Quality Assurance during Latex Glove Production

Relevant for: Latex, chemicals, coatings, polymers

The coagulant dipping process is most commonly used to produce latex gloves, where molds are subsequently dipped into a coagulant and latex compound solution. The concentration of both solutions is a key parameter and affects the final glove quality and durability.

1 Introduction

Natural rubber latex is the oldest and most familiar material used in protective and medical gloves.

Nowadays it has increasingly been replaced by synthetic latex. These materials, such as synthetic polyisoprene, chloroprene or NBR (nitrile) latex, are produced on the basis of petrochemical raw materials.

Although the main reason for the replacement of natural rubber latex is to avert allergic reactions to rubber, modern synthetic latex also offers better chemical resistance and often superior wearing comfort compared to natural rubber.

Both, natural as well as synthetic latex concentrates are used in the so-called “coagulant dip process” to manufacture the gloves.

Anton Paar’s inline refractometer L-Rix 5100 has proven to be well suited for the continuous concentration monitoring of coagulant and latex compound solution and can be directly installed into the production line or tank to measure concentration (%) in real-time.

2 Production process

Production uses hand-shaped dip molds, or formers, made out of ceramic or aluminum which exhibit high heat capacity, are cheap and simple to produce and show little wear. The molds are mounted on a chain dipping system where pairs of molds are sequentially immersed in different aqueous mixtures and then passed through various ovens.

The production process starts by washing the molds in hot water and chlorine to ensure there is no residue from previous batches.

Then the molds are dipped into the coagulant, a hot saline solution that usually consists of calcium chloride or calcium nitrate. When the mold is pulled out of the salt solution, the water evaporates and a very thin homogeneous Ca^{2+} film remains on the mold’s surface.

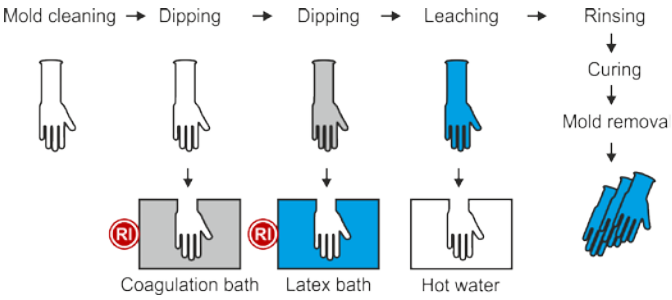

Figure 1: Latex glove production process

The concentration of the coagulation bath is maintained at its optimal level to help the latex mixture adhere to the formers and to help ensure the latex is distributed evenly.

Next, the molds are dipped into the latex suspension, where coagulation of the latex occurs immediately and a thin latex film is formed on the ceramic mold. The concentration of the latex suspension is continuously monitored as it has a crucial effect on the final quality and product specification.

The freshly molded gloves are leached with hot water to remove unwanted chemicals or proteins.

Finally, to develop the elastic properties the latex film on the surface of the mold is vulcanized at 130 °C.

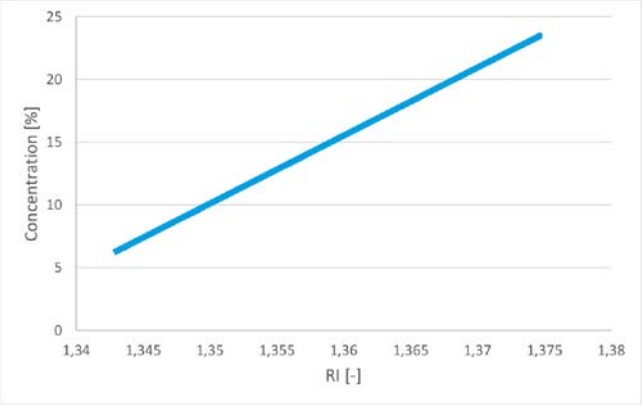

Figure 2: Latex Concentration versus RI

3 Measurement Setup

The Anton Paar solution for concentration measurement consists of the L-Rix 5100 Inline Refractometer which is installed at different stages of the latex glove production line to measure the concentration of the coagulant and the concentration of the latex suspension. Doing so the baths can be adjusted when needed, reducing the production costs and ensuring the quality.

The L-Rix can be installed directly in the line or tank and measures the refractive index and temperature continuously.

The application specific concentration calculations are carried out in the mPDS 5 or with the Pico 3000 (optional also with HMI) evaluation units. The results can be displayed and transferred to a PLC or to the Davis 5 data acquisition and visualization software.

Alternatively the L-Rix can be connected to a Pico 3000 RC housing for remote control (for a single production line).

Figure 3: L-Rix 5100 Inline Refractometer

Specifications of L-Rix 5100:

Refractive Index	1.3100 to 1.5400 Accuracy: nD ±0.0002 (equivalent to ± 0.1 % mass) Repeatability: nD ±0.0001 (equivalent to ± 0.05 % mass)
Process temperature	-20 °C to 120 °C CIP/SIP up to 145 °C for 30 minutes
Ambient temperature	-20 °C to 60 °C
Pressure range absolute	100 mbar to 16 bar (10 bar @ >120 °C)
Communication (using Pico 3000)	Analog/Digital Modbus RTU PROFIBUS DP PROFINET IO EtherNet/IP

4 Benefits

The reliable and accurate L-Rix 5100 enables

- Precise monitoring of the coagulant solution concentration in real-time
- Precise monitoring of the latex suspension solution concentration in real-time
- Improved end-product quality and consistency
- Enhance productivity
- Reduce production costs
- Direct comparison with lab reference method

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