with us. We are pleased to offer you the position of **"Intern"** in our **"QAD"** department on the terms and conditions mutually discussed and agreed. You are required to join on or before **16.03.2022**. A detailed letter will be given to you at the time of joining.

During your period of internship at our Company, as a goodwill gesture we will be paying you a consolidated stipend of Rs. 7500/- P.M. and we will also pay you conveyance and other allowances of Rs. 2500/- P.M.

On behalf of Management and Staff of the company we extend you a hearty welcome and look forward to your joining.

We wish you all the best

Thanking you,

Yours faithfully,

for **ORIENTAL RUBBER INDUSTRIES PVT. LIMITED**

AVANTIKA MAKAR
PRESIDENT – OPERATIONS & HR.

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CIN - U25199PN1949PTC006875

CERTIFICATE

This is to certify that the work reported in this report as an intern at Oriental rubbers Pvt Ltd is being submitted to the School of Chemistry, Dr. Vishwanath Karad MIT World Peace University, Pune, as partial fulfillment of the requirement for the degree of Master of Science in Industrial Polymer Chemistry by ***Numadevi Falke*** is *carried out under our supervision at the School of Chemistry of Dr. Vishwanath Karad's MIT World Peace University, Pune during the academic year 2021-2022.*

Dr. Vandana Mooss (Internal)
Project mentor
School of Chemistry
MIT WPU, Pune

Prof. (Dr.) Vasi Shaikh
Program Head – MSc IPC
School of Chemistry
MIT WPU, Pune

DECLARATION

I, the undersigned Numadevi Falke declare that the work embodied in this report, forms my own contribution to the work carried out under the guidance of Mr. Biswajit Pal Oriental Rubber Pvt Ltd, Dr. Vandana A. Mooss , Department of Chemistry, Dr. Vishwanath Karad MIT World Peace University, Pune in partial fulfillment for the degree of Master of Science in Industrial Polymer Chemistry, is a result of my own work and has not been previously submitted to any other University for any other Degree/ Diploma to this or any other University.

I, hereby further declare that all information in this report is in accordance with academic rules and ethical conduct. This internship was carried out at the Oriental Rubber Pvt Ltd Karandi, Pune.

Place: Pune

Date: 10-06-2022

Name:
PRN No:
M.Sc. Chemistry (Industrial Polymer Chemistry
School of Chemistry, MIT World Peace University
Pune - 411038

INDUSTRY PROFILE

The oriental rubber industries Pvt. Ltd. was established in 1949, over theyears, it has developed the reputation of being a world-class manufacturerof conveyor belt and other specialized critical rubber products. They endeavor to comply with the ever-demanding needs of the customers in terms of product quality and technical support. They have responsive approach and spirit of constant innovation has led to a wide range of conveyor belts installed in several projects in India and abroad. Their belts cater to the critical requirements of material handling application in the steel, coal, cement, power, fertilizers, mining, aggregates, quarrying and food industries. They always strive to develop and introduce new products in the market and have supplemented and expanded range to become one stop shop for their customers. Oriental led by technocrats and professionally qualified personnel with rich experience in their area of functions, thus providing an ideal combination of man and machine. Oriental was the first to introduce synthetic fiber reinforced conveyor in India. Oriental has three plants, one is at Koregaon, another is at shikrapur100% EOU plant (both are in India) and another one in south Africa.

INDEX

1. Product range

S. No	Company Name	Purpose of Belt
1	MAXX TUFF	General Purpose Belts
2	MAXX AGNI	Fire resistance Belts
3	MAXX OLEO	Oil resistance
4	MAXX SURYA	Heat resistance
5	MAXX ELEV	Chevron Belts
6	MAXX POWERSAVE	Energy saving Belts
7	MAXX ROUND	Pipe conveyor Belts
8	MAXX ROCK	High impact and High tear resistance Belts
9	MAXX SHIELD	Cut Protection Belts
10	MAXX ARMOUR	Aramid Belts
11	MAXX IMPACT	High impact resistance Belts
12	MAXX STEEL FLEX	Steel cord Belts
13	DURO MAXX	Rubber sheets
14	MAXX ORB	Impact Bars
15	MAXX GRIP	Pulley Lagging
16	MAXX TRAK	Ceramic Pulley Lagging

2. Introduction

Conveyor belts transport materials from one location to another, either within the factory or from a remote location to the plant. It may also occur between countries in specific situations. Conveyor belt systems are a cost-effective solution to move things at a faster rate. There are three primary components to the conveyor belt system. Covers, carcass, and skim/bonder.

2.1 Carcass:

The "carcass" is the reinforcement that is commonly located on the interior of a conveyor belt. The carcass is, in a way, the conveyor belt's heart because it must:

1. Provide the necessary tensile strength to move the loaded belt
2. Absorb the impact of material impinging on the conveyor belt.
3. Provide the appropriate bulk and lateral stiffness for load support.
4. Provide sufficient strength for proper bolt and/or fastener retention.

The carcass is usually rated in terms of "maximum recommended operating tension" (in KN/m) by the manufacturer.

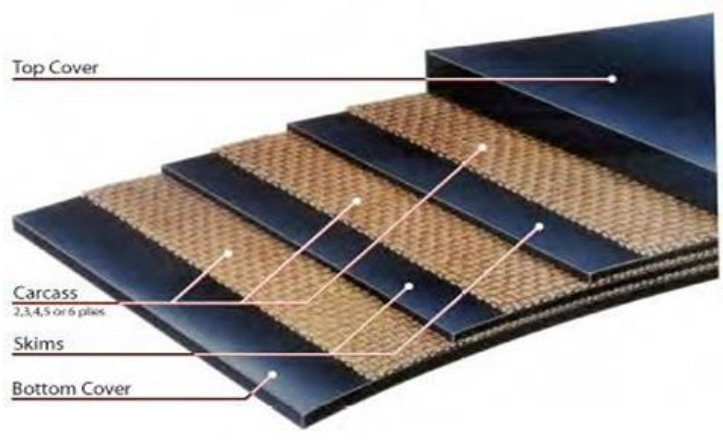


Figure 1. Belt description (Textile)

Figure 2. Belt description (Steel cord)

2.2 Skims or bonder:

For textile reinforced belts, the rubber between the plies is referred to as a skim, and for steel reinforced belts, it is referred to as a bonder. Skims have a crucial part in defining belt load support and trough ability, as well as contributing to internal belt adhesions and impact resistance. Belt performance can be harmed by improper or marginal skims, which can lead to ply separation and/or idler junction failure.

2.3 Covers:

Conveyor belt covers are used to protect and, if possible, extend the service life of the base conveyor belt carcass. Furthermore, covers give the finished belt several desirable characteristics, including the following:

- Textures

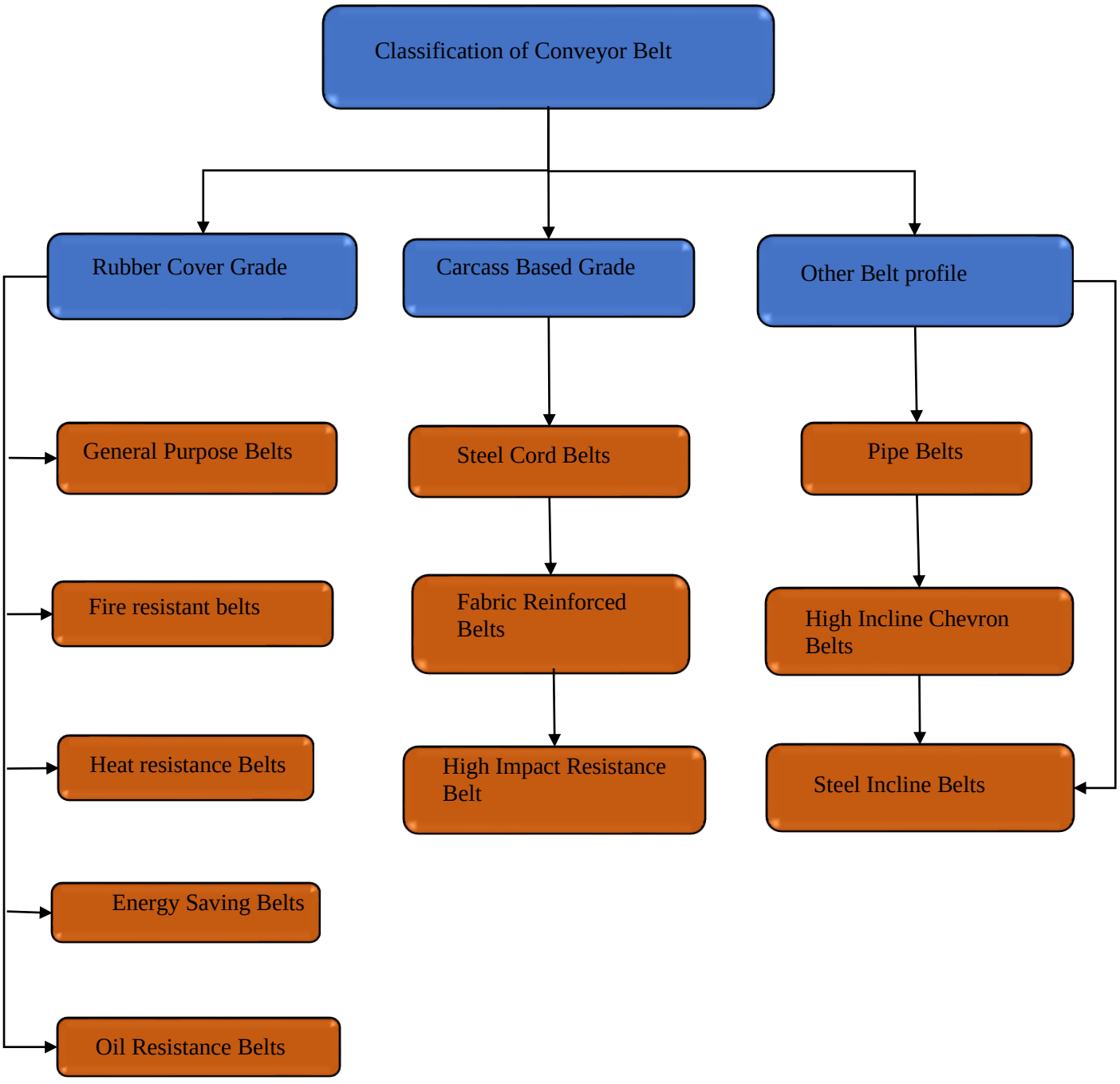
(A) To increase inclination

(B) To control product

- Cleanability
- Cut and Gough resistance
- Enhanced impact resistance
- Wear Resistance
- Fire retardance
- Oil & Chemical use
- Heat & Cold

The kind, quality, and thickness of the cover are selected to complement the belt's service life. The material to be conveyed and the environment in which the belt will work define the precise cover composition utilized in each belt construction. Because of the cotton carcass components, historic belt structures were especially sensitive to moisture and chemical attack As a result, the belt coverings were commonly extended over the belt's edges, a process known as molded edge construction Because of the added work and machine time required, this form of manufacturing can be costly. The belt edges are trimmed after manufacture in the cut edge construction; thus, a very wide belt can be easily split into smaller widths for rapid supply.

3.Classification of conveyor belt



4. Production (Processing)

4.1 Mixing

PPC provides monthly & daily plans in terms of target & code, followed by mixing station provides raw materials request plant to the raw materials store. The store sends the required quantity for raw materials to mix, followed by supervisorfrom mixing department verifies the raw materials as per plan. Then QA provide formulation cards as per mixing plan. The flow sequence of compound preparationis as follows:

PPC provides monthly and daily plans

Mixing section provides RM request to store departmentStores

send requested RM to mixing department Supervisor (mixing)

verifies RM received

QA provides formulation card as per mixing plan

Development of new compound starts from lab Banbury, then sheeting done using two roll mills. After careful evaluation of all properties required to produce in large scale has been validated with rheological, physical, viscosity and so on. After approval from QAD the compound starts its journey in large scale production.The basic operation cycle/ critical parameter that controls compound quality are listed below:

1. Start operation
2. Discharge door closed
    a) Ram up
    b) Hopper door open
3. Compound input.
4. Mixing started (Rubber + Chemical powders)
5. Close hopper door
6. Carbon is charged
7. Mixing for given period
8. Ram up
9. Oil injection
10. Ram down
11. Ram up/down

12. Ram float
13. Open discharge door
14. Start the next cycle

The following compounding additives & base rubbers being used here:

- ✓ Base rubbers like NR (block), SBR, SSBR, Nd BR, NR reclaim, CRcrumb, CR, EPDM, NBR.
- ✓ Black & white fillers.
- ✓ Activators.
- ✓ Acid acceptors.
- ✓ Curatives & Accelerators.
- ✓ Rubber process oils.
- ✓ Process aid.
- ✓ Anti-degradants.
- ✓ Flame Retardants.
- ✓ Homogenizer.

The mixing of rubber compound starts from adding base rubbers initially into the mixing chamber along with other additives like process oil, process aid, anti-degradants, cure activators, followed by 50% of filler and finally remaining 50% offiller along with oil. In Banbury dispersion occurs between rotor tip and chamber, for distribution between wings of the rotos. This process makes master batch which refers to compound without curatives, then compound is kept for maturation time depends on base rubber it may varies. Then the mix is dumped at dump mill, followed by sheeting mill through conveyor and finally compound is cooled using Technol HX235 (20% of powder in 200l of water). Then the mix is ready to add itscuratives system which makes rubber product to convert from weak plastic to strongelastic nature after vulcanization takes place. The filler makes the rubber matrix withits strength properties along with cost reduction. The reduction in filler size from agglomeration to aggregation generates enormous amount of heat inside the chamber. The dispersive mixing happens at Banbury between rotor tip and chamberand distribution happens in between wings, however due to high volume capacity time taken for distribution may be higher (might light to polymer degradation), thusmilling is one better way to do distributive mixing. The temperature control of the compound is very much important as it is going to decide the processing behavior &final properties of the vulcanizate. For cooling the water

is supplied at 8-20°C with pressure of 1-1.5Kg/cm² via centrally drilled cooling channel in the rotors which hastwo wings, along with chamber, drop door.

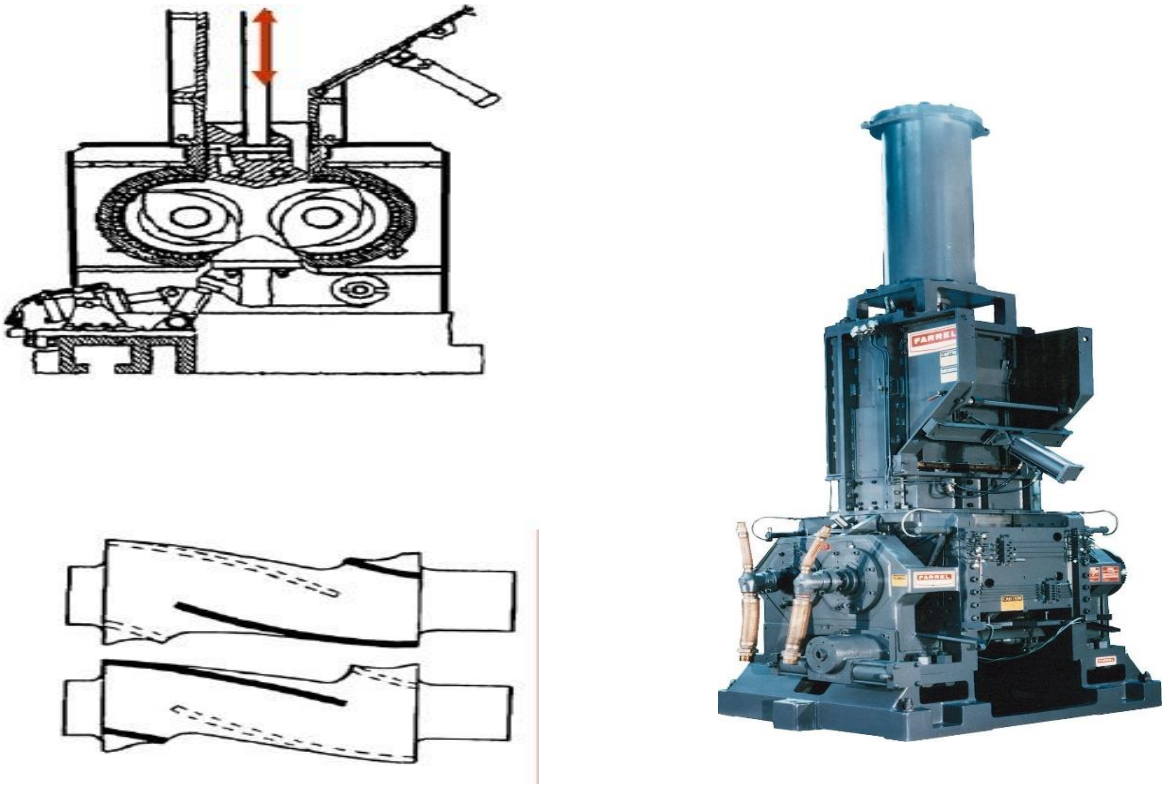


Figure 3. Banbury Machine

4.2 Calendaring:

Calendaring is the process of making where the reinforcing member of the conveyor belt presents. The calendar has 4 rolls with two different configuration L and inclined Z type. The process starts from feeding the final compound into the cold feed extruder which is pin barreled with head temperature around 75 to 80°C. The extruded compound was stripped in to two pieces at the end of the extrusion and conveyed through conveyor. The conveyor feeds the compound at the top roll of the calendar, the thickness of the calendared sheet/ skim coated fabric is adjusted at the top roll. Usually, compound is fed between 1,2 and 3,4, textile fabric fed in between 2 and 3 rolls, thus at the endof the calendar process rubber coated fabric will be winded up after cooling. For controlling rolls temperature steam is supplied at the range of 60-70°C. The exit temperature of the calendar process is 90°C. Then the compound is cooled using various cooling drums, which makes compound to cool at room temperature. Since the width of the calendar is limited as mentioned in the dimensions, if products above the width mentioned need to be processed, it should be split up into various width accordingly to the ease of processing.

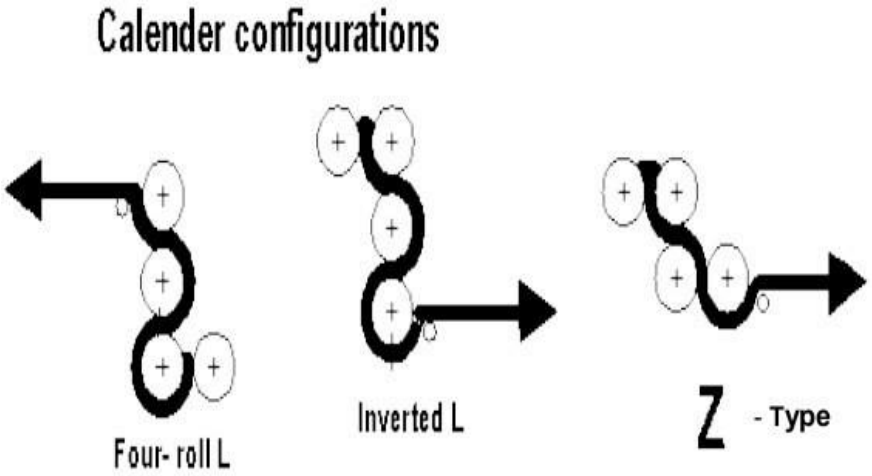


Figure 4. Types of Calendars

Most of the conveyor belt contains textile fabric as a reinforcing member andin some cases where long traveling belt or low extension belt is required, there should be steel cords instead of fabric. Thus, instead of skim compound steel cord has bonder which acts in a similar way like skim to provide adhesion between other components of the belt. The other most important components of the conveyor belt are top and bottom cover which also processed by the calendar processing. Generally, compounds should have above 50MU to maintain its dimensionalstability and to resist cold flow.

During calendaring process, the roll of calendar gets deformed at the center due to the force generated by the compound, this makes various in thickness at the center than at the edges.

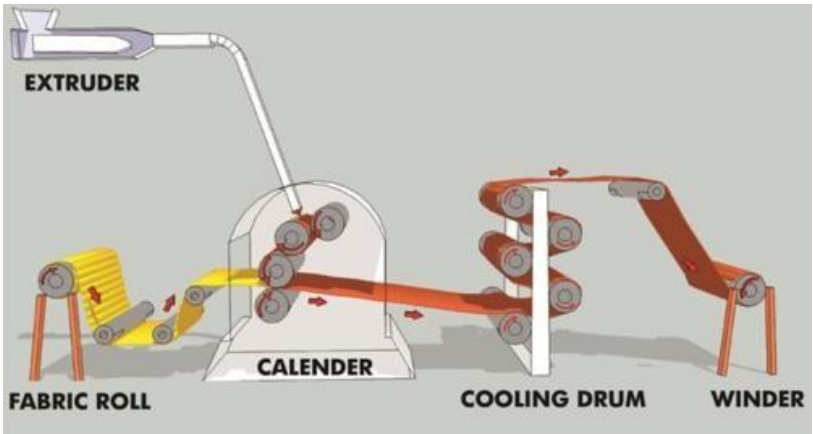


Figure 5. Calendaring

To overcome this issue roll crowning is done which is simply making concave structure at the center of the roll, so the output of the calendared sheet will be at uniform thickness. This crowning might cause severe problem in roll separation which again makes variation in sheet thickness. To overcome roll separation, roll is kept at off-axis, this makes roll separation force at minimum.

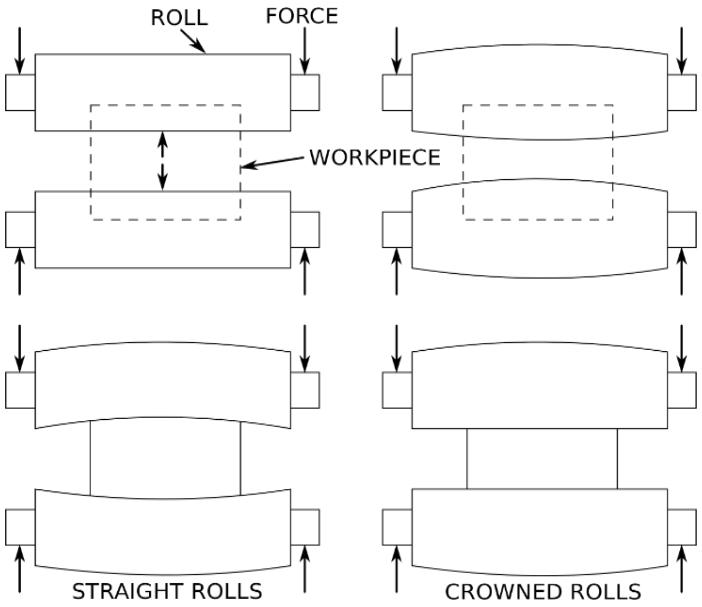


Figure 6. Crowned Roll

4.3 Belt Building:

The calendar sheets were built at building section where each separate components of the belt gets its structure i.e., entire belt composite. In most cases thecover component either top or bottom and skim coated fabric component will be adhered at calendaring itself. There are three building machines with various widthand length. At building area three unwinder/let off units is there to supply individualcomponents of the belt to be built. Top, skim coated fabric and bottom comes together and passes initially three set of guiders like rolls, followed by pressurized rolls at the end with the application of pressure of 4-5Kg/cm². The green belt shelf life may be for 12, 16 or 24hrs depending upon grade or nature of the compounds being used. On an average 2Kms of belt being built at ORIL. Since the polymers having shrinkage characteristics which is more pronounced in fabrics, the conveyorbelt also experiences shrinkage, the maximum allowable shrinkage is up to 3% (depends on fabric that are being used). To overcome this issue fabric width will have additional up to 3% from its original width required for the product that aregoing to run at the end application.

Figure 7. Textile building machine

Two kinds to conveyor belts being produced at ORIL, one is molded edge (ME) in which small strip of rubber is placed at both the edges during the building which is around 5-15mm in width which has no structural advantage & can be susceptible to severe damage at heavy duty

applications. The other one is cut edge (CE), in which the cured belt is trimmed to specified width as requested by the customer where the textile fabric reinforcement will be vulnerable to the environmental factors.

4.4 Curing:

The green belt is cured to get strong elastic product which improves product physicals, durability, and adhesion. Totally there are 6 curing presses with varying width and length. For curing of a rubber product three key parameters must be optimized to get better quality product, temperature, time, pressure. Even any one of the parameters doesn't meet the criteria to get complete cured state of thebelt, it will fail at the end application. The curing temperature ranges from 135- 155°C and the specific pressure maintained for textile belt is around 20-25 bar, alsofor steel belt it is around 30-35 bar.

Figure 8. Hydraulic Curing Press

Compression factor of the belt to be cured is more important as the product gets compressed by the applied pressure, if the compression is too higher this could leadto product failure. The compression factor formula is provided below,

$$= \frac{(green\ belt\ width) * (green\ belt\ thickness) - (edge\ iron\ gap) * (edge\ iron\ thickness)}{green\ belt * green\ belt\ thickness}$$

4.5 Cure cycle determination:

As conveyor is a thick rubber composite which is reinforced with either fabricor steel cords. The temperature supplied by both the platens will take time to reach the center part of the rubber composite.

Cure time for conveyor belt = ½ thickness in mm +Tc90 (this tells us time required to reach the inner temperature, based on this we can adjust the cure cycle)

In a general rule, a decrease in 10°C 1.8 times of time should be increased toget optimum cure this may go vice versa. One should choose this wisely depends on product/rubber to get optimized set of properties.

4.6 Final Inspection and Repair:

If the belt has some manufacturing defects it needs to be repaired before it is being packed and dispatched to the customer, as it cost severe during service. Thus, all cured belts are inspected as per the industry norms and the defects are rectified accordingly. Usually, inspection is done visually by experienced workers. The manufacturing defects are adhesion failure, blister, ply air, buckling, bareness, cockling, ply folds, ply missing, tilt, sponginess, cooling end repair, humps, molded edge defects, faulty repairs, banana cut, wavy belt edges.

If some part of the belt has blister, the area of the blister is found, then pricked using hand tool and the area affected is removed. Then the repair patch compound is applied to the affected area by the application of chemlok OC3/243B. The patched area is cured at 160°C for the period of 12-15minutes. After inspection and repairing is over the belt is winded up for packing. Both the top and bottom side of the belt is inspected, some of the defects are allowed and repaired while some defects are not allowed like adhesion failure.

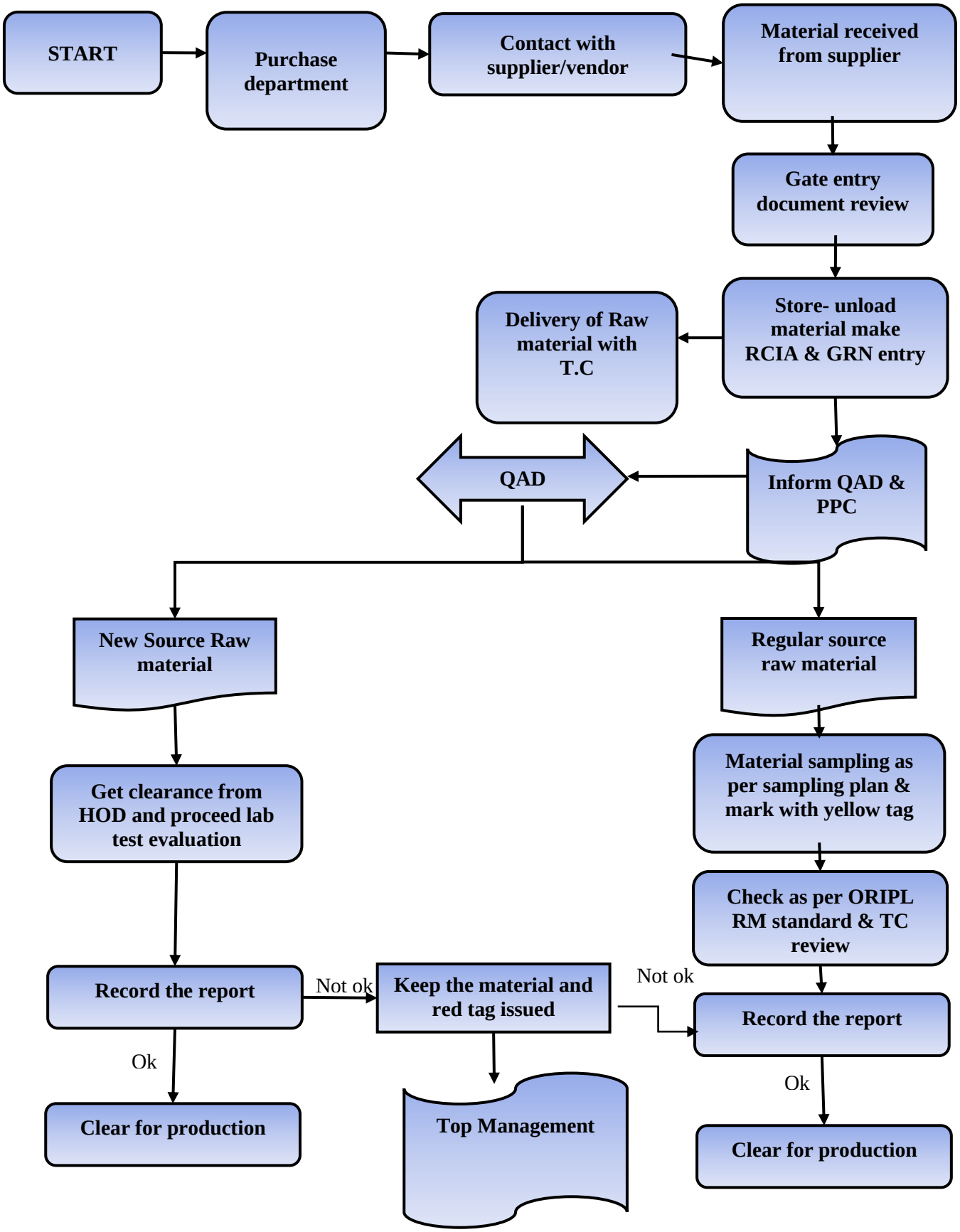
The inspected belts are winded up and packed mostly using HDPE package and tied up with belts. Then the package will be dispatched to the customer. The conveyor belts are graded accordingly to the defects analyzed and repaired during the inspection process

5. Quality Assurance

QA is a stringent thing like how law and order of a country should be, that each choice of raw materials should meet the customer expectation as well as the industry standards. Thus, the choice of raw materials from different supplier needs extensive evaluation before that are being planned for production level.

5.1 Raw Material Selection

The raw materials choice is primarily depending on end use application as well as the cost, then industry processing parameters. The workflow of the raw material choice starts from getting order from the customer end. The below flow chart describes it clearly -


START
Purchase department
Contact with supplier/vendor
Material received from supplier
Gate entry document review
Store- unload material make RCIA & GRN entry
Delivery of Raw material with T.C
QAD
Inform QAD & PPC
New Source Raw material
Regular source raw material
Get clearance from HOD and proceed lab test evaluation
Material sampling as per sampling plan & mark with yellow tag
Check as per ORIPL RM standard & TC review
Record the report
Not ok
Keep the material and red tag issued
Not ok
Record the report
Ok
Ok
Clear for production
Top Management
Clear for production

6. Raw Materials

RM's can be classified in to three classes based on supplier response, productperformance and few things as listed below,

A- process performance, product batch variability, delivery, support (cost reduction), adequacy and effectiveness.

B- process performance, product batch variability, price, support in suppliermanaged inventory.

C- based on individual batch results and in compliance with specifications.

Other than above mentioned classification RM's can be classified based on itsusage on rubber product (conveyor belt) and RM's purpose is spoken in below section.

Base rubbers:

NR- natural source of rubber with high green strength than any other rubbers available. Due to its strain induced crystallization over 200% elongation, its strengthproperties usually increase. More unsaturation more prone to oxidation, heat and ozone degradation. High strength, lower heat buildup, poor abrasion and the only rubber with 99% of cis content.

SBR- styrene butadiene rubber, alternative to NR with better abrasion resistance.

PBR- mechanically weaker but abrasion resistance is to high along with high heat buildup. It can't be used alone.

CR- same chemical structure as NR except methyl group is replaced by chlorine. This makes them to be flame retardant and helps in slowing down oxygen ozonedegradation due to highly electro negative atom (Cl) during radical formation, Cl absorbs the radical and makes them inactive. It can also show SIC behavior like NR but has high trans %.

EPDM- a thermoplastic behavioral rubber with totally different polymerization catalyst system, breaking the crystalline zone is more important to make two plasticsinto a rubber. Diene content helps to cure this elastomer with sulfur, among ENB is faster one.

Reclaimed and crumb rubber- both major sources are from waste tyre product whichhelps to recycle and to cut the cost of the compound. To be noted both reduces strength properties in the compound.

Black filler- carbon black a major reinforcing/semi reinforcing filler system that hasbeen majorly consumed by tyre and non tyre sectors. N denotes normal cure, and first number denotes particle size, followed by other two numbers denote structure.In general, lower particle size, higher will be the surface area and better will be rubber-filler interaction, but poorer in dispersion and processing as well. Usually, higher structure provides better processing and dispersion as well as lower abrasionloss compared to similar surface area and particle size grades. Carbon black has standard classification as per ASTM D1765.

White filler- silica is highly reinforcing when used with coupling agents and also lowers the energy loss (hysteresis) happening at lower frequency and at higher temperature, due to strong H-bonding compared with CB which has weak Vander Waals force of attraction. But abrasion resistance is major problem that can't be matched with CB due to inherent behavior during mixing of highly silica filler compound. Other white fillers like $CaCO_3$, China clay all are considered as inert/ extender fillers.

Process oil- aromatic for general purpose rubbers, for specialty rubbers paraffinic/naphthenic oils can be used. The choice of oil depends on solubility parameter with base rubber & polarity of the rubber. For polar rubbers polar process oils like DOP, DOA. The purpose of process oil is to provide internal lubrication which makes rubber chains to slip, also it reduces the hardness of the compound.

Activators- they usually reduce the activation energy required for vulcanization process which increases the productivity. Zinc oxide and stearic acid are commonly used which forms zinc stearate.

Anti-degradants- unsaturation in rubbers makes them more prone to oxygen, ozone and heat. This will make the rubber product to loss its properties over the period. Anti-degradants will protect the rubber molecules from above mentioned factors.

Accelerators- chemicals that speeds up the vulcanization process along with other curatives and to deliver optimized cross link density to the rubber product.

Curatives- curatives are chemicals which turns the rubber compound from weakly plastic to strong elastic nature, thus improving entire compound system in strength and dynamic performance wise. For unsaturated rubbers sulfur is curative, for very few unsaturation or saturated rubbers peroxide, resin cures, for halogen group containing rubbers metal oxide as curatives.

Retarder- a chemical which inhibits the accelerator- curative for a while without affecting the other cure characteristics which favors in extended processing window.

Bonding agents- it promotes the adhesion between rubber and zinc/brass coated steel cords.

Resin system- resins like PF, CI, wood rosin improves adhesion between rubber and fabric system. Resin sometimes also increases the dynamic performance of the compound.

Homogenizer- this chemical makes two different polymer system or a compound containing high reclaim, it makes both systems to behave in a synergistic manner.

Anti-tacking agent - which reduces tackiness of the compound for easier processing.

Reinforcing members- since conveyor belt is a composite, a distinct reinforcing member like textile fabric or steel cord is provided at the carcass which acts as strength providing member in a belt system.

FR chemicals- which reduces chances of fire catching by various mechanisms, like graphite transfers heat, zinc borate suppresses the smoke when belt catches fire, ATH will begins its endothermic breakdown in the range of 180–200 °C releasing its chemically bonded water, antimony trioxide increases the activity of halogenated flame retardants by hindering chain reaction of flame gas phase through stepwise release of halogenated radicals which will occur at above 315°C, at these temperatures, antimony halides and oxyhalides are formed and act as flame extinguishing moieties by quenching radicals.

Pigments- which gives color to the rubber product.

7.Raw material and compound testing

7.1 Ash Content

Estimation of ash content in raw rubber is done to determine the amount of carbon and other elements and contribute to the properties of rubber. Ash content is quantitatively measured, and percentage of ash content is then measured.

Standard Operating Procedure

- Take the weight of the rubber sample and weight of crucible individually and then together.
- Place the crucible inside the machine and close the furnace.
- Now set the temperature and time of the machine (Temp- 800^{O}C, Time- 4hrs)
- After that take the weight of the ash and calculate the percentage of ash content in the rubber material.

Figure 9. Muffle Furnace

7.2 Moisture Content

Moisture content is to determine the amount of water present in the material. Moisture content analysis is a very important component of material quality and essentially a function of quality control in rubber industry. Excessive or deficient moisture content of a substance can have adverse impact on the physical properties of a material

Procedure

The process is carried out in a drying oven using a balance to ascertain the sample's beginning and final weights, and the moisture content is calculated using a simple mathematical formula. This procedure can take several hours to complete and is prone to human error. A moisture analyzer, on the other hand, works on the same concept but is an automated system that combines a microprocessor-controlled heating element and an analyzer into one device; the moisture content of a sample can be tested in minutes rather than hours using such a device.

$$\frac{\text{Initial weight - Final Weight}}{\text{Initial weight}} \times 100$$

Figure 10. Moisture Analyzer

7.3 Mooney Viscometer (ASTM D1646)

Rubber testing laboratories use the Mooney Viscometer to check the viscous flow of raw materials to ensure stable and uniform manufacturing processes. These protocols cover the measurement of a property known as Mooney viscosity. The shearing torque resisting rotation of a cylindrical metal disc (or rotor) immersed in rubber within a cylindrical hollow is known as Mooney viscosity. These test techniques specify the dimensions of the shearing disc viscometer, test temperatures, and procedures for measuring Mooney viscosity.

Purpose- We may use the Mooney Viscometer to perform a range of tests, such as Mooney Viscosity, Mooney Stress Relaxation, and Mooney Scorch. These three tests are crucial because they let you to comprehend the viscometer, elastic behaviour, and scorch time.

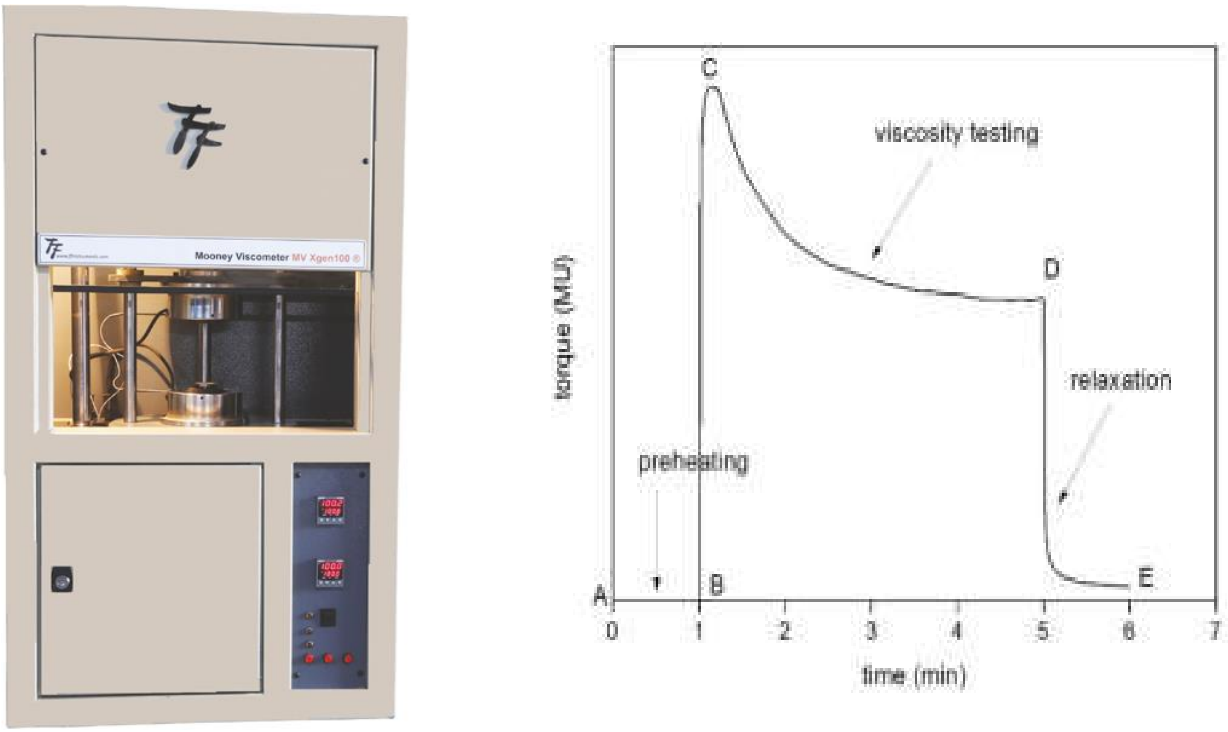


Figure 11. Mooney Viscometer and Mooney curve

7.4 Tensile Testing (ASTM D 412C)

Tensile set testing of a rubber or thermoplastic elastomer determines the residual elongation of a test sample after it has been stretched and relaxed in the prescribed manner. Because this elongation has both permanent and recoverable components, the time spent stretching and recovering is critical, and D 412 specifies both.

Test Procedure

At the endpoints of the gauge length of the dumbbell shaped specimens, two marks are carefully affixed on each test sample. For each sample, the initial distance between these markings is measured. To ensure equal alignment and location, the samples are carefully installed in the test fixture. The device stretches the samples to the desired length and then keeps them in place for 10 minutes. After that, the samples are taken out of the fixture and allowed to rest for 10 minutes. The final distance between the markings is measured after the relaxing period.

Specimen Size

A dumbbell-shaped specimen is required by ASTM D 412. The sample dimensions are described in six ways in the specification, but the chosen sample is "Die C." Die C is 115mm (4.5 inches) long overall, with a narrow section measuring 33mm (1.31 inches). This results in a gauge length of 25mm (1 inch) and a gauge width of 6mm (benchmark) (0.25 inch).

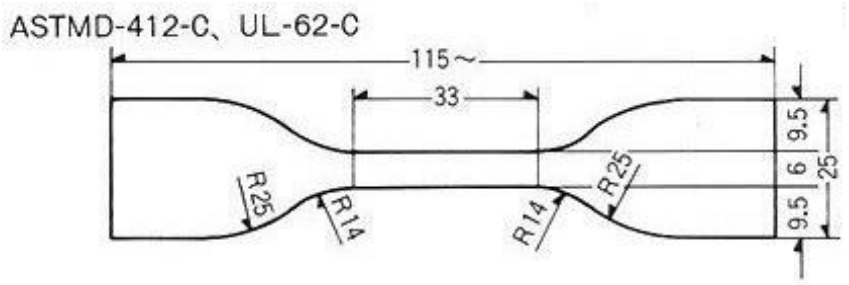


Figure 12. ASTM D 412C Specimen Size

Figure 13. Universal Tensile Testing Machine

7.5 Rheograph (Oscillating Disc Rheometer)

A Rheograph cure curves are obtained using a "Oscillating Disc Rheometer," which is one tool for determining kinetic crosslinking. Test compounds surround an oscillating rotor, which is housed in a heated chamber. The needed torque for oscillating the rotor is measured as a function of time 2. All the vulcanization parameters of the rubber compound can be derived immediately from the torque vs. cure time curve.

Rheograph is divided into 3 phases –

1- Phase-1: It represent processing behavior of the rubber compound.
2- Phase-2: It describes the curing characteristics of the rubber compound.
3- Phase-3: It gives an indication of physical properties of the rubber compound.

To acquire the varied outcomes, the plot of torque against time is studied. The rheograph is presented in real time on an oscillating disc rheometer, and at the end of the test time, the computer analyses the graph, and the results are automatically generated and displayed on the screen or printer.

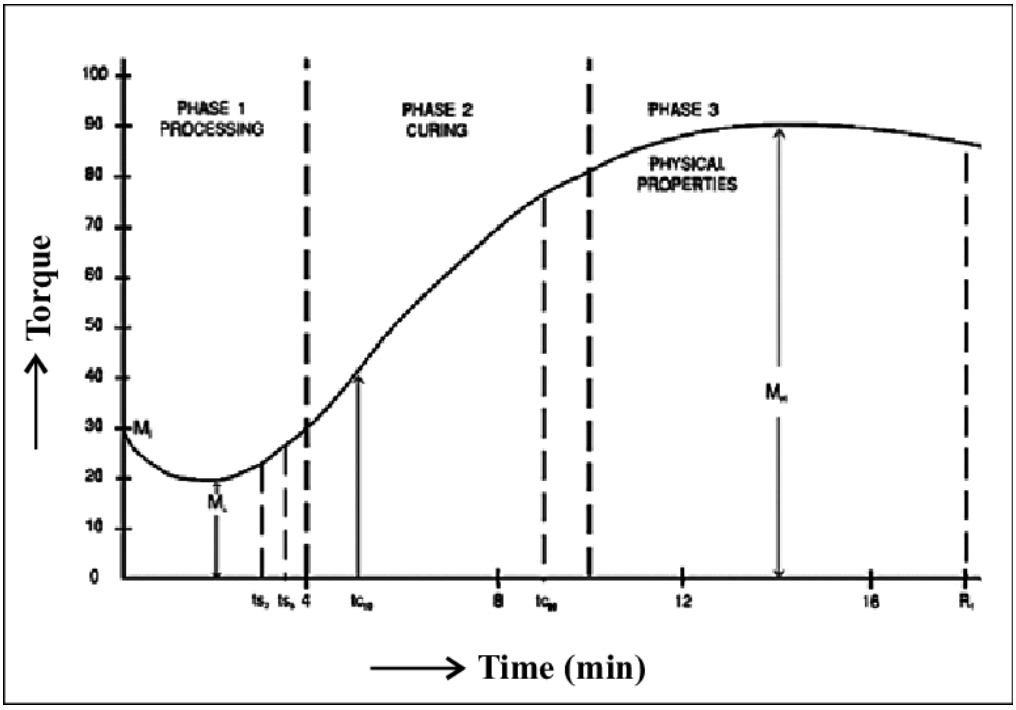


Figure 14. Rheograph (Cure Curve)

The displayed results of rheograph are categorized into three reports

(i) Torque report in (lb-in)
(ii) Time reports in minutes
(iii) Derived reports

Figure 15. Oscillating Disc Rheometer

8. Conveyor Belt Manufacture Flow Chart: