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Glazing Materials

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THE *Fred C. Gloeckner* FOUNDATION, INC.

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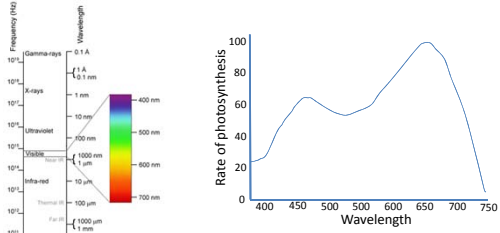
Topics

- Glass
- Rigid panels
- Film plastic



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Light transmittance through glazing material



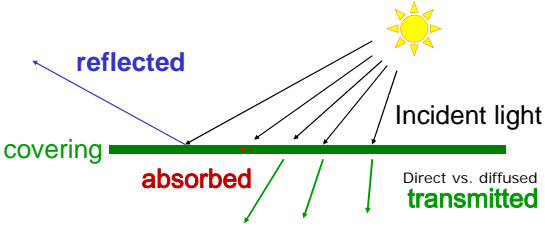
www.wikipedia.org

- Light quality = wavelengths
- Light quantity = photosynthetically-active radiation (PAR)

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Light transmittance through glazing material

About 4.5% of energy is lost when enters glazing
About 4.5% lost upon exiting glazing



reflected

covering

absorbed

Incident light

Direct vs. diffused transmitted

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Glass

- Most expensive to build
- But...
- Except, subject to damage by...

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Hail damage

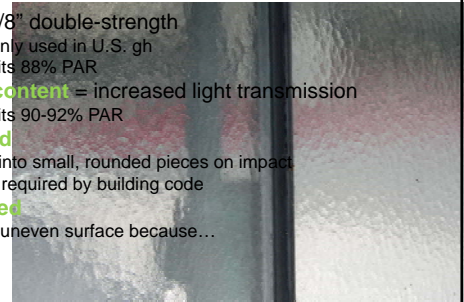


Hail damage



Types of glass

- **Float** = 1/8" double-strength
 - Commonly used in U.S. gh
 - Transmits 88% PAR
- **Low-Fe content** = increased light transmission
 - Transmits 90-92% PAR
- **Tempered**
 - Breaks into small, rounded pieces on impact
 - May be required by building code
- **Hammered**
 - Rough, uneven surface because...



Replacing glass panes



Rigid Panel - Fiberglass

- **FRP: Fiberglass Reinforced Plastic**
 - More popular in past
 - 5-20 yr life expectancy, depending on grade
 - Panels flexible; can cover quonsets and A-frames
 - Transmits 88-90% PAR
 - Resistant to breakage
 - Fewer structural members than glass



Rigid Panel – FRP Disadvantages

- Subject to etching by dust abrasion
- **FIRE HAZARD**
 - polyester & acrylic resins binding glass fibers burn



Rigid Panel – Acrylic & Polycarbonate

- Double or triple layers
- Rigid panels
- 10-year+ life
- Often coated to prevent condensation drip
- Acrylic coating on polycarbonate slows UV degradation
- 8 mm – 16 mm thickness; thinner can be bent, thicker cannot



Rigid Panel – Acrylic & Polycarbonate

- Used extensively for glazing side and end-walls



Rigid panel

Acrylic

- Highly flammable
- Transmits 83%+ PAR, guaranteed not to lose > 3% transmission in 10 yrs
- Careful installation to prevent prevent condensate

Polycarbonate

- Not flammable
- Transmits 79%+ PAR, loses ~ 1% per yr in thin panels

Hail damage possible



Photo by Jim Robbins

Fire rating

- Glass - None
- Plastic – Melts
- Fiberglass - Burns
- Polycarbonate - Melts
- Acrylic - Burns



www.wikipedia.org

Film plastic



Why film plastic glazing?

- Less expensive to build than glass and RP
- Less expensive to heat (40% savings over single-layer glass or FRP)

BUT...

- Short-lived (at best, 4-7 yrs)
- Recycling / disposal issues

Structural considerations



Types of film plastic

- Polyethylene
 - Most of U.S. construction
 - 1 mil = 1/1000 of an inch
 - Nearly all gh have 2 layers, 6 mil outer and 4-6 mil inner layer

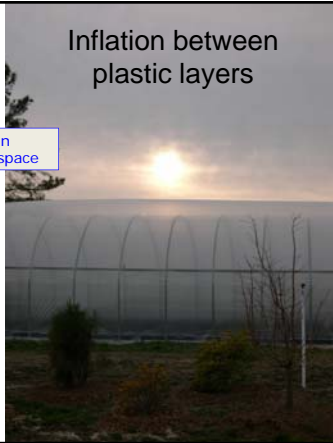
Squirrel-cage fan

Draw air from outside (colder than air between layers, and as it warms, it dries which helps control condensation b/n layers)



Inflation between plastic layers

Dead air space is great insulation
0.5 – 4" is ideal width for air space

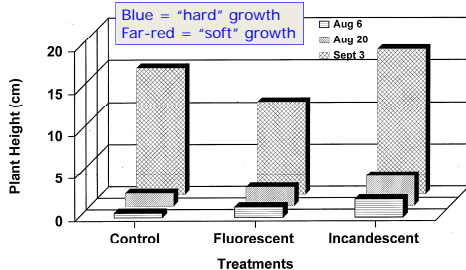


Additives to polyethylene

- UV-inhibitor
 - UV light is < 400 nm
 - Blocks UV light to slow discoloration & hardening of plastic
 - Never purchase construction plastic which is not UV-stabilized
 - Disease control: UV radiation of 280-320 nm is essential for sporulation of *Botrytis cineraria*
 - UV radiation causes dark, bluish pigment to form on tips of rose petals (petal blackening)

Photoselectivity

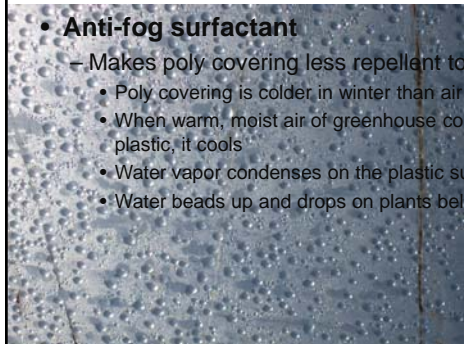
EFFECT OF END-OF-DAY R:FR LIGHT ON SUNFLOWER HEIGHT



Fluorescent R:FR = 11.5; Incandescent R:FR = 0.7
Research by Paul Jennings (Fluorescent treatment started on August 22)

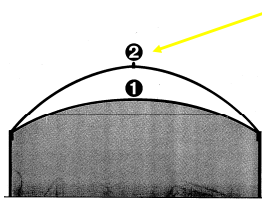
Additives to polyethylene

- Anti-fog surfactant
 - Makes poly covering less repellent to water
 - Poly covering is colder in winter than air inside gh
 - When warm, moist air of greenhouse contacts plastic, it cools
 - Water vapor condenses on the plastic surface
 - Water beads up and drops on plants below



Additives to Polyethylene

Rough Brothers 'White House'



RP covering has anti-fog surfactant

Additives to polyethylene

- Infra-red (IR) heat-blocking chemical
 - Prevents radiant energy loss
 - Warm objects radiate IR energy; Poly is a poor barrier to radiant energy loss
 - IR-blocking chemicals reduce loss by half, 10-15% of total heat loss in gh at night

Additives to polyethylene

- Light transmission is affected by chemical additives

Covering	% PAR
UV-stabilized	87%
IR-absorbing	82%
2-layers UV-stabilized	76%

What compensates for the lower light transmission of poly compared to the 86+% of glass?



Building a poly quonset



Building a poly quonset



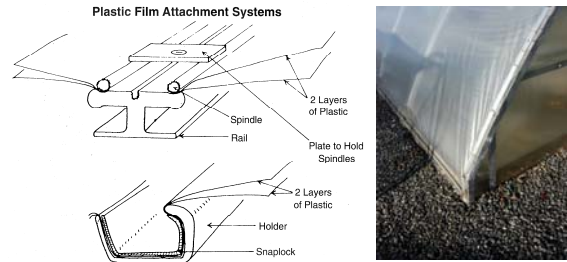
Building a Poly Quonset Gh



Building a Poly Quonset Gh



Attaching poly



Attaching Poly



Covering high tunnel

http://www.youtube.com/watch?v=EzP0Wf_cIXI



e-GRO Electronic Grower Resources Online **Types of film plastic**

- Polyester – Mylar
 - Light transmittance is similar to glass
 - Has no electrical charge
 - Excellent durability
 - Used before 1960's, but after other industrial uses were discovered, became too expensive
 - Used in heat retention curtains because...

e-GRO Electronic Grower Resources Online **Types of Film Plastic**

- Vinyl (polyvinyl chloride)
 - 8, 12 mil thicknesses; lasts 4-5 years
 - Has static electrical charge, so...
 - May last 1-2 years longer than poly, but costs ~ 3X as much
 - Not used much in N. America; more prominent in Japan

e-GRO Electronic Grower Resources Online **Types of film plastic**

• ETFE, F-Clean

- Ethylene tetrafluoroethylene
- Light transmission is 95%, so...
- Used as a covering on solar collectors
- Lasts >10 years
- Only 50" rolls, but can be bonded to desired widths and cut to required lengths
- Manufactured and used primarily in Japan
- 2-mil = \$1/ft²



www.f-clean.com

e-GRO Electronic Grower Resources Online **What factors must be considered when determining the true cost of a glazing material?**



e-GRO Electronic Grower Resources Online **What factors must be considered when determining the true cost of a glazing material?**



- Cost to purchase material
- Replacement costs incl. labor
- Life expectancy
- Energy savings
- Geographical location impacts choice, related to insurance cost
- Light transmission
 - Shadows
 - How much decreases over time

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