What is degreening?
The process of exposing “green” citrus fruit with low levels of ethylene to enhance coloration.

Ethylene Degreening
What do we degreen?
- Early season navel oranges
- Re-greened valencia oranges
- Lemons
- Mandarins
Preharvest Factors Affecting Degreening

Fruit Maturity, Tree Vigor, and Climatic Effects

- Immature fruit may be poorly colored
- Fruit from trees that are vigorously flushing are more difficult to degreen
- Natural color break needs to have been initiated
  7 - 13°C (45 - 55°F) night temperatures
- For best color development in CA valencia orange need
  Young and Erickson, 1961
  20°C (68°F) day; 7°C (45°F) night; 12°C (54°F) soil

Cultural Practices

- Rootstock
  Affects tree vigor and may therefore affect color break
- Spray Programs
  Summer oil insecticide sprays may delay color break
  Gibberellin application
- Fertilization Practices
  High Nitrogen which increases tree vigor, thereby affecting color break
  Grierson and Newhall (1969)

Ethylene Degreening

Recommended Conditions

- Ethylene: 1-5 ppm
- Temperature:
  - 20-21°C (68-70°F) in CA
  - 28-29°C (82-84°F) in FL
- Humidity: 90-95%
- Ventilation: 1 air exchange/hour
- Carbon Dioxide: reports varies, <1%

The Degreening Atmosphere

- Ethylene
- Temperature
- Humidity
- Air Circulation
- Ventilation and Atmospheric Composition
The Degreening Atmosphere - Ethylene

- Results in the destruction of chlorophyll and the development of carotenoids
- Will stimulate respiration; with low ethylene levels effect is transitory
- May stimulate volatile production
  Greater stimulation in green vs yellow lemons (Norman and Craft, 1968)
- May enhance decay especially stem end rots as well as anthracnose
- Hastens button senescence
- Literature for the most part indicates that it is unnecessary to exceed 5 ppm, lower concentrations may be equally effective depending on cultivar

The Degreening Atmosphere - Humidity

- Low R.H. may result in soft fruit and loss of size
- Very low humidity may inhibit process
- Low R.H. may accentuate physical blemishes and increase stem end rind breakdown
- Best results with 90-95%
The Degreening Atmosphere - Temperature

- De-greening temperature varies with growing region
  - 29°C in FL vs. 20-21°C in CA
- High temperatures inhibit carotenoid pigments (>30°C; 86°F)

The Degreening Atmosphere – Air Circulation

Good air circulation is required
- to equalize conditions of temperature, humidity, ethylene through entire room
- to uniformly deliver ethylene to every fruit
- to remove unwanted products such as carbon dioxide and volatiles (?) from room

The Degreening Atmosphere – Atmospheric Composition

High carbon dioxide can inhibit ethylene

Threshold values of CO₂ inhibitory effect is unclear
- 1% - FL orange and grapefruit degreening rooms (Grierson and Newhall, 1960)
- 2.5%, Shamouti oranges; 5%, lemons (Cohen, 1973) in controlled environment

Oxygen concentration may have some influence; reports are confusing

Other Factors Affecting Degreening

Packinghouse Treatments

- Bin Drenching
- Washing
  - Increases time for degreening?
- Waxing
  - Inhibits
- Color Sorting
  - Increases efficacy of treatment

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Degreening
- early season navels
- late season valencias

1 - 5 ppm ethylene
68 - 70 F; 90 - 95% RH
<1% CO₂
Degreening of Mandarin

Mainly early season satsumas harvested before the onset of cool temperatures

Fungicide application

2 ppm ethylene
No ethylene

Pre-DeGreening

Imazalil or Thiabendazole
Fungicides in Storage WAX
Water rinse
Water brushing
Dryer
Color sorting

Soak tank
1 to 4 min residence

Storage (Coastal Lemons)
Degreening/Packing (Desert Lemons)

Other resource information on degreening

FRESH CITRUS FRUIT 2nd Edition
Florida Science Source, 2006
http://www.ultimatecitrus.com/fssource

Recommendations for Degreening Florida Fresh Citrus
Ritenour et al. 2008
University of Florida Circular 1170
http://postharvest.ifas.ufl.edu

Lemon Degreening

Desert lemons harvested in August - October
Coastal lemons on a more limited basis
Thank you for your attention