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Additives Primer
Blown Films, Cast Films & Extrusion Coating

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“Common” Additives for PE & PP Films

- Slips
- Antiblocks
- Antistats
- Antifogs
- Antioxidants
- UV absorbers
- UV inhibitors
- Fillers

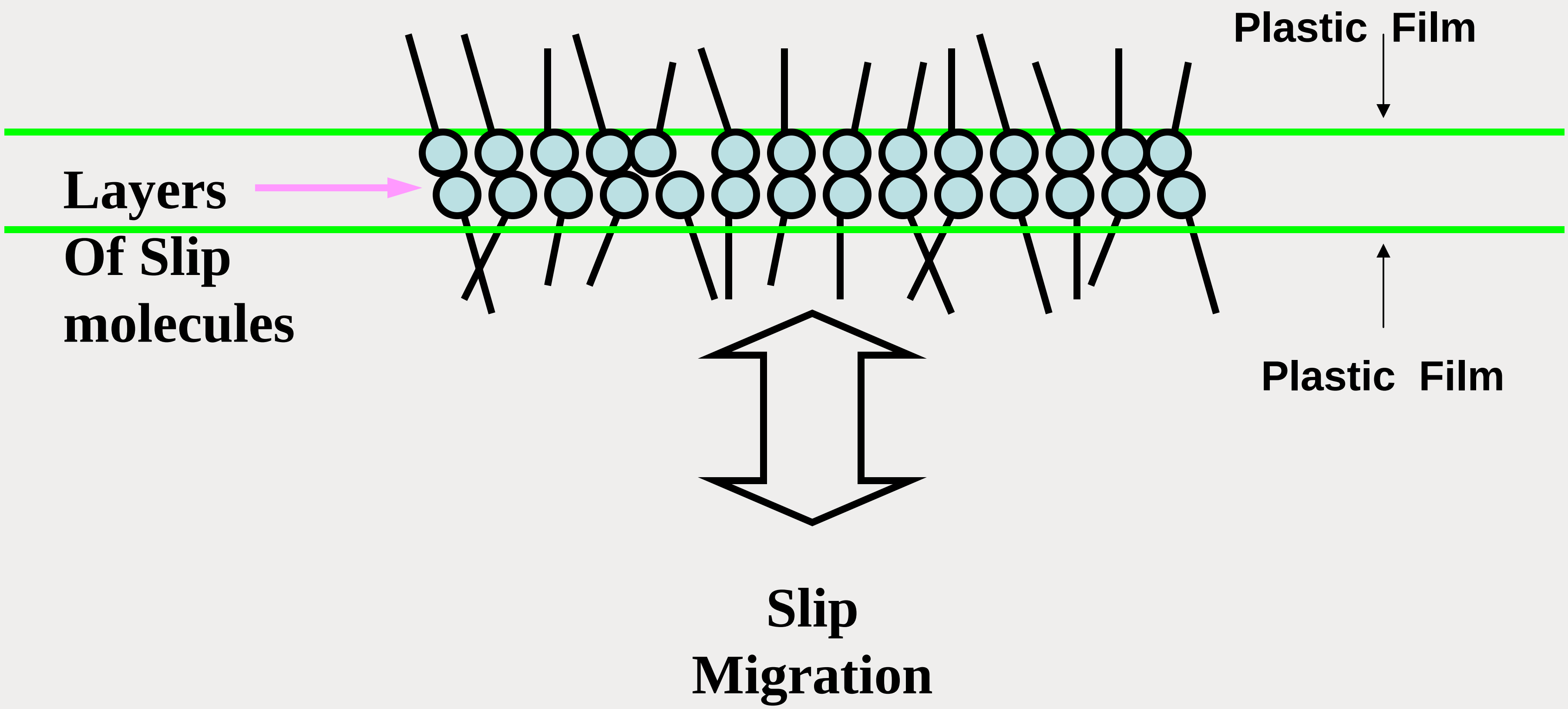
“Exotic” Additives

- Nucleating/Clarifying agents
- Flame Retardants
- Antimicrobials
- Oxygen scavengers
- Odor absorbers
- Desiccants

Processing Temperatures for PE films

- **Blown Film- Typically < 400F**
- **Cast Film- Range from 450 to 550F**
- **Extrusion Coating – Generally > 600F**
- **Challenges for high temp. processes (Cast film & extrusion coating)**
  - **Thermal Stability of additives**
  - **Moisture adsorption by additives**

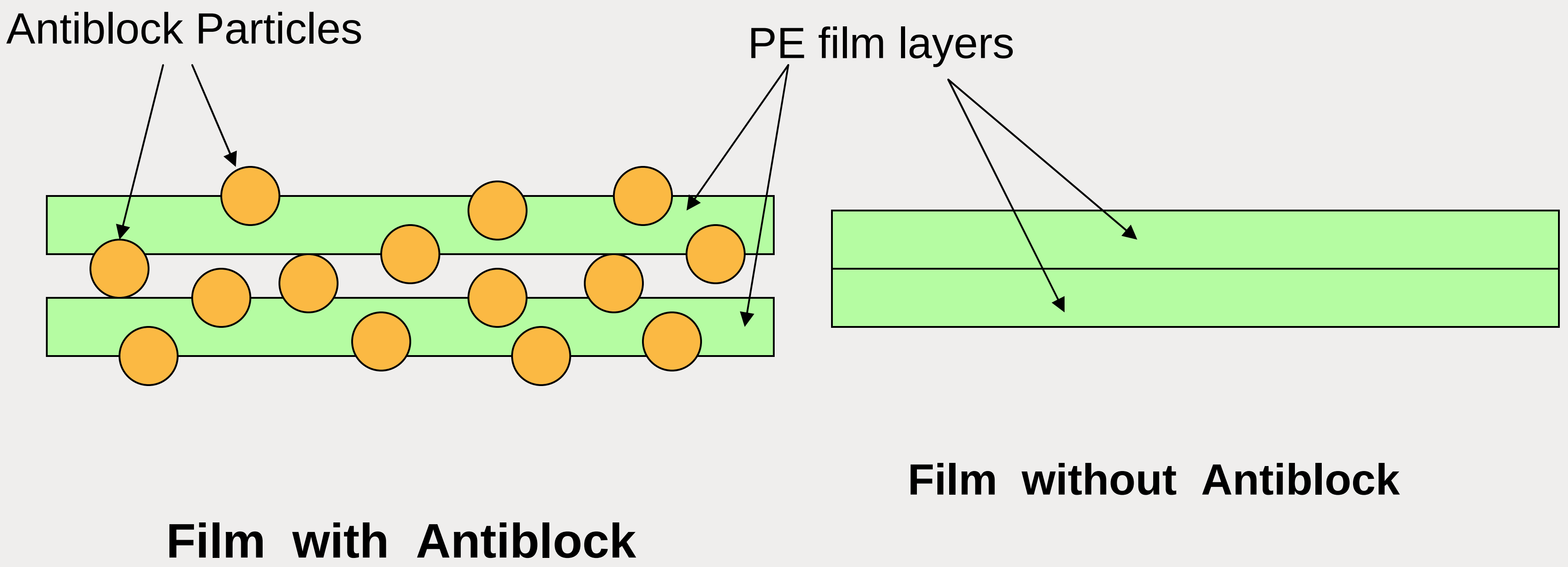
Slips: Mechanism



Slips

- Erucamide & Oleamide- most commonly used
- Challenges:
  - COF Control- Correct Loading
  - Thermal Stability (CF, EC)
  - Heat sealing
  - Printing
  - Maintenance of corona treatment
  - Adhesive laminations
  - Transfer on a roll

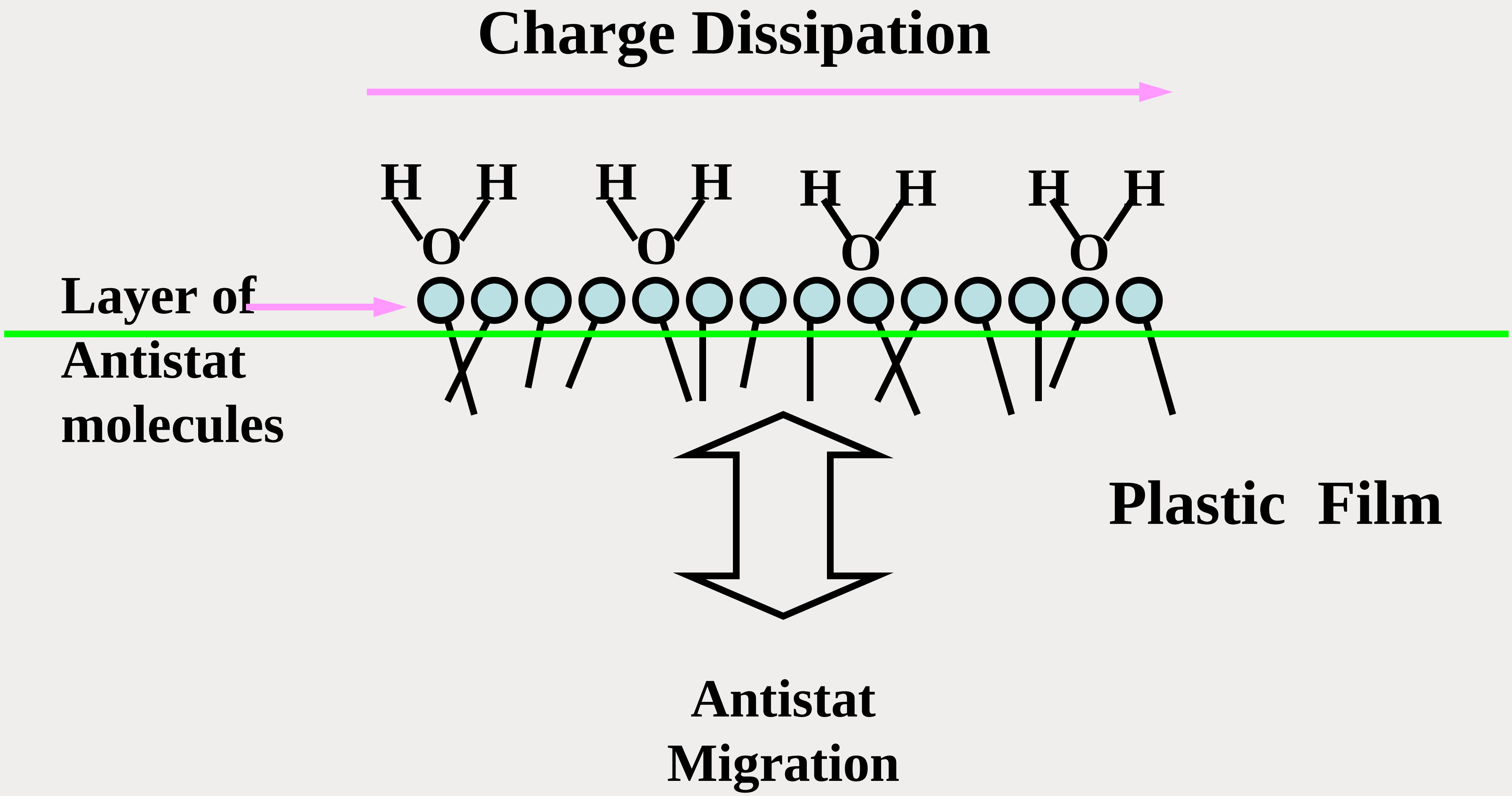
Antiblocks- Mechanism



Antiblocks

- Diatomaceous earth (DE) and Talc- the most commonly used
- Challenges:
  - Quality of dispersion
  - Particle size & film layer ratios
  - Abrasiveness
  - Haze/Clarity
  - Correct loading (Related to polymer type)
  - Synergy with slips

Antistats- Mechanism



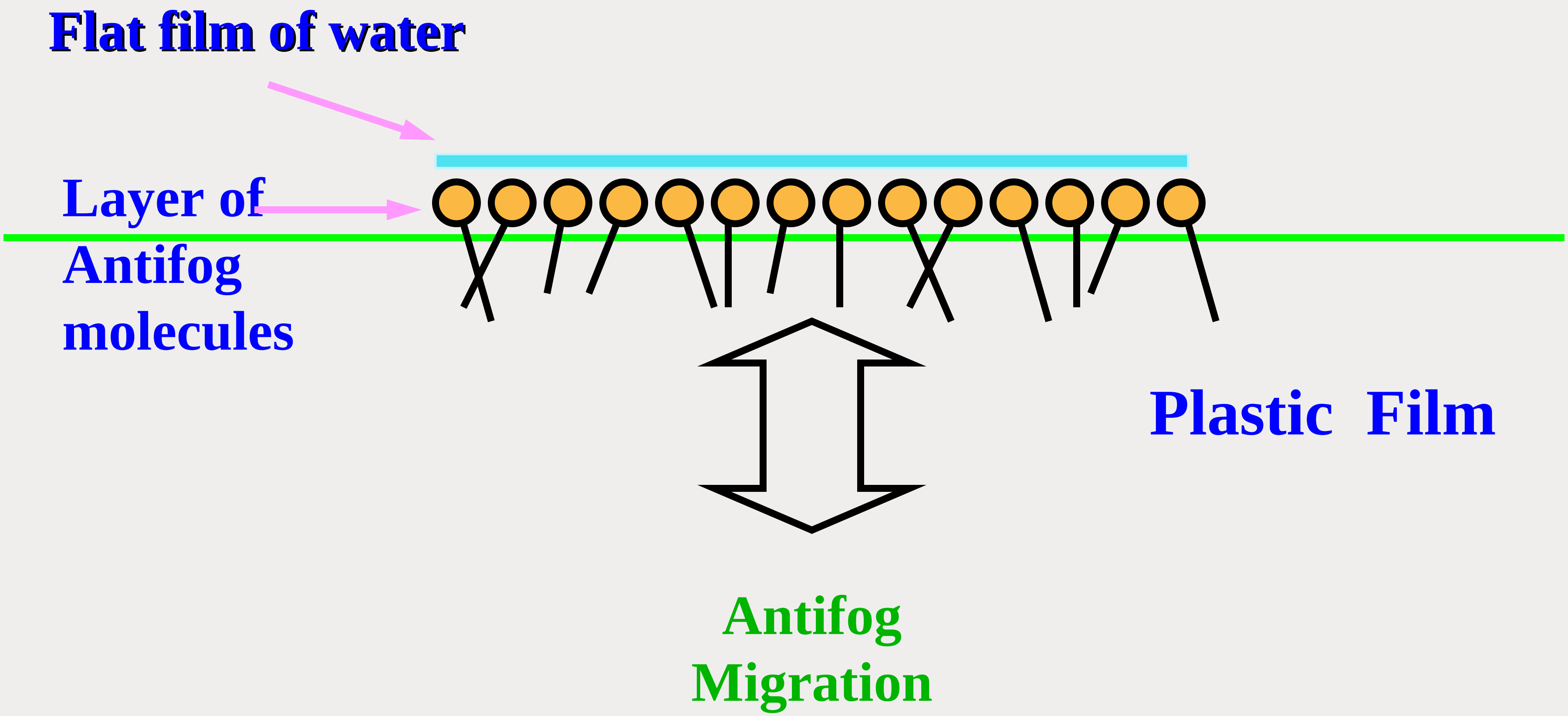
Antistats

- Various Chemistries- Amines, Amides & Esters most common
- Challenges:
  - Knowledge of specifications
  - Humidity Dependent
  - Migration slow- properties are time dependent
  - Polymer selection (Diff. AS chemistry)
  - Correct Loading (Multilayer films)

Antistats

- **Challenges:**
  - **Thermal stability (CF, EC)**
  - **Heat Sealing**
  - **Printing (Ink Adhesion)**
  - **Maintenance of corona treatment**
  - **Adhesive Laminations**
  - **Other additives**

Antifogs- Mechanism



Antifogs

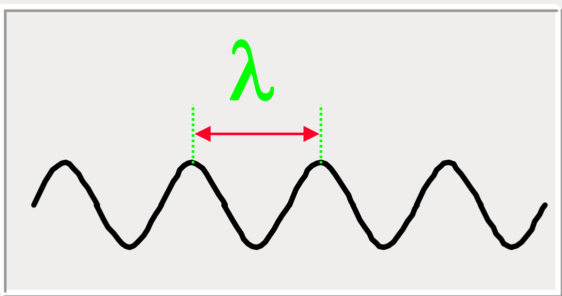
- Chemistries must be FDA approved
  - Limited Chemistries
- Challenges:
  - Migration slow- properties are time dependent
  - Polymer selection (Diff. AF chemistry)
  - Correct Loading (Multilayer films)
  - Performance dependent on film structure, type of test, test equipment etc.

Antifogs

- Challenges:
  - Thermal stability (CF, EC)
  - Heat Sealing
  - Printing (Ink Adhesion)
  - Maintenance of corona treatment
  - Adhesive Laminations
  - Other additives

Electromagnetic Spectrum

- ***Infrared (IR) : 750 - 35000 nm***
- ***Visible light : 400 - 750 nm***



Red : 647-750 nm

Orange : 585-647 nm

Yellow : 575-585 nm

Green : 490-575 nm

Blue : 424-490 nm

Violet : 400-424 nm

Intensity of the total sun irradiation is expressed in

Kilolangleys (Kly) :

1 Kly = 4.184 KJ/cm2

- ***Ultra Violet (UV) : 200 - 400 nm***
- ***X Rays : 0.01 - 10 nm***

UV Absorbers vs. UV Inhibitors

- UV light (high energy)- can degrade the polymer as well as degrade the contents of a plastic package
- UV inhibitors- added to prevent polymer degradation and protect the film or the plastic package itself
- UV absorbers- added to absorb UV light & protect contents of a package
  - Organic UV absorbers
  - Inorganic UV absorbers

Organic UV Absorbers

■ Efficiency

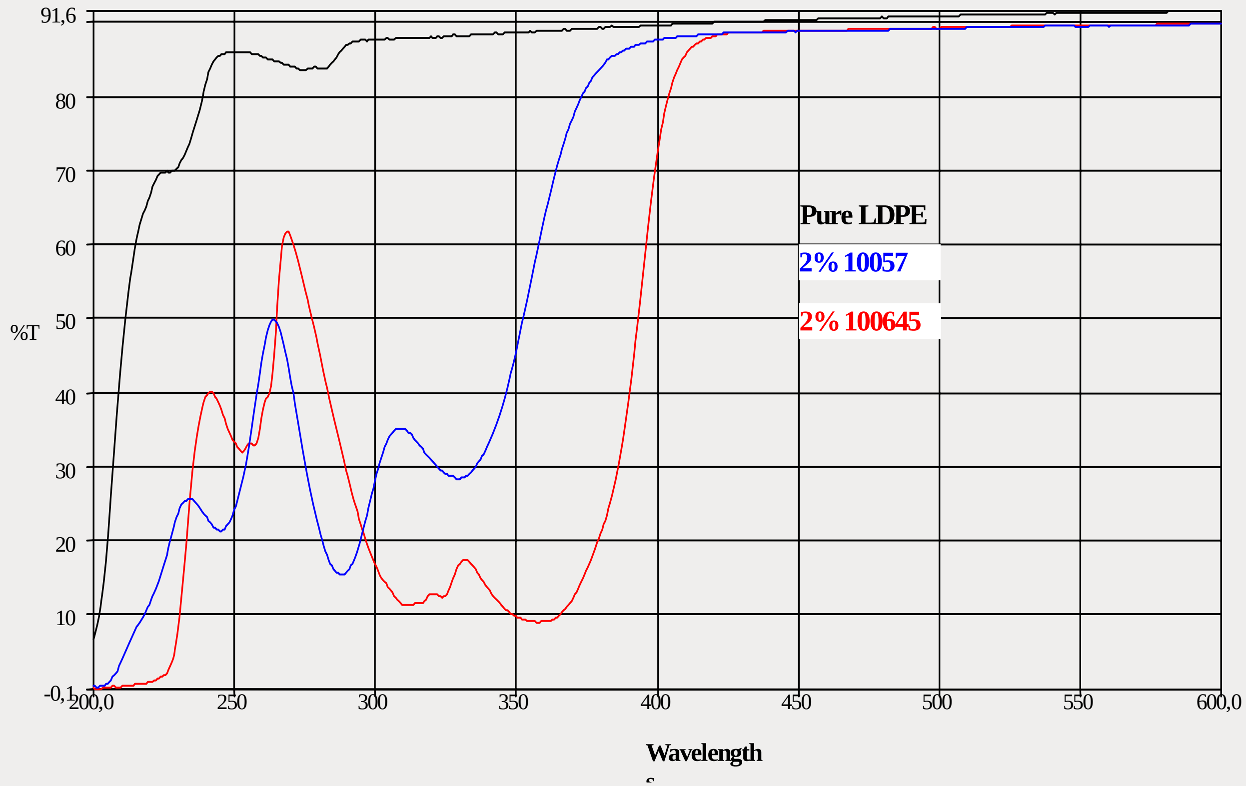
- Lambert-beer's law

$$\text{Abs} = k.t.c \quad \begin{cases} \text{Abs} = \text{Absorbency} \\ k = \text{extinction coefficient} \\ t = \text{thickness} \\ c = \text{concentration} \end{cases}$$

- UV absorbency is proportional to additive concentration and film thickness
- Only for "thick" film (above 100µm)
- Compatibility limit : 5000-6000ppm

Organic UV Absorbers

- UV Screening of 100µm films containing 2000ppm Organic UV Absorber 1 (2% 10057) and 2000ppm Organic UV Absorber 2 (100645)



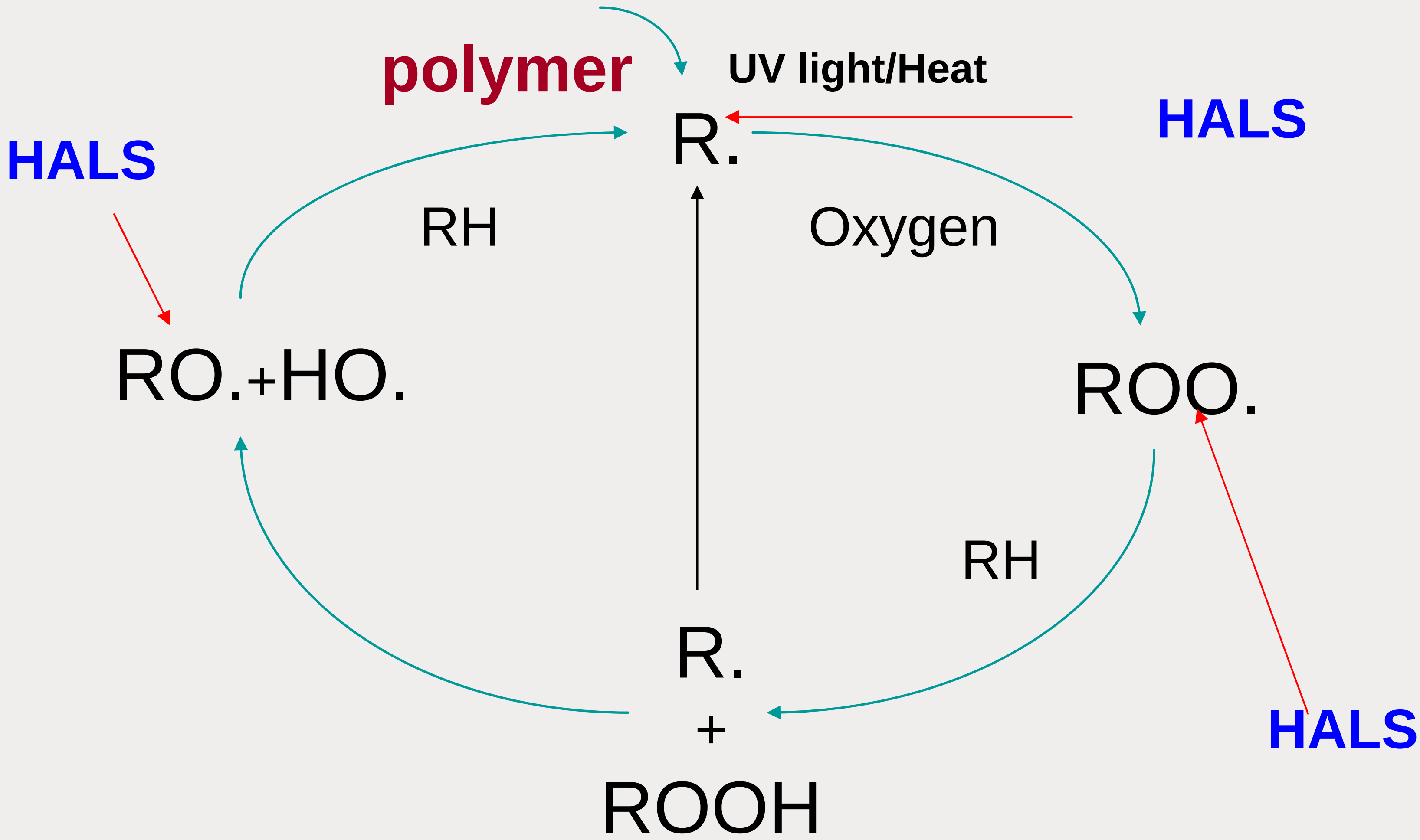
UV Absorbers

- Challenges:
  - Blocking UV light completely in a thin, transparent film (< 100 μ)
  - Organic UVAs
    - Additive migration
    - Yellowish color
  - Inorganic UVAs
    - Quality of dispersion
    - Haze/poor clarity

UV Inhibitors

- Protect the polymer from degradation caused by exposure to UV light
- Scavenge free radicals
- Hindered Amine Light Stabilizers (HALS) are the most common ones

Auto Oxidation Cycle



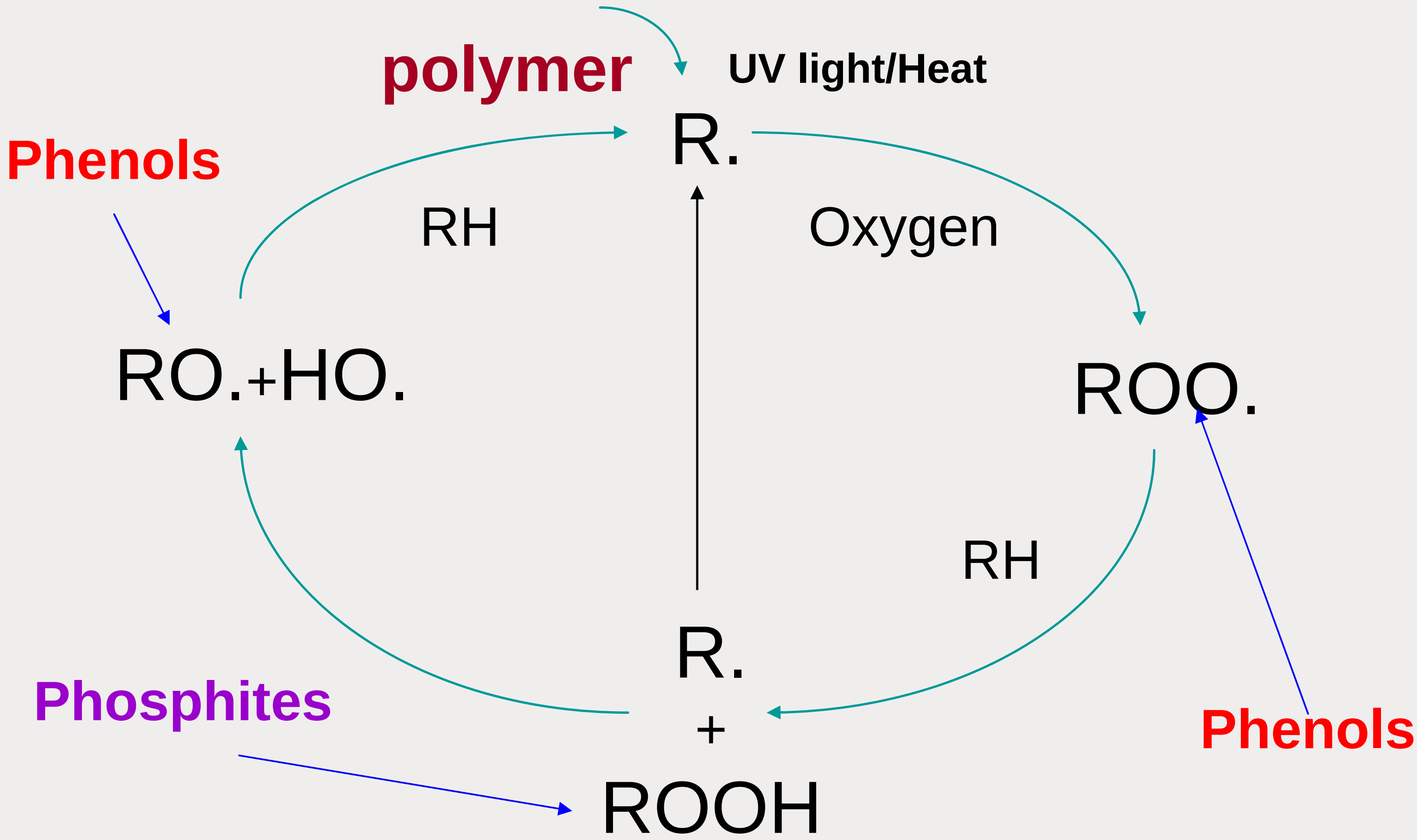
UV Inhibitors

- **Challenges:**
  - Correct loading
  - Proper selection of HALS
  - Interaction with other additives
  - Interaction with acidic chemicals such as pesticides & herbicides

Antioxidants

- Protect the polymer from thermal degradation
  - Processing
  - Long term storage under hot conditions
- Hindered phenols (primary AO) and phosphites (secondary AO) are the most common

Auto Oxidation Cycle



Antioxidants

- Challenges:
  - **Discoloration such as pinking or yellowing caused by phenolic AOs (biggest challenge)**
  - **Hydrolysis of phosphites**
  - **Correct loading**

SUMMARY

- **Additive Challenges:**
  - **Proper chemistry selection & correct loading**
  - **Migration (slips, antistats, antifogs)**
  - **Thermal Stability/Smoking (cast film & extrusion coating)**
  - **Heat sealing, Printing & Adhesive Lamination**

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Thank You

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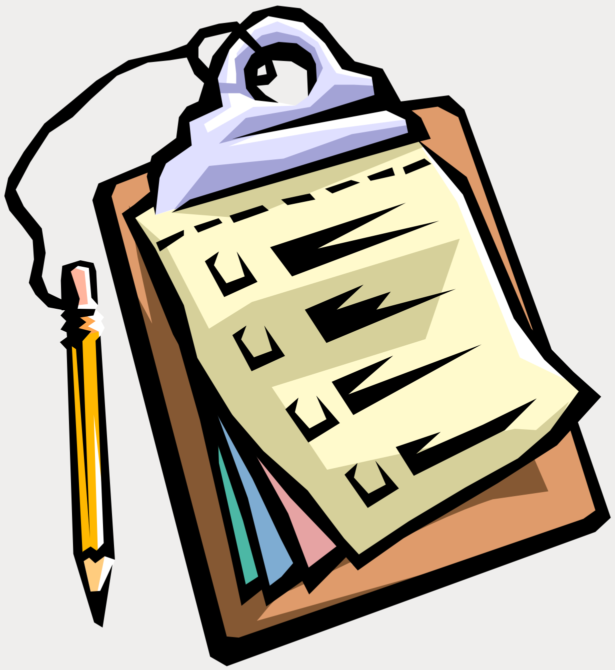

Please remember to turn in your evaluation sheet...