High Performance Green Coating

By Ashraf Wassef
Agenda

- What is the challenge?
- Green Building Rating Standards
- How can coatings contribute to the solution
- High Performance Green Coating
Dear Humans,
You are the weapons of mass destruction.

sincerely,
The World

That day when the North Pole became a lake...

North Pole - July 22, 2013
Climate Changed.
Global Population 2009

6.8 billion

9 billion 2050

Source: US Census Bureau
Cities grew as well

Disturbed eco balance
Source: United Nations

Urbanization

1975
15 @ 5-10M
3 @ 10M+

2007
30 @ 5-10M
19 @ 10M+

2025
48 @ 5-10M
27 @ 10M+
Mass consumption and mass production

Mass Consumption of natural resources

Mass-Consumption

Mass-Production

Mass Energy production
Earth’s near future

SINCE RIO 1992, GLOBAL FOREST COVER HAS DECREASED BY THREE MILLION SQUARE KILOMETRES

Green forest to deserts
Mass Waste!
Cities consume 75% of the world’s energy and produce 80% of its greenhouse gas emissions.
Green House Gases and VOC

- Greenhouse Gases all expressed as CO$_2$ equivalents, weighted with their Global Warming Potential (CO$_2$, CH$_4$, N$_2$O,..)
- VOC -“Volatile Organic Compounds are emitted as gases into the air at room temperature and contribute to the formation of smog
- HAP’s fine particles PM2.5 < $10$ micrograms per cubic meter /year & larger pollutants PM10 < $20$ micrograms per cubic meter /Y
- Peshawar registered a PM10 level of $540$ in 2010, Delhi in India had an average PM2.5 of $153$ micrograms per cubic meter in the same year.
WHO says air pollution in many cities is breaching its guidelines

- The World Health Organization says 1,600 cities in 91 countries revealed that nearly 90% of people in urban centers breathe air that fails to meet levels deemed safe!
- The WHO says that about half of the world's urban population is exposed to pollution at least 2.5 times higher than it recommends.
- Beijing had the highest recorded pollution in April 2014
- Tehran Air Pollution Keeps Iran's Capital Shut Down Amid 'Un-breathable' Smog, Jan 2013
Why green buildings?

• Create 30% less greenhouse gas emissions
• Use 85% less energy
• Use 60% less drinking water
• Send 70% less waste to landfill
• Deliver IEQ (Indoor Environmental Quality), social and economic benefits
Australia, New Zealand and South Africa, and various other country level rating systems

Japan - CASBEE (Comprehensive Assessment System for Building Environmental Efficiency)
LEED v4 – certification levels

Points earned can be applied towards the following LEED ratings:

- 40+
- 50+
- 60+
- 80+
What makes a coating green?

- Energy-efficiency
- Low VOC
- HAP’s Free
- High Performance – high Durability – Better LCA
High Performance Coatings

• Objective: Develop a new water born complete system that meets Green Building Rating Standards; LEED was selected as the most widely used in the countries where Jotun has factories and sales offices.

• Three labs joint efforts to develop full solution to Steel structures Fabrication Industry; Anticorrosive lab, Topcoat Lab and Intumescent Coating lab.

• The project started approximately 3 years ago and new products were launched during December 2013 to May 2014.
High Performance Coatings

• **First product**: 2 component waterborne epoxy primer (will name it in this paper **2CWB primer**)
• **Second Product**: 2 component HAP’s Free epoxy primer (will name it in this paper **2CSB primer**)
• **Third Product**: 1 component acrylic topcoat - LEED compliant (will name it in this paper **1CWB topcoat**)
• **Fourth Product**: 1 component waterborne intumescent fire proofing coating - LEED compliant (will name it in this paper **1C WB INTU**)
Project No. 1: 2C WB primer

- Economical formulation design requires deep understanding of paint chemistry and extensive knowledge of existing raw materials.
- Final formulation of the 2C WB primer waterborne epoxy primer was reached with balanced properties and formulation cost.
- Extensive accelerated corrosion testing to ISO 12944 in waterborne or hybrid systems used from C2 to C5 corrosion environments
- Salt Spray (ISO 7253 and ASTM B117-97), Prohesion (ASTM G85-94), and Humidity (BS 3900-part F2) test results confirm that the 2C WB primer can compete with solvent borne epoxy in anticorrosive performance
Corrosion protection

ISO 12944 C3, C4 and C5
Corrosion protection testing

- C3 High : Water condensation 240h / Salt spray* 480h
- C4 High : Water condensation 480h / Salt spray* 720h
- C5 High : Water condensation 720h /

* Salt spray is not an applicable method for water-borne coatings
Adhesion to steel Sa 2½
pull-off test ASTM D 4541 and ISO 4624

<table>
<thead>
<tr>
<th>Temperature/Humidity</th>
<th>2C WB Primer</th>
<th>Older&amp; Expensive WB Primer</th>
</tr>
</thead>
<tbody>
<tr>
<td>40ºC/70%RH</td>
<td>8,9</td>
<td>9,7</td>
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<tr>
<td>23ºC/50%RH</td>
<td>9,8</td>
<td>11,6</td>
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<td>10ºC/80%RH</td>
<td>10</td>
<td>7,9</td>
</tr>
<tr>
<td>5ºC/85%RH</td>
<td>10,2</td>
<td>6,4</td>
</tr>
</tbody>
</table>
Flexibility - Conical mandrel

Old WB Primer

2C WB Primer

Other water-borne epoxies
Important parameters are temperature, good ventilation and RH control.
Trial Production & Application
Project No. 1: 2C WB primer

Water Born 2 pack epoxy
Corrosion protection and performance
ISO 12944 C3, C4 and C5
LEED® requirements
Water-borne coatings has the best HSE
Eliminate explosion risk
Minimize health risks
Green Step
Fast and green

-Without compromising on product performance
Project No. 2: 2C SB primer

- Develop a 2C SB primer, curing down to 0°C, quick drying/dry to handle. Reduces the emission of volatile organic compounds (VOC) to a minimum; less environmental impact and safer to use. High solids primer/intermediate coat for protection of steel and other non-ferrous substrates in urban and industrial atmospheres, coastal areas with low/moderate salinity and where fast dry-to-recoat and/or dry-to-handle times are desired.

- Product shall be VOC compliant, HAP’s Free and compatible with intumescent coatings.
Project No. 2: 2C SB primer

- Tests (lab and field): Low temp cure, application at low temp, recoating, VS% test, corrosion tests, condensation tests, abrasion, flexibility, adhesion on various substrates with various topcoats, adhesion of intumescent, fire tests etc.
- The result is a versatile product meets all wanted features; easy to use providing protection to steel and other substrates in urban and industrial atmospheres, coastal areas with low/moderate salinity and where fast dry-to-recoat and/or dry-to-handle times are desired
Project No. 2: 2C SB primer

Solvent Born 2 pack epoxy

Corrosion protection and performance

ISO 12944 C3, C4 and C5

LEED® requirements

Green Step

Fast and green

-Without compromising on product performance
Project No. 3; 1 C WB Topcoat

- The target was to develop a new 1C WB topcoat for use in selected Protective markets.
- The focus areas were to develop a glossy topcoat to be tinted on the MC WB tinting machines.
- The product should have good application properties and in accordance to LEED requirements.
Project No. 3; 1 C WB Topcoat

- WB acrylic technology was selected
- Screening was done on a range of acrylic resin
- Tested for critical criteria`s as gloss level, hardness development, color compatibility, appearance by airless spray e.g.
- Selected acrylic resin was then tested and optimized to match the criteria of the product: Application properties, durability, flexibility, appearance, hardness, drying times, Health profile, worldwide accessibility and cost
- The WB topcoat has been tested by an external company and passed LEEDv4 requirement regards VOC content and VOC emission. It has passed the low flame spread test, IMO 2010 FTPC and it is also approved to C3 according to ISO 12944.
Application and Properties

- NO thinning
- Fast drying
- Gloss measured according to ISO 2813:1999 gloss at 60° is 70-90%.
- Low odour
- Low VOC 55 gms/ltr,
- ISO 11890-2; 2006
- Dries down to min 10°C
- Fully complies with LEED v4 (2014) requirements for VOC content and VOC emissions
Dry Film – Adhesion

Adhesion to different primers, applied on Stainless steel Sa 2 ½
Adhesion by pull off and cross cut
ASTM standard D 4541-95 and ISO 4624
Application site: Customer in Norway.
- 2C WB Primer (100μ)
- 1C WB Topcopat (50μ)

Excellent coverage and application properties with airless spray and brush.

Fast drying and low odor. Nice edges when tape is removed while drying.

Very good sag-resistance. Application in too high WFTs may result in shrinking (e.g. >2 X max WFT).
1 C WB Topcoat

Water Born acrylic topcoat

LEED® requirements
Water-borne coatings has the best HSE
Eliminate explosion risk
Minimize health risks
Green Step

Fast and green
-Without compromising on product performance
Project No. 4 - 1 C WB INTU

• The target was to develop a new 120 minute water borne intumescent coating for the infrastructure market which is both competitive and environment friendly

• Conform to Green standard (Formaldehyde, APEO and Phthalate free)

• LEED v3 & v4 ready
Tested to BS 476

• First part of the extensive testing was carried out internally with over 40 sections fire tested when an acceptable formulation was established.

• This program was devised to give us the best possible outlook on how to test externally, as testing can be the most difficult part of the product development process.

• The second part of the test was conducted externally with over 80 sections including 3 loaded beams, 4 tall columns, 1 loaded column and 6 cell beams.
Results

- The results obtained on these tests were very good, reaching up to 30% better loadings than the major global competitor at the 120 minutes target area.
- The product can also cover all time periods with some protection for up to 180 minutes on certain section sizes.
1 C WB INTU

Up to 3 hours fire proofing
HAPS free
Low VOC
Low odour
Low environmental impact
Low explosion risk
Questions?