HELPFUL HINTS

GLAZING

PUBLISHED BY
THE NATIONAL GREENHOUSE
MANUFACTURERS ASSOCIATION

What materials are most commonly used for glazing commercial greenhouses?

Type 1: Thin plastic films, generally ranging from 2 to 8 mils (.002"-.008"), normally installed using two layers with air inflation between the layers to provide added insulation. Specific types of films: ethylene vinyl acetate (EVA), polycarbonate (PC), polyester, polyethylene (PE), polyvinyl chloride (PVC), and polyvinyl fluoride.

Type II: Rigid Plastic panels such as single layer corrugated polycarbonate and fiberglass-reinforced plastic (FPR); multi-wall acrylic, impact modified acrylic and polycarbonate.

Type III: Rigid Glass materials including annealed, tempered and laminated.

What are the characteristics of the most commonly used glazing materials?

Acrylic is the most weatherable clear thermoplastic and is generally polymerized from methyl methacrylate monomers. It has the highest light transmission of the clear multi-wall panels. approx. 90% multi-wall configuration which allows for energy efficiency. Acrylic is not affected by UV, is shatter resistant, and has limited impact strength.

Fiberglass-reinforced plastic (FPR) is one of the least weatherable of the glazing options. It is also the most flammable of the rigid glazing materials.

Glass is made from various base ingredients including sodium, iron, lead, silica, etc. It is typically annealed or tempered (tempering increases impact strength). The most common thickness (3 mm) used offers 88% light transmission in a single pane; 77% in a double pane installation.

Impact Modified Acrylic is the newest clear weatherable thermoplastic. Clear multi-wall panels transmit approx. 85% light transmission. Multi-wall configuration allows for energy efficiency. It is not effected by UV, has 10 times the impact strength of acrylic, and is ideal for locations were hail is a concern.

Polycarbonate is a clear thermoplastic polyester of carbonic acid. It offers the highest impact strength when new. It is the most fire resistant of all the plastic glazing materials. It is available in either single pane corrugated or multi-wall panels. Corrugated panels transmit approx. 90% light, while multi-wall panels transmit approx. 80%.

Corrugated panels are the least energy efficient of the glazing materials while multi-wall panels are some of the highest. Polycarbonate offers good long-term performance as most products are manufactured with UV protection.

Polyethylene films are highly flexible plastic and are typically manufactured with UV absorbers to improve weathering characteristics and allow for multi-year use. Two types are generally offered: stiffer and stronger material called high density, and more-flexible, lower-melting, low-density film. It is the lowest cost glazing available.

Are there specific tests for various types of glazing materials?

YES, most glazing materials are manufactured to meet specific industry standards for strength and light transmission according to ASTM (Association of Standards and Test Methods) guidelines. The NGMA Glazing Standards lists various ASTM test procedures that apply to typical greenhouse glazing materials. There are tests recognized by the NGMA, including those for measuring light transmission, tensile strength, flexural strength, impact strength, and more. Consult the NGMA Glazing Standards for the complete list.

What is light transmission and how is it measured?

Light transmission is the amount of light (solar energy) which is able to pass through a given substance of glazing material. Light transmission or solar energy can be objectively tested according to ASTM tests. The unit of measurement for light is nanometers (nm). The entire solar spectrum contains various ranges of light (i.e. UV, PAR, visible, infrared, etc.). Each of these ranges is explained below.

Ultraviolet Light

Ultraviolet (UV) constitutes the lowest range in the solar spectrum, from 10 to 400 nm. Although UV radiation amounts to only 3% of the total radiation that reaches the earth but it is energetic enough to cause chemical reactions, weathering of polymers, fading of certain dyes and can be damaging for humans.

Visible Light and PAR light

Visible light is the 400nm to 700nm band. Within this band colors occur in the sequence seen in the rainbow, ranging from violet through blue, green, yellow, and orange to red. PAR (photosynthetically active radiation) is the visible portion of the spectrum and is regarded by many horticulturists as being critical for proper-plant growth and development.

Near-Infrared

Near-Infrared is thermal solar radiation which adds to the heating of the greenhouse. The near infrared range spans from 700nm to 2,500nm.

Medium and Far-Infrared

Far-infrared energy is the energy reproduced by the mass inside the greenhouse. Transmission rate of far-infrared through a covering affects the heat retention capability of a greenhouse. Far-infrared transmission varies widely among different types of coverings and should be closely evaluated.

Medium-infrared region spans 2,500 nm to 25,000 nm and the far-infrared region spans 25,000 nm to 1,000,000 nm.

What is total solar radiation?

It is the entire energy spectrum (all wavelengths) created by the sun.

What are UV absorbers?

UV absorbers are chemical compounds with the ability to selectively absorb UV radiation. When incorporated into plastics they reduce the degrading effects of ultraviolet light.

How is the energy efficiency of glazing rated?

"U" and "R" values are what most manufacturers report. The "U" value is the overall rate of heat or energy transfer; the lower the value the more resistance to heat transfer. "R-Value is the reciprocal (=1/U) and is commonly used in consumer advertising and is commonly reported on a per inch basis. The higher the value the more resistance to heat transfer the material is. This data is used to calculate heating loads for a greenhouse.

Is there a difference in energy efficiency in different glazing systems?

Air infiltration is a significant factor in heat loss, but is not a part of the "U" value calculation. Glazing systems, or the way in which the glazing is attached, can vary significantly in regards to heat loss due to air infiltration. Gasketed systems are tighter, restricting air infiltration, and therefore are more energy efficient than non-gasketed systems.

What is anti-drip and why is anti-drip important?

Anti-drip treatments lower the co-efficient of friction on the surface of the material. This slippery surface ensures that the condensation sheets off in an even film and is not allowed to form into a droplet. The anti-drip feature reduces the incidence of moisture dependent diseases and damage to delicate crops. It ensures high light quality during the early morning sunrise hours.

Are some glazing materials more resistant to hail?

Yes, impact modified acrylic and polycarbonate are made to withstand hail. While initially more expensive, in areas with a high probability for hail, the increased investment may be well worth it.

Is there a covering made that will reduce heat-gain in a greenhouse?

Yes. Actually all greenhouse glazing materials are available with formulations or tints that can reduce heat-gain and light transmission. Typically, pigments are added to reduce heat transfer and or increase diffusion for more uniform crop response.

Do government regulations apply to greenhouse glazing materials?

Yes, OSHA governs the installation of greenhouse coverings and permits are required depending on local zoning and codes.

How do I find out more about glazing?

You can find out more about glazing by contacting the NGMA for a free copy of the glazing standards or download them off the web: www.NGMA.com.

NATIONAL GREENHOUSE MANUFACTURERS ASSOCIATION
NGMA
MEETING THE CHALLENGES OF TODAY'S HORTICULTURAL INDUSTRY

VISIT US ON THE WEB:
W W W . N G M A . C O M

20 W. Dry Creek Circle, Suite 110
Littleton, CO 80120
800-792-NGMA (6462)
303-798-1338 • FAX 303-798-1315