KOSSAN

STRETCHING LIMITS • SINCE 1979

Glove Manufacturing

1.What is latex compounding?

Films made from natural rubber latex or synthetic latex, on their own, are not functional. In the raw state, they are soft and not elastic. The rubber molecules of natural rubber latex and synthetic latex have to be cross-linked into a network to provide the necessary mechanical strength and hardness for the product to be functional, i.e. this process of crosslinking or vulcanization will allow the product to be elastic and stretchable, suitable for glove application. Crosslinking of rubber molecules which carry unsaturated double bonds can be effectively carried out using sulfur and other chemicals which act as accelerators and activators to enhance the crosslinking process. To develop a latex compound for making gloves involve the following steps:

- Choosing the raw latex/chemical ingredients/additives
- Developing a formulation
- Working out an appropriate mixing procedure for all the ingredients
- Making an experimental batch
- Running some tests if the gloves so produced provide the desired properties
- Finalizing the recipe/formulation
- Scaling up to a factory scale to produce gloves

2. What are the components found in a latex compound?

Several materials are needed in a latex compound. The latex used can either be natural rubber latex, synthetic rubber latex such as nitrile latex, polychloroprene latex, polybutadiene latex or polyisoprene latex. Next comes the vulcanizing/crosslinking system.

Other components include the following:

- The stabilizers: surfactants, emulsifiers
- Processing aids: wetting agents, dispersing agents, foaming agents, foam stabilizers, viscosity modifiers
- Protection system: antioxidants, antiozonants, antidegradants, waxes
- Properties enhancement materials: fillers, pigments, plasticizer.

Typical latex compound formulation is given below for a natural rubber latex compound.

NATURAL RUBBER LATEX	100 PARTS BY WEIGHT
Potassium hydroxide solution	0.3 – 0.5
Additional stabilizer (fatty acid soap)	0.05 to 0.2
Sulfur dispersion	0.4 to 1.2
ZDC accelerator dispersion	0.3 to 1.0
Zinc oxide dispersion	0.1 to 1.0
Antioxidant dispersion	0.5 to 2.0
Pigment dispersion	0 to 0.5
Defoamer	as required
Dewebber	as required
Water	as required

3. Why are chemical accelerators used in glove manufacturing?

Because of its low cost, ease of availability and minimal interference with other compounding ingredients, sulphur is the most important crosslinker used in latex compounding. However, vulcanization of rubber molecules using sulphur alone is very slow. Even at elevated temperatures above 140oC, it will take a few hours for vulcanization to complete. Ideally, the sulphur curing system must include activators and accelerators. Activators (usually metal oxide e.g. zinc oxide in combination with stearic acid) can catalyze the reaction. Accelerators are organic substances that accelerate vulcanizing reaction. In the presence of activators and accelerators, the crosslinking process can complete in 15 to 20 minutes at 140 C.

Most of the common accelerators suitable for latex are metal dialkyl dithiocarbamates such as zinc dialkyl dithiocarbamates ZDC, thiouram polysuphides and thiazoles. These accelerators are used in both the natural rubber latex and synthetic latex glove production. Unfortunately, most of these accelerators, if present in gloves, have the potential to induce delay Type IV hypersensitivity of contact dermatitis allergy.

Note: (In 2008, KOSSAN launch a new breakthrough in nitrile examination glove under the brandname Chemax 7th Sense without the need for accelerator chemicals, making the users of these gloves less susceptible to Type IV allergies.)

4. In glove manufacturing, how does one remove the excessive accelerators?

To reduce the presence of residual chemicals such as accelerators in gloves, one must only use the optimal amount of the chemicals in the compound formulation to avoid excessive usage of chemicals. Any unreacted chemicals i.e. as residual chemicals in gloves should be leached away in the processing step known as leaching. Leaching refers to the process of immersing the latex–coated formers into a bath, to wash out the excess additives from previous stages. In natural rubber gloves, extractable latex proteins can also be leached out at this stage.

5.What are the alternatives to powder in reducing tackiness?

Chlorination reduces the stickiness of the latex by modifying the rubber surface for easy donning as well as reduces the amount of extractable proteins either by: denaturing the protein and leaching

Polymer Coating creates a slippery surface on the inside of the glove which aids donning. The coating may also act as a barrier between the users' skin and the latex in reducing the exposure to the latex proteins.

6. How should gloves be stored to avoid degradation?

The shelf life of the gloves is estimated at 3-5 years (depending on the type of glove) from the date of manufacture. The storage period is applicable provided the following storage conditions are adhered.

- Rotate the supply of gloves so that the oldest supply is used first
- Keep gloves in their original box until they are needed
- Avoid direct sun and fluorescent lighting
- Stored with temperature not exceeding 40 degree C
- Storage area should not contain equipment that generate ozone (example: x-ray machines, mercury vapor lamps, high voltage electrical appliances or appliances that give rise to electrical sparks or discharges
- Avoid direct contact to metals
- Avoid contact with oil-based antiseptic phenols, greases, petroleum jelly, spirit, parafins and other related compounds