BASIC ACRYLIC MONOMER MANUFACTURERS, INC.

CHEMICAL-PROTECTIVE GLOVES

FOR ACRYLIC ACID AND ACRYLATE ESTERS

MARCH 2006

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Introduction

Contact with all chemicals should be avoided, whether by inhalation, ingestion, or skin contact. Avoiding all skin contact with acrylic acid and acrylate esters is especially important because of the potential of absorption through intact skin, corrosion, and/or skin sensitization with these chemicals. Therefore, an effective chemical-protective glove program can be an important element in protecting worker health.

Hierarchy of Industrial Hygiene Controls

The use of protective gloves, as with all personal protective equipment (PPE), should be considered a “last resort” approach to the protection of human health. To prevent contact with chemicals the Industrial Hygiene “Hierarchy of Controls” should be followed whenever practicable. First on this list of controls is Engineering Controls, such as the use of closed systems, automated operation, and local-exhaust ventilation. The second is Administrative Controls, which includes designated work practices and housekeeping procedures that will eliminate or minimize exposures to workplace hazards. Only then should PPE be considered as an acceptable means of worker protection, and only then as an interim measure while engineering controls are being investigated or until they can be implemented.

Protective Gloves, General

Protective gloves are available in a wide variety of styles and materials of construction for protection against cuts, abrasions, thermal burns, and chemicals. The choice of an inappropriate glove, however, may be potentially more harmful than using no glove at all. If a leather or fabric glove or a punctured chemical protective glove is contacted by acrylic acid or an acrylate ester, the chemical will be conducted to the skin’s surface and will be held in contact with the skin in a manner similar to that of a chemical patch test. This can occur often without the knowledge of the wearer. In contrast, if no glove at all is worn, chemicals contacting the skin would have the opportunity to evaporate.

Chemical-Protective Gloves

For protection against chemicals, there are a wide variety of elastomeric and laminate gloves available. Elastomeric gloves such as those of neoprene or butyl rubber are typically made by a dipping process using molds of human hands in various sizes. Common materials of construction for elastomeric gloves include: latex, or natural rubber; neoprene, or polyisoprene; nitrile rubber, or acrylonitrile/butadiene/styrene rubber; butyl rubber; polyvinyl alcohol (PVA); polyvinyl chloride (PVC); and DuPont’s VITON® fluoroelastomer. Laminate gloves are made by cutting and then heat-sealing patterns of various hand sizes from laminated sheets of PVA sealed between layers of polyethylene. Laminate gloves usually are not elastic and hence should not be worn alone when mechanical shear forces are applied as long as the glove is worn. This might result in a punctured laminate glove. It is possible to wear a combination of gloves including a laminate glove thereby reducing the aforementioned risk. Please refer to section "Use and Care of Chemical-Resistant Gloves" for further information. These laminate gloves are available from at least two suppliers of chemical-protective gloves. Latex and butyl rubber gloves are available in glove material thickness down to three-four mils (0.08-0.1 mm) and up to more than 20 mils (>0.5 mm). Other elastomeric gloves are typically available in material-of-construction thicknesses greater than 10 mils (0.25 mm). In general, the thicker the glove material, the greater the permeation resistance. However, glove thickness should be considered when tactile sensation is required in addition to chemical protection. Typical glove material thickness of 10-20 mils is widely used for protection against liquid chemicals while maintaining an effective measure of tactile sensation. Elastomeric gloves are available in flocked and lined models, which provide for greater wearer comfort. In contrast, laminate gloves are only ca. 3 mils thick and at present are only available in the unlined version.

The cost of gloves for protection against chemicals covers a range from a few dollars per pair for laminate gloves and for neoprene and nitrile elastomeric gloves to more than $15 per pair for butyl and PVA gloves and approximately $40 per pair for VITON® fluoroelastomeric gloves.

When in contact with chemicals, there are three potential adverse consequences that might occur with these laminate and elastomeric gloves: degradation, penetration, and permeation. Degradation of the glove may result from the reaction of the chemical with the glove material or a chemical leaching of a component of the glove material and may cause cracking, shrinking, and/or the loss of elasticity. Penetration is the passage of a liquid chemical through small openings in the glove material, such as pinholes or punctures. Permeation is the passage of a chemical on the molecular level through the intact glove material, often without any apparent evidence of this effect.

Permeation Tests

When selecting gloves for workers handling acrylic acid and acrylate esters, permeation test results should be consulted in conjunction with glove costs.

The permeation data in Tables I and II will assist you in making rational decisions in the selection of protective gloves for your operations.

Permeation tests have been conducted according to the American Society for Testing and Materials standard: ASTM F 739-96, Standard Test Method for Resistance of Protective Clothing Materials to Permeation by Liquids or Gases Under Conditions of Continuous Contact. This test involves placing a disc of glove material in a standardized test cell. The challenge chemical is placed in one side of the cell against the test specimen, and the downstream side is monitored on a continuous or repeating basis for the presence of the challenge chemical. The collection medium is typically nitrogen, air, or water. Detection methods used to check for the presence of the challenge chemical include gas chromatographic and photoionization techniques when using a gas collection system or conductivity when using water as the collection medium.

The time at which the challenge chemical is first detected downstream of the test specimen is called the "breakthrough time". The other major parameter evaluated in the standard ASTM F 739 test is the "permeation rate," that is the chemical flow through the specimen once it has reached an equilibrium rate.

Glove suppliers and glove materials were selected based on widespread availability, practicality, and reasonable cost, e.g. PVA gloves were not included in the study because of their water solubility, and VITON ® was not included in the study because of cost.

Permeation test results are presented in Table I for acrylic acid and in Table II for the acrylate esters. Results are presented in decreasing resistance to permeation based on breakthrough time. A list of glove manufacturers referenced in this report is included on page 10.

<u>Use and Care of Chemical-Resistant Gloves</u>

Chemical-resistant gloves should be used as splash protection and not as immersion protection. When a glove is contacted with acrylic acid or an acrylate, it should be rinsed immediately with water while still being worn.

It should then be removed and discarded, and whenever a glove shows any sign of degradation, penetration, or permeation, it should be discarded and the wearer should wash his hands immediately and thoroughly with soap and water.

Operator comfort, and consequently operator acceptance, should be considered as an essential aspect of an effective protective-glove program. If the glove selected is not comfortable, either from the standpoint of its inability to absorb sweat, if it irritates the skin, or other, there is a greater chance that the glove will not be used when required. The use of flocked or lined gloves will help. Another approach is the use of cotton glove liners or under-gloves. Thin gauge knitted cotton under-gloves or the use of tubular knit under-gloves that cover the palm and wrist are very effective in providing wearer comfort. In the case of the laminate glove, to improve both wearer comfort as well as provide needed tactile sensation, the following is recommended: wear the whole-hand or palm-cover knitted cotton under-glove; pull the laminate glove tightly over the cotton under-glove; over all wear an elastomeric glove such as a 15 mil (0.38 mm) nitrile glove. Although this may sound cumbersome, it has proven to be feasible and acceptable to the wearer. Demonstration of the use of this combination is recommended as part of PPE use training.

Chemical-Resistant Gloves as Part of an Overall PPE Program

Personal protective equipment includes equipment worn by individuals to protect their eyes, face, head, and extremities; protective clothing; and respiratory-protective devices. These devices and equipment are intended to prevent injury by preventing inhalation, absorption, and physical contact with hazardous materials in the workplace. A PPE program includes: selection of suitable PPE based on a hazard assessment; training in the use and care of the selected PPE; and a maintenance and inspection program.

The use of chemical-resistant gloves can be an essential part of an overall PPE program. To ensure that individuals who handle acrylic acid and acrylates are in fact protected, the chemical-protective glove program should include the following elements:

- Selection of gloves that provides permeation resistance consistent with cost effectiveness.

- Use of gloves as splash protection and not as immersion protection.

Chemical-Resistant Gloves as Part of an Overall PPE Program (cont.)

- Inspection of gloves for evidence of degradation, pinholes, and punctures that may cause chemical penetration of acrylic acid or its esters.

- Immediate water rinsing of chemical-contacted gloves while still worn, followed by removal of the contaminated glove and washing the hands thoroughly with soap and water.

- Replacement of gloves promptly when there is evidence of damage and otherwise on an established time schedule.

- Disposal of chemical-contacted gloves as contaminated waste.

Table I

Acrylic Acid Permeation Test Results

Glove Description: Supplier, Material	Breakthrough Time, minutes	Permeation Rate, $ug/cm^2/sec$	Glove Thickness, mils/mm
Safety 4, 4H® laminate	>480	ND	3/0.08
North, butyl, Catalog No. B174R	>480	ND	22/0.56
Ansell-Edmont, neoprene Style 29-845	116	173	17/0.43
Ansell-Edmont, nitrile Style 37-165	32	173	20/0.51
Ansell-Edmont, PVC Style 12-254	30	173	40/1.1

Notes for Tables I and II:

- All entries are average values for three individual tests
- ND = none detected

Table II

Acrylate Permeation Test Results

Butyl Acrylate

Glove Description: Supplier, Material	Breakthrough Time, minutes	Permeation Rate, $ug/cm^2/sec$	Glove Thickness, mils/mm
Safety 4, 4H® laminate	>480	ND	3/0.08
North, butyl Catalog No. B174R	274	81.7	23/0.58
Ansell-Edmont, nitrile Style 37-165	148	309	20/0.51
Ansell-Edmont, neoprene Style 29-845	22	309	18/0.46
Ansell-Edmont, PVC Style 12-254	14	309	43/1.09

Ethyl Acrylate

Glove Description: Supplier, Material	Breakthrough Time, minutes	Permeation Rate, $ug/cm^2/sec$	Glove Thickness, mils/mm
Safety 4, 4H® laminate	>480	ND	3/0.08
North, butyl Catalog No. B174R	309	5.45	22/0.56
Ansell-Edmont, nitrile Style 37-165	52	241	20/0.51
Ansell-Edmont, neoprene Style 29-845	12	241	17/0.43
Ansell-Edmont, PVC Style 12-254	4	241	43/1.09

2-Ethylhexyl Acrylate

Glove Description: Supplier, Material	Breakthrough Time, minutes	Permeation Rate, ug/cm2/sec	Glove Thickness, mils/mm
Safety4, 4H®laminate	>480	ND	3/0.08
Ansell-Edmont, nitrile Style 37-165	>480	ND	20/0.51
North, butyl Catalog No. B174R	365	2.93	23/0.58
Ansell-Edmont, neoprene Style 29-845	125	22.8	18/0.46
Ansell-Edmont, PVC Style 12-254	104	61.4	43/1.09

Table II, cont'd.

Hydroxyethyl Acrylate

Glove Description: Supplier, Material	Breakthrough Time, minutes	Permeation Rate, ug/cm2/sec	Glove Thickness, mils/mm
Safety 4, 4H® laminate	>480	ND	3/0.08
North, butyl Catalog No. B174R	>480	ND	23/0.58
Ansell-Edmont, neoprene Style 29-845	>480	ND	18/0.46
Ansell-Edmont, nitrile Style 37-165	>480	ND	21/0.53
Ansell-Edmont, PVC Style 12-254	>480	ND	45/1.14

Hydroxypropyl Acrylate

Glove Description: Supplier, Material	Breakthrough Time, minutes	Permeation Rate, ug/cm2/sec	Glove Thickness, mils/mm
Safety 4, 4H® laminate	>480	ND	3/0.08
North, butyl Catalog No. B174R	>480	ND	25/0.64
Ansell-Edmont, neoprene Style 29-845	>480	ND	18/0.46
Ansell-Edmont, nitrile Style 37-165	>480	ND	21/0.53
Ansell-Edmont, PVC Style 12-254	332	1.95	45/1.14

Methyl Acrylate

Glove Description: Supplier, Material	Breakthrough Time, minutes	Permeation Rate, ug/cm2/sec	Glove Thickness, mils/mm
Safety 4, 4H® laminate	>480	ND	3/0.08
North, butyl Catalog No. B174R	365	1.53	22/0.56
Ansell-Edmont, nitrile Style 37-165	31	207	20/0.51
Ansell-Edmont, neoprene Style 29-845	11	207	18/0.46
Ansell-Edmont, PVC Style 12-254	4	207	42/1.06

Glove Manufacturers/Suppliers

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(800) 800-0444
www.ansell-edmont.com

Safety 4
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Lenexa, KS 66215
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For more information, see your supplier's Material Safety Data Sheet or contact:

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