Improving Facade Performance with Innovative and Sustainable Materials

Dr. Eiji Shidoji
Executive Director (Technology)
AGC Asia Pacific Pte Ltd
19-September 2015
Penang, Malaysia
A Façade is any side of a building that faces the public

Basic Considerations

• Safety
• Aesthetics
• Strength (Wind Load, etc.)
• Thermal performance (U-Value, SC)
Modern Urban Considerations

- Life Cycle Costs
- Functionality
- Weatherability
- Comfort (Sound, Daylight, etc.)
- Renewable Energy
1. Improving Durability
Fluoropolymer protective coatings

2. Use of Energy Efficient glass materials
Coated Glass
Insulated Glass Unit (IGU)
ATTOCH
BIPV

3. Dynamic materials to enhance Aesthetics in Façade
Combination of Film and LED lighting
1. Improving Durability
   Fluoropolymer protective coatings

2. Use of Energy Efficient glass materials
   - Coated Glass
   - Insulated Glass Unit (IGU)
   - ATTOCH
   - BIPV

3. Dynamic materials to enhance Aesthetics in Façade
   Combination of Film and LED lighting
WWR (Window to Wall Ratio) & SC (Solar Coefficient) are dominant factors!
Minimize Window Size (WWR)
Required SC & U to meet regulation

OTTV of each products in case of WWR=0.5

- Sunergy/Green (Tv:56%)
  - OTTV = 55
- Sunergy/Green IGU
  - OTTV = 44
- Stopray (Tv:52%)
  - OTTV = 35
- Single Glazing Coated Glass
  - OTTV = 70
- Single Glazing Glass
  - OTTV < 50

WWR=0.5
# OTTV Regulation in SE Asia

<table>
<thead>
<tr>
<th></th>
<th>Singapore</th>
<th>Malaysia</th>
<th>Indonesia</th>
<th>Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>50</td>
<td>45</td>
<td>45</td>
<td>50</td>
</tr>
</tbody>
</table>

(W/m²)
OTTV Regulation in SE Asia

\[ OTTV = \alpha((1-WWR)\times U_w)\times T_{Deq} + (WWR\times U_f\times \Delta T) + (WWR\times SC\times SF) \]

Conduction through wall  
Conduction through window  
Radiation through window

OTTV in each country  
in case of \(U_{\text{window}}=3.0\), \(WWR=0.5\)

OTTV formula should be adjusted according to the climate
AGC Range of Solar Control (Low E) Glazing

**Stopsol (On Line)**
- Good SC
- Easy handling

**Sunergy (On Line)**
- Versatile pyrotic
- Easy handling

**Stopray (off Line)**
- Excellent selectivity
- Neutral color
- Low U

Wide range products for various requests.
● Improved solar shielding performance (SC: Shading coefficient)

**Single pane**
- SC: 1.0
- Solar energy: 100%
- Transmittance: 86%
- Reflection: 8%
- Absorption: 6%
- Re-radiation: 2%
- Re-radiation: 4%

**Double glazing**
- SC: 0.90
- Solar energy: 100%
- Transmittance: 74%
- Reflection: 14%
- Absorption: 12%
- Re-radiation: 7%
- Re-radiation: 5%

**Low-E double glazing**
- SC: 0.28
- Solar energy: 100%
- Transmittance: 21%
- Reflection: 35%
- Absorption: 44%
- Re-radiation: 40%
- Re-radiation: 4%

This is the key point

● Improved thermal insulation (U value)

**Single pane**
- U value: 5.8 W/(m²K)

**Double glazing**
- U value: 3.0 W/(m²K)

**Low-E double glazing**
- U value: 1.6 W/(m²K)

Special Metal Film

Glass facing interior

Spacers

Desiccant

Structure of Low-E double glazing

Energy Efficient
The Secret of Heat Shielding

Optimal design of multi-layered film structure

Cross section TEM Photograph

Layered structure of Low-E Film

The optical interference effect is used to enable visible light to pass through and infra-red light to be reflected

Optimal design of multi-layered film structure

Spectroscopic transmittance

Spectroscopic reflectance

Energy Efficient
The low emissivity of silver suppresses heat transfer by radiation

Uses low emissivity of silver

Heat dissipation by radiation reduced to 1/10

Layered structure of Low-E Film

Conventional glass

Low-E glass

Emissivity: 0.9

Emissivity: below 0.1

The Secret of Thermal Insulation

Energy Efficient
Strength of Offline Coating

Various Materials Combination

- Higher Energy Performance
- Variety: Various Color Appearance
Project References

Project Name: Catalana Occidente (Barcelona, Spain)
Glass Product: Stopray Indigo 48T

Project Name: Myzeil, (Frankfurt, Germany)
Glass Product: Stopray Vision 50T
AGC Range of Solar Control (Low E) Glazing

**Stopsol (On Line)**
- Good SC
- Easy handling

**Sunergy (On Line)**
- Versatile pyroptic
- Easy handling

**Stopray (off Line)**
- Excellent selectivity
- Neutral color
- Low U

Wide range products for various requests.

Energy Efficient
**Strengths of Online Coating**

- **High Durability & Resistances**: Scratch, Chemical, etc...
- **Easy Handling**: for Glass Processing
- **Versatile**: Can be used Single or double glazed.

**Pyrolitic (On Line) Coating – CVD**

**Stopsol, Sunergy**

**Float Online Production**

- Raw material
- Burner
- FURNACE
- Molten glass
- Under coater – layer #1
- Top coater – layer #2
- Glass Temp. 600°C ~ 700°C

**Energy Efficient**
Comparison of Stopsol and Sunergy

- **Visual light**
  - **Stopsol**: ~35%
  - **Sunergy**: ~8%

- **Solar energy**
  - **Stopsol**: High light reflection
  - **Sunergy**: Low light reflection

Energy Efficient
Project References

Project Name: Bishan Library, Singapore
Glass Product: Sunergy Clear

Project Name: Peterson Condominium, Singapore
Glass Product: Sunergy Azur
Project References

Project Name: Wavelink, Singapore
Glass Product: Sunergy Green

Project Name: Waterplace Condominium
Singapore
Glass Product: Stopsol Classic Dark Blue

Energy Efficient
1. Improving Durability
   Fluoropolymer protective coatings

2. Use of Energy Efficient glass materials
   Coated Glass
   Insulated Glass Unit (IGU)
   ATTOCH
   BIPV

3. Dynamic materials to enhance Aesthetics in Façade
   Combination of Film and LED lighting
Fluon® ETFE FILM

Enhance Aesthetics
What is ETFE FILM?

- Fluon® ETFE FILM is high-performance film produced by AGC with its own Fluon® ETFE resin.
- Fluon® ETFE FILM shows the excellent features, and can be used in various applications.

AGC’s advantage is to develop and produce both resin and film.

Ethylene-Tetrafluoroethylene copolymer
Various Applications of Fluon ETFE FILM

- **Structure**
  - **Roof and façade**
  - Greenhouse covering

- **Energy**
  - Solar-cell protection
  - Fuel battery

- **Electronics**
  - Release film for Flexible Printed Circuits
  - Release film for semiconductor

- **Others**
  - Protective film for noise insulation
  - Wallpaper surface
  - Range hood

25 Enhance Aesthetics

All rights reserved by Asahi Glass Co., Ltd
1. Outstanding Weatherability
2. High Light Transmittance
3. Flexible Design
   • Free Printing
   • Wide range of Colours
   • Unique Design
   • Evening Illumination
   • Light Support Structure
Film Property: UV transmittance over long service life

Enhance Aesthetics
Weatherability

Film Property: Tensile strength retention over long life

Enhance Aesthetics
High Light Transmittance for Lawn

- Transparent films for East-South roof
- White films for other part (including façade)

Grass growth!
Free Printing

“P12” Covering Ratio 46%

“P63” Covering Ratio 63%

“P61” Covering Ratio 80%

Enhance Aesthetics
Wide Range of Colours

Standard Colours:
- WT: (White)
- TB: (Blue)

Other colours: More than 100 colours are available (Depends on volume)
Lighter support structure required (compared to glass)

ETFE film (2m)

Glass (1m)
1. Single Layer

2. Cushion Type (Multi Layer)

Fastener
Film
Frame

Tension

Air Pressure

Thermal Insulation!

Enhance Aesthetics
How Strong is ETFE Film?

Unique Design / Strong Cushion

...... VERY!

Enhance Aesthetics

All rights reserved by Asahi Glass Co., Ltd
Allianz Arena (Football stadium) (2005, Munich in Germany)

- 2 layered Cushion for Roof & Facade
- White & Transparent Film
- Approx. 200,000 sqm as film

Enhance Aesthetics
Evening illumination / Allianz Arena, Germany

- 2 layered Cushion for Roof & Facade
- White & Transparent Film
- Illumination by fluorescent back-light
- Contribution of film due to diffused light transmittance
- Reflecting 2 team color: FC Bayern München (Red), TSV München von 1860 (Blue)

Enhance Aesthetics
2 layered Cushion for Roof & Facade
White Film
Illumination by LED back-light which can change colour by electric control
Contribution of film due to diffused light transmittance
Project references

Khan Shatyr Entertainment Center

Astana, Kazakhstan

Enhance Aesthetics
Sentosa Universal Studio

Singapore

Enhance Aesthetics
Project references

Sports Hub

Singapore

Enhance Aesthetics
End of Presentation

Thank you for your kind attention

Dr Eiji Shidoji