PPG Architectural Coatings
400 Bertha Lamme Drive
Cranberry Township, PA, 16066

Environmental Product Declaration – COMEX® Anticorrosion coating system E31 MIO and X-65 Polysiloxane

This EPD describes an anticorrosion system with two layers (E31 MIO and X-65 Polysiloxane). Comex E31 MIO is a high-build multi-purpose self-priming epoxy, manufactured with zinc phosphate/micaceous iron oxide for effective corrosion protection of steel structures. Comex X-65 is a two-component hybrid inorganic coating with high-tech modified polysiloxane-acrylic that provides durable protection to metal and concrete structures. Similar in appearance to a high-solids polyurethane with great resistance to the environment and color and gloss retention, with the advantage of an isocyanate-free product with outstanding mechanical characteristics.

Visit www.comex.com.mx/ for more information.

Declaration Holder	PPG Architectural Finishes, Inc. (email: PPGACProductStewardship@ppg.com); website: www.ppgac.com for additional information)	
Declaration Number	EPD10147	
Declared Product	*Comex E31 MIO and X-65 Polysiloxane*	
Product Category and Subcategory	Architectural Coatings – Interior Coatings	
Program Operator	NSF International (ncss@nsf.org)	
PCR	PCR for Architectural Coatings – 6-23-2017	
Date of Issue	November 30, 2018	
Period of Validity	5 years from date of issue	
Product Contents	See Table 2.	
The PCR review was conducted by	Thomas P. Gloria, PhD – Industrial Ecology Consultants (t.gloria@industrial-ecology.com)	
This EPD was independently verified by NSF International in accordance with ISO 21930 and ISO 14025.	Jenny Oorbeck joorbeck@nsf.org	☐ Internal ☒ External
This life cycle assessment was independently verified in accordance with ISO 14044 and the PCR by	Jack Geibig – EcoForm jgeibig@ecoform.com	☐ Internal ☒ External
Functional Unit	1m² of covered and protected substrate for a period of 60 years (the assumed average lifetime of a building)	
Market-Based Lifetime Used in Assessment	5 years	
Design Lifetime Used in Assessment	3 years (See Table 4)	
Test Methods Used to Calculate Design Life	ASTM D2805-11, ASTM D2486-06, ASTM D6736-08, ASTM D4828-94	
Estimated Amount of Colorant	Not applicable – product is not tintable	
Data Quality Assessment Score	Very Good	
Manufacturing Location(s)	All PPG Comex manufacturing locations in Mexico producing the products listed in this EPD.	

Contents of the Declaration:

In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the building level per ISO 21930 guidelines. The results of this EPD reflect an average performance by the product and its actual impacts may vary on a case-to-case basis.

Product Definition, Characteristics and Specifications:

Comex E31 MIO is a high-build multi-purpose self-priming epoxy, manufactured with zinc phosphate/micaceous iron oxide for effective corrosion protection of steel structures. Comex X-65 is a two-component hybrid inorganic coating with high-tech modified polysiloxane-acrylic that provides durable protection to metal and concrete structures. Similar in appearance to a high-solids polyurethane with great resistance to the environment and color and gloss retention, with the advantage of an isocyanate-free product with outstanding mechanical characteristics.

Product Classification and Description:

The products listed in Table 1 are included within this assessment. For additional information on each of the specific products, please visit www.comex.com.mx/.

Table 1 - List of formulas assessed by LCA model and report

EPD Product Name	Usage	Mixing Ratio with Part A/B (wt%)
E31 MIO RESINA	Primer - Part A	49%
E31 MIO ENDURECEDOR	Primer - Part B	51%
COMEX IND X-65 A RESINA BLANCO	Topcoat - Part A	87%
COMEX IND X-65 B ENDURECEDOR	Topcoat - Part B	13%

Under the Product Category Rule (PCR) for Architectural Coatings, Comex X-65 falls under the General exterior and interior coatings category, and Comex E31 MIO falls under the category of Primers, sealers and undercoaters as defined by the PCR. All products described in this EPD are considered to be Interior Architectural Coatings (See Glossary for category definitions). The manufacturing process for architectural coatings primarily involves the mixing and dispersing of raw materials into a homogeneous mixture. Raw materials include *pigments and fillers*, which provide color, hiding, and gloss control; *resins/binders*, which dry to form a solid film and adhere the coating to the substrate; *water*, which acts as a thinner and carrier; and *additives*, which assist with various coating properties. The product is then packaged for distribution to the customer.

The typical composition of these coatings is shown by % weight in Table 2 along with simplified version of this process shown in Figure 1.

Ingredient category	% of product by weight
Additives	1-80%
Preservatives	0%
Binders	2-90%
Fillers	0-20%
Glycols, esters, ethers	0-10%
Pigments	0-10%
Solvents	0-30%
Titanium dioxide	0-20%
Water	0-10%

Table 2 - Composition of products listed in this EPD

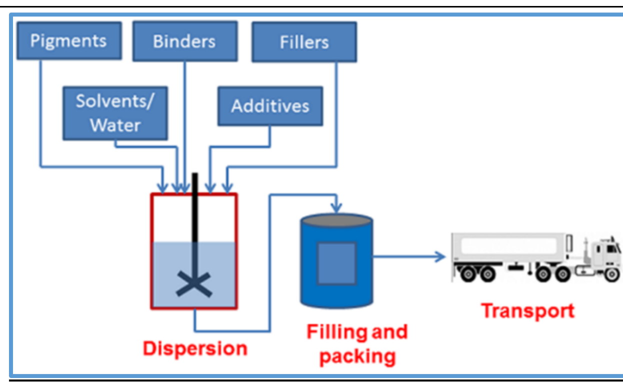

Figure 1 - Simplified process diagram for architectural coatings manufacturing

Life Cycle Assessment Methodology:

Calculation of quantities needed to satisfy the functional unit:

In accordance with the PCR, this EPD is based on a cradle-to-grave LCA, and the functional unit for the study is defined as 1 m^2 of covered and protected substrate for a period of 60 years (the assumed average lifetime of a building). The PCR requires separate analyses for a market-based lifetime and a design lifetime for the coating product, with the exception of primers. The prescribed market-based lifetime for interior coatings is 5 years. Durability testing is specified to determine the design lifetime, separated into low quality (3 year lifetime), medium quality (7 year lifetime) and high quality (15 year lifetime) finishes. The specific tests and results required to qualify for each design lifetime classification are shown in Table 3. No durability testing was performed to support this EPD, resulting in a default classification of "low quality" for Comex X-65 Polysiloxane. Comex E31 MIO, as a primer, does not have a design lifetime requirement. Calculated lifetimes and quantities are shown in Table 4.

Table 3 - Required testing for design lifetime of interior coatings

Test Type	Test	Substrate	Low Quality	Mid Quality	High Quality
Scrub Resistance	ASTM D2486-06 (2012)e1	Plastic	< 100 scrubs	100 – 400 scrubs	> 400 scrubs
Burnish – 20 cycle	ASTM D6736-08 (2013)	Plastic	Change in gloss > 20	Change in gloss between 10 – 20	Change in gloss < 10
Washability	ASTM D4828-94 (2012)e1	Plastic	Avg. score < 3	Avg. score between 3 – 7	Avg. score > 7

Table 4 - Coating lifetimes and quantities needed to satisfy functional unit

EPD Product Name	E31 MIO RESINA	E31 MIO ENDURECEDOR	COMEX IND X-65 A RESINA BLANCO	COMEX IND X-65 B ENDURECEDOR
Design lifetime (years)	3	3	3	3
Market lifetime (years)	5	5	5	5
Design lifetime quantity (kg)	2.77	2.84	4.59	0.69
Market lifetime quantity (kg)	1.66	1.70	2.76	0.41
Colorant - Technical lifetime (g)	N/A	N/A	N/A	N/A
Colorant - Market lifetime (g)	N/A	N/A	N/A	N/A

Allocation:

In the LCA model, the only allocation used was a mass-based allocation during the manufacturing process, to assign PPG manufacturing plant inputs and outputs across multiple products produced at the same plant.

System Boundary:

Because this is a cradle-to-grave LCA as required by the PCR, the system boundary includes all life cycle stages as defined by ISO 21930, from raw material extraction and processing, coating manufacture, application and end-of-life treatment, with transportation included in all stages. The system process flow diagram is shown in Figure 2. Items shown outside the system boundary in Figure 2 were excluded from the assessment in accordance with the PCR.

Criteria for the inclusion of inputs and outputs:

All components of the coating formulations which comprised more than 0.1% of the manufactured product were included in the study. The models were constructed to meet the minimum of 95% of the total mass, energy, and environmental relevance of the system, except for items excluded from the study as specified in the PCR.

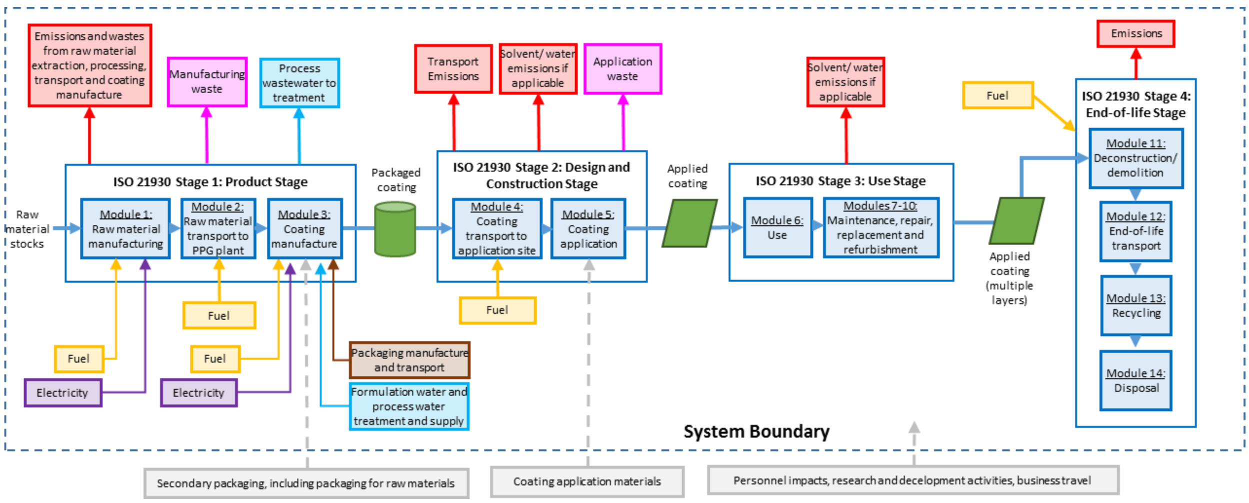

Figure 2 - Process flow diagram and system boundary for this EPD

Life Cycle Impact Assessment Methodology:

The Life Cycle Impact Assessment (LCIA) step of the analysis groups emissions and resource consumption into categories by known environmental impacts to which they contribute, and applies characterization factors to calculate the relative importance of each substance in a category. The U.S.-based TRACI 2.1 (Bare 2011) method was used to calculate the impacts in the following impact categories, in accordance with the PCR:

- Climate change or global warming potential (GWP 100 years) [kg CO_2-eq.]: Biomass carbon uptake and its re-release of CO_2 and CH_4 were reported separately based on the biogenic carbon content of the products.
- Acidification potential of land and water sources (AP) [kg SO_2-eq]:
- Photochemical ozone creation potential (POCP, or "Smog Formation") [kg O_3 eq.]
- Eutrophication potential (EP) [kg N eq.]
- Stratospheric ozone depletion potential (ODP) [kg CFC-11 eq.]

Additional life cycle inventory results reported in accordance with the PCR are the following:

- Depletion of non-renewable energy resources [MJ]
- Depletion of non-renewable material resources [kg]
- Use of renewable primary energy [MJ] - defined as renewable non-fossil energy sources: wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.
- Use of renewable material resources [kg] - defined as materials that can be readily replaced by natural means on a level equal to their consumption.
- Consumption of freshwater [m^3] – limited to the net value between uptake and re-release, accounting only for evaporation and other forms of water displacement.
- Hazardous waste [kg] – as defined by RCRA under 40 CFR 261.33
- Non-hazardous waste [kg]

Key Environmental Parameters:

The LCIA results from the TRACI method for each product are shown in Table 5. Average results for all products included in this EPD are documented and grouped separately into the different life cycle stages from ISO 21930:2007 (as shown in Figure 2) and are shown graphically in Figure 3. Results for individual products are not expected to differ substantially from the results shown in the Figure.

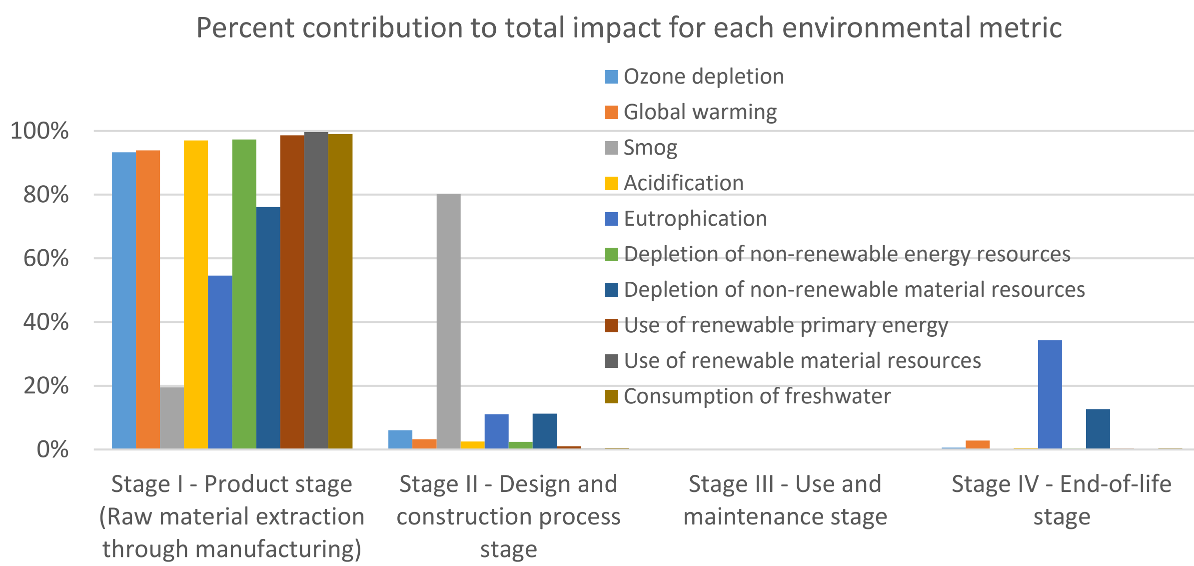

Figure 3 - Graphical impacts for the average product in this declaration showing % contribution by life cycle stage

Table 5 - LCIA results (TRACI impact categories)

Impact category	Formulations			
	E31 MIO RESINA	**E31 MIO ENDURECEDOR**	**COMEX IND X-65 A RESINA BLANCO**	**COMEX IND X-65 B ENDURECEDOR**
Life cycle impact assessment results for design life scenario				
Ozone depletion (mg CFC-11 eq)	NA	NA	3.57	0.74
Global warming (kg CO2 eq)				
Without biogenic carbon	NA	NA	20.16	3.31
With biogenic carbon	NA	NA	*21.33*	*3.72*
Smog (kg)	NA	NA	1.94	0.41
Acidification (kg SO2 eq)	NA	NA	0.11	0.02
Eutrophication (kg)	NA	NA	0.11	0.02
Life cycle impact assessment results for market life scenario				
Ozone depletion (mg CFC-11 eq)	0.39	0.43	2.14	0.44
Global warming (kg CO2 eq)				
Without biogenic carbon	6.18	8.55	12.09	1.98
With biogenic carbon	*6.46*	*8.81*	*12.80*	*2.23*
Smog (kg O3 eq)	1.91	5.43	1.17	0.25
Acidification (kg SO2 eq)	0.04	0.03	0.07	0.01
Eutrophication (kg N eq)	0.03	0.03	0.06	0.01

Material and Energy resources, Emissions and Wastes:

Additional Life Cycle Inventory Results

The additional inventory results required by the PCR for each product are shown in Table 6. As with the TRACI LCIA results, average results for all products included in this EPD are documented and grouped separately into the different life cycle stages and are also shown graphically in Figure 3.

Table 6 - Additional life cycle inventory results

Impact category	Formulations			
	E31 MIO RESINA	E31 MIO ENDURECEDOR	COMEX IND X-65 A RESINA BLANCO	COMEX IND X-65 B ENDURECEDOR
Additional environmental metrics results for design life scenario (See note 1)				
Depletion of non-renewable energy resources (MJ)	NA	NA	358.1	67.2
Fossil	NA	NA	*337.0*	*63.9*
Nuclear	NA	NA	*21.0*	*3.3*
Depletion of non-renewable material resources (kg)	NA	NA	12.34	1.70
Use of renewable primary energy (MJ)	NA	NA	10.08	4.31
Bio-based	NA	NA	*7.83*	*5.87*
Wind/Solar/Geothermal	NA	NA	*1.05*	*0.14*
Water	NA	NA	*7.92*	*1.18*
Use of renewable material resources (g)	NA	NA	3.10	1.19
Consumption of freshwater (m3)	NA	NA	0.23	0.06
Hazardous waste (%)	NA	NA	24.1%	24.1%
Non-hazardous waste (%)	NA	NA	75.9%	75.9%
VOC emissions (g)	NA	NA	745.5	135.5
Additional environmental metrics results for market life scenario (See note 1)				
Depletion of non-renewable energy resources (MJ)	120.8	187.5	214.8	40.3
Fossil	*112.3*	*177.0*	*202.2*	*38.4*
Nuclear	*8.3*	*10.1*	*12.6*	*2.0*
Depletion of non-renewable material resources (kg)	4.19	2.30	7.40	1.02
Use of renewable primary energy (MJ)	2.88	3.38	10.08	4.31
Bio-based	*1.21*	*1.75*	*4.70*	*3.52*
Wind/Solar/Geothermal	*0.13*	*0.17*	*0.63*	*0.08*
Water	*1.53*	*1.45*	*4.75*	*0.71*
Use of renewable material resources (g)	0.15	2.32	3.10	1.19
Consumption of freshwater (m3)	0.12	0.14	0.23	0.06
Hazardous waste (%)	24.1%	24.1%	24.1%	24.1%
Non-hazardous waste (%)	75.9%	75.9%	75.9%	75.9%
VOC emissions (g)	254.8	254.8	447.3	81.3
Note 1: The LCA did not explicitly include measurable amounts of secondary fuels or secondary/recycled materials.				

Emissions to Water, Soil, and to Indoor Air:

Because coatings are a passive product during use, the only impacts occurring during this phase are generally due to the off-gassing of material components in the paint. These VOC emissions are accounted for in the TRACI Smog results and also identified as an inventory item in **Table 6**.

LCA Interpretation

The LCA results show that the raw materials (Stage I, Module 1) tend to contribute highly to the impact of many indicators. This high contribution of raw materials to the impact indicators is not unexpected. As paints are primarily mixtures of pre-processed ingredients, much of the expenditure of energy, raw materials, processing, waste processing, etc. in bringing the product to existence has occurred prior to the entry of the raw materials onto the PPG production site. The majority of the impact of the raw materials comes from the titanium dioxide and the binder. This is typical for coatings products since these two raw materials are often present in high proportions and have a relatively high processing energy demand. The use phase contributes no impacts because maintenance repainting is calculated as a multiple of the initial impacts for the raw materials, manufacturing, transport and application (Stages I and II) of each product.

Additional Environmental Information:

Preferred End-of Life Options:

Please visit www.paintcare.org for information about disposing unused latex paint. If possible, unused paint should be taken to an appropriate recycling/take-back center or disposed of in accordance with local environmental regulatory agency guidance.

Data Quality Assessment:

To assess the input quality of the specific product data used in the LCA modeling, the pedigree matrix developed by Weidema and Wesnaes (1996) was used. The pedigree matrix rates data on a scale of 1 to 5 (1-poor, 2-fair, 3-good, 4-very good, 5-excellent) for each of 5 rating criteria: reliability of source, completeness, temporal correlation, geographical correlation, and technological correlation. Primary data for the year 2015 was obtained from PPG environmental reporting systems dealing with manufacturing plant operations. When primary data was for processes not directly under PPG's control, data was taken from the ecoinvent v3.1 database. ecoinvent is widely accepted by the LCA community. The regional U.S. electric power grid generation mix for each plant was used in the LCA model according to the percentage of product made at that plant. The primary data is considered to be of excellent quality and ecoinvent very good. Because the transportation, application and disposal stages contained several assumptions specified in the PCR, these stages received a minimum score of good. Considering that the majority of environmental impact is in the stages for which the data was of higher quality, the overall data quality rating was assessed as Very Good.

References:

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ISO 14040:2006 *Environmental management - Life cycle assessment – Principles and framework*.

ISO 14044:2006 *Environmental management - Life cycle assessment – Requirements and guidelines*.

ISO 21930:2007 *Sustainability in building construction – Environmental declaration of building products*.

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Glossary:

Acronyms & Abbreviated Terms:

- ACA: American Coating Association
- ASTM: A standards development organization that serves as an open forum for the development of international standards. ASTM methods are industry-recognized and approved test methodologies for demonstrating the durability of an architectural coating in the United States.
- ecoinvent: a life cycle database that contains international industrial life cycle inventory data on energy supply, resource extraction, material supply, chemicals, metals, agriculture, waste management services, and transport services.
- EPA WARM model: Unite States Environmental Protection Agency Waste Reduction Model.
- EPD: Environmental Product Declaration. EPDs are form of as Type III environmental declarations under ISO 14025. They are the summary document of data collected in the LCA as specified by a relevant PCR. EPDs can enable comparison between products if the underlying studies and assumptions are similar.
- GaBi: Created by PE INTERNATIONAL GaBi Databases are LCA databases that contain ready-to-use Life Cycle Inventory profiles.
- LCA: Life Cycle Assessment or Analysis. A technique to assess environmental impacts associated with all the stages of a product's life from cradle to grave (i.e., from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling).
- NCSS: NSF International's National Center for Sustainability Standards
- PCR: Product Category Rule. A PCR defines the rules and requirements for creating EPDs of a certain product category.
- TRACI: Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts.
- VOC: Volatile organic compounds

Terminology from the PCR:

- Architectural coating: a coating recommended for field application to stationary structures or their appurtenances at the site of installation, to portable buildings, to pavements, or to curbs. For purposes of the PCR an 'architectural coating' does not include adhesives and coatings for shop applications or original equipment manufacturing, nor does it include coatings solely for application to non-stationary structures, such as airplanes, ships, boats, and railcars. Please see the product category requirements in Section 1.1 of the PCR. General architectural coatings are decorative or protective paints or coatings formulated for interior or exterior architectural substrates including, but not limited to: drywall, stucco, wood, metal, concrete, and masonry. Primers, sealers and undercoaters are coatings formulated for one or more of the following purposes: to provide a firm bond between the substrate and the subsequent coatings; to prevent subsequent coatings from being absorbed by the substrate; or to prevent harm to subsequent coatings by materials in the substrate; or to provide a smooth surface for the subsequent application of coatings; or to provide a clear finish coat to seal the substrate; or to prevent materials from penetrating into or leaching out of a substrate. Interior architectural coatings are defined as coatings that meet the product category requirements in section 1.1 of the PCR and that are applied to substrates that primarily reside in interior.
- Biologic growth or bio deterioration: any undesirable change in material properties brought about by the activities of microorganisms.
- Blistering: the formation of dome shaped hollow projections in paints or varnish films resulting from the local loss of adhesion and lifting of the film from the surface or coating.
- Burnish resistance: the resistance of a coating to an increase in gloss or sheen due to polishing or rubbing.
- Design life: The estimated lifetime of a coating based solely on its hiding and performance characteristics determined by results in certain ASTM durability tests.
- Durability: the degree to which coatings can withstand the destructive effect of the conditions to which they are subjected and how long they retain an acceptable appearance and continue to protect the substrate.
- Erosion: the wearing away of the top coating of a painted surface e.g., by chalking, or by the abrasive action of windborne particles of grit, which may result in exposure of the underlying surface. The degree of resistance is dependent on the amount of coating retained.
- Flaking/Peeling: the phenomenon manifested in paint films by the actual detachment of pieces of the film itself either from its substrate or from paint previously applied. Peeling can be considered as an aggravated form of flaking. It is frequently due to the collection of moisture beneath the film.
- Gloss: a value of specular reflection which is often used to categorize certain types of paints.
- Intermediate processing: the conversion of raw materials to intermediates (e.g. titanium dioxide ore into titanium dioxide pigment, etc.).
- Market-based life: The estimated lifetime of a coating based off the actual use pattern of the product type. In this instance, a repaint may occur before the coating fails.
- Pigment: the material(s) that give a coating its color.
- Primary materials: resources extracted from nature. Examples include titanium dioxide ore, crude oil, etc. that are used to create basic materials used in the production of architectural coatings (e.g., titanium dioxide).
- Resin/Binder: acts as the glue or adhesive to adhere the coating to the substrate.
- Scrubbability or scrub resistance: the ability of a coating to resist being worn away or to maintain its original appearance when rubbed repetitively with an abrasive material.
- Secondary materials: recovered, reclaimed, or recycled content that is used to create basic materials to be used in the production of architectural coatings.
- Washability: the ease with which the dirt can be removed from a paint surface by washing; also refers to the ability of the coating to withstand washing without removal or substantial damage.