

Investigating the Physical Properties of Latex Gloves

John K. Bennett, PhD

Department of Electrical and Computer Engineering
Rice University, Houston, Texas

Researchers at the Rice University Latex Glove Research Laboratory (LGRL) are investigating the physical properties of latex surgical and examination gloves. The goal of this effort is to develop an understanding of the relationship between the electrical, chemical, and biological properties of natural rubber latex gloves.

The most clinically relevant of the physical properties under investigation include hydration rate, conductivity, and extractable protein and allergen content. *Hydration* refers to the absorption of fluid into interstitial areas within the glove. This absorption causes gloves to swell, changing their tensile and tactile properties. Hydrated gloves will often be more susceptible to tearing or puncture, as well as feeling “tacky”. In addition, a heavily hydrated glove may be less effective as a chemical barrier. There is little evidence to suggest that a hydrated glove is necessarily a less effective biological barrier. All natural rubber latex gloves hydrate to some extent, although gloves from different manufacturers, and different glove styles from the same manufacturer, hydrate at significantly varying rates. Some gloves may hydrate significantly in just a few minutes of exposure to fluids, others may not exhibit significant hydration after several hours of exposure.

Conductivity refers to the ability of the glove to permit or impede the flow of electric current. A glove with very high conductivity may expose its wearer to increased risk of shock or burn from electrocautery procedures. Very high conductivity may also preclude the monitoring of glove barrier integrity by electrical means. This is because it is very difficult to distinguish between a glove with very high conductivity, and a low conductivity glove with a barrier breach. Since most bodily fluids and irrigating solutions are themselves electrically conductive, electrical conductivity and hydration are closely related. A heavily hydrated glove will have much higher conductivity than a glove that is less hydrated. The variability of conductivity over glove manufacturer and style correlates strongly with the degree of hydration.

The *allergenicity* of natural rubber latex medical products is of increasing concern to health care professionals, since they are regularly exposed to these products, especially ex-

amination and surgical gloves. At the 1992 AORN conference, 30% of the 1738 respondents to a AORN/CDC survey reported some latex allergy. Of the 1133 reports to the FDA of severe latex allergic reactions (including anaphylaxis) that occurred between 10/1/88 and 9/30/92, 408 of the injuries reported involved examination gloves, and 77 involved surgical gloves. Approximately 68% of the injuries reported involved health care workers, and 65% of this group were patients at the time of injury. Other studies have confirmed that health care workers, particularly females, with a prior history of latex sensitivity are among those more likely to experience a more severe latex allergic reaction upon additional exposure. The result of these concerns is that many glove manufacturers have undertaken to reduce the allergen content of their products. These allergens are believed to be found in some of the naturally occurring proteins in the latex itself. Most natural latex rubber products are made from a liquid extract of the *Hevea Brasiliensis* tree, and thus there are many such proteins. Most of these proteins probably do not cause allergic reactions. Efforts are underway, at the Rice LGRL and elsewhere, to identify those proteins that are responsible for causing allergic reactions. In the meantime, those glove manufacturers seeking to reduce the allergen content of their gloves are taking steps to reduce the total extractable protein content. Allergen content and total extractable protein content have not been shown to be strongly correlated, but reducing the total protein content should tend to reduce the allergen content as well. Researchers at the Rice LGRL have recently found evidence to indicate that the extractable (water-soluble) proteins in latex gloves are one of the primary causal agents of glove hydration and increased conductivity. These data suggest that a glove with high extractable protein content will hydrate more quickly, and its conductivity will increase more rapidly, than a similar glove with less extractable protein. This means that efforts to reduce glove extractable protein levels should yield gloves that have improved hydration and conductivity properties as well.