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VINNAPAS® DISPERSIONS OF WACKER BINDER TECHNOLOGY OF CHOICE FOR DEMANDING ENVIRONMENTAL LABELS IN MODERN ARCHITECTURAL PAINTS

Tareq Awadallah, WACKER POLYMERS, Dispersions Europe, 11 October 2012, Jeddah

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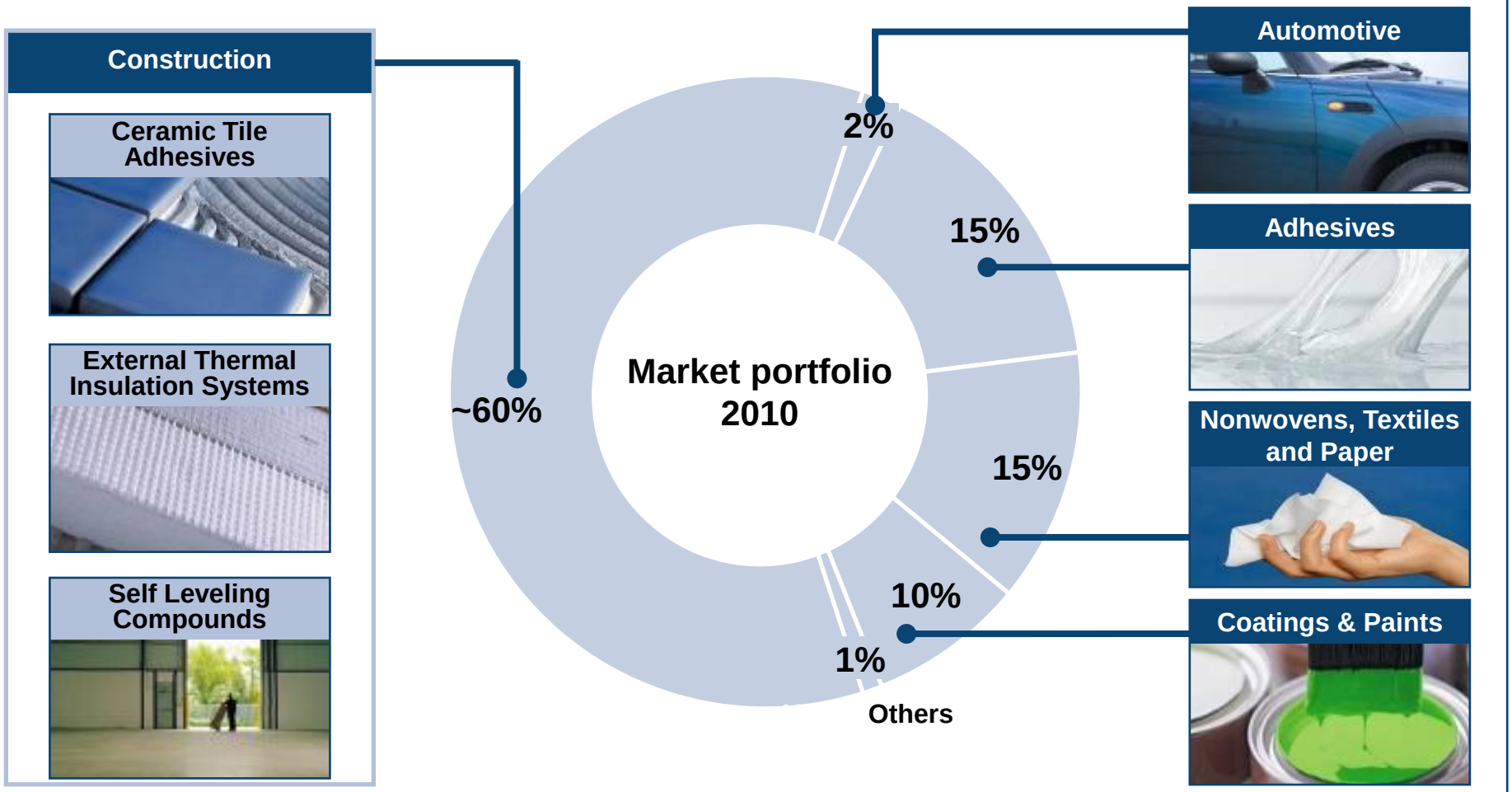
- Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.
- Learning objectives:
  - Understand the improved environmental impact of Vinyl Acetate Ethylene binders in modern paints & coating.

CONTENT

(*) Note: VAE dispersions = vinyl acetate – ethylene copolymer dispersions

POLYMERS' PRODUCTS ARE SERVING DIVERSE END-INDUSTRIES

Market Structure by Application Segment 2010



WACKER estimates

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BRIEF HISTORY OF VAE(*) DISPERSION & CURRENT EUROPEAN DISPERSION MARKET

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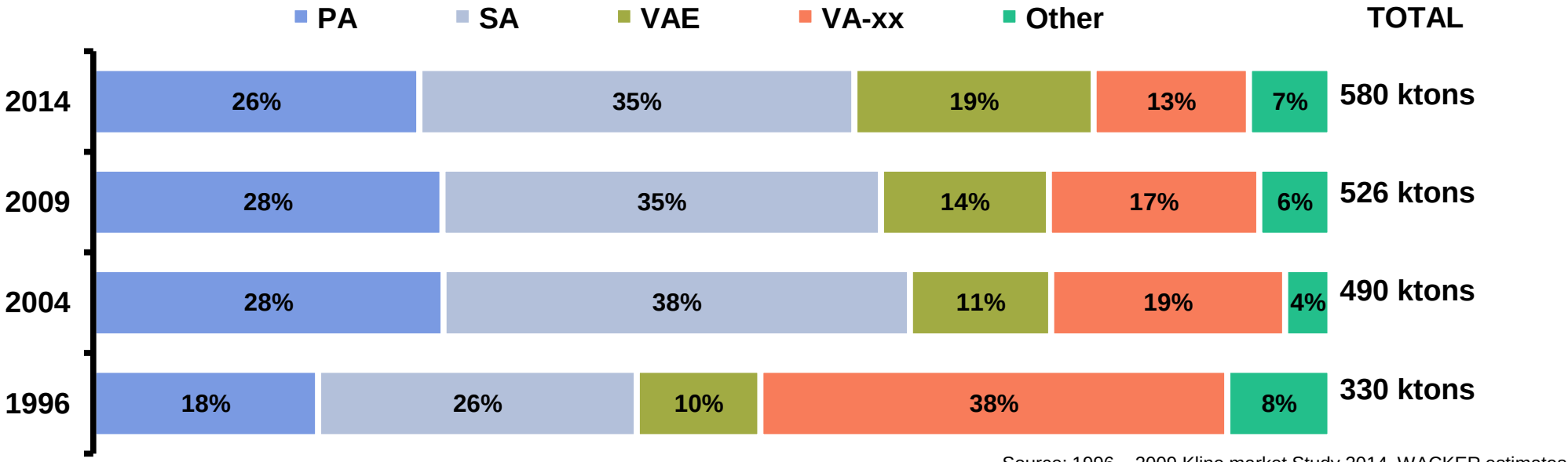
BINDER EVOLUTION DRIVEN BY TECHNICAL & ENVIRONMENTAL MARKET DEMAND

Burghausen 2004

- 1950: • Development of cellulose stabilized dispersions • First Acrylate system introduced
- 1960: • US: VAc-A Copolymers introduced • EU: launch of plasticized PVAc dispersions
- 1970: • Launch first terpolymers • Fundamental work with Ethylene as “softening” agent
- 1980: • Optimization of VAc-E and VAc-E-VC copolymer emulsion copolymerization for EU paints and coatings
- 1990: • Strong pressure to develop more environmentally friendly binders in Europe
- 2000: • VAE(*) dispersions growing in EU pushed by increasing ecological awareness
- 2010: • VAE(*)-dispersions gaining widespread attention in coatings in US

VAE(*) TECHNOLOGY GAINING MARKET SHARE OVER TIME

- **European Dispersion Market for Coatings: about 1 million ton of dispersion in 2009**
- **VAE(*) proportion growing since 20 years: from 10% in 1996 to 14% in 2009**
  - Further development of the VAE(*) technology seen
  - VAE at 20+ % market share in short term future is a realistic assumption
  - Environmentally friendly wave (growing awareness of consumer, always more restricting legislation, eco-labels, …) supporting this evolution



Source: 1996 – 2009 Kline market Study,2014 WACKER estimates

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ECO-LABELS OR LEGISLATION IN PLACE AND THEIR IMPACT ON COATINGS INDUSTRY

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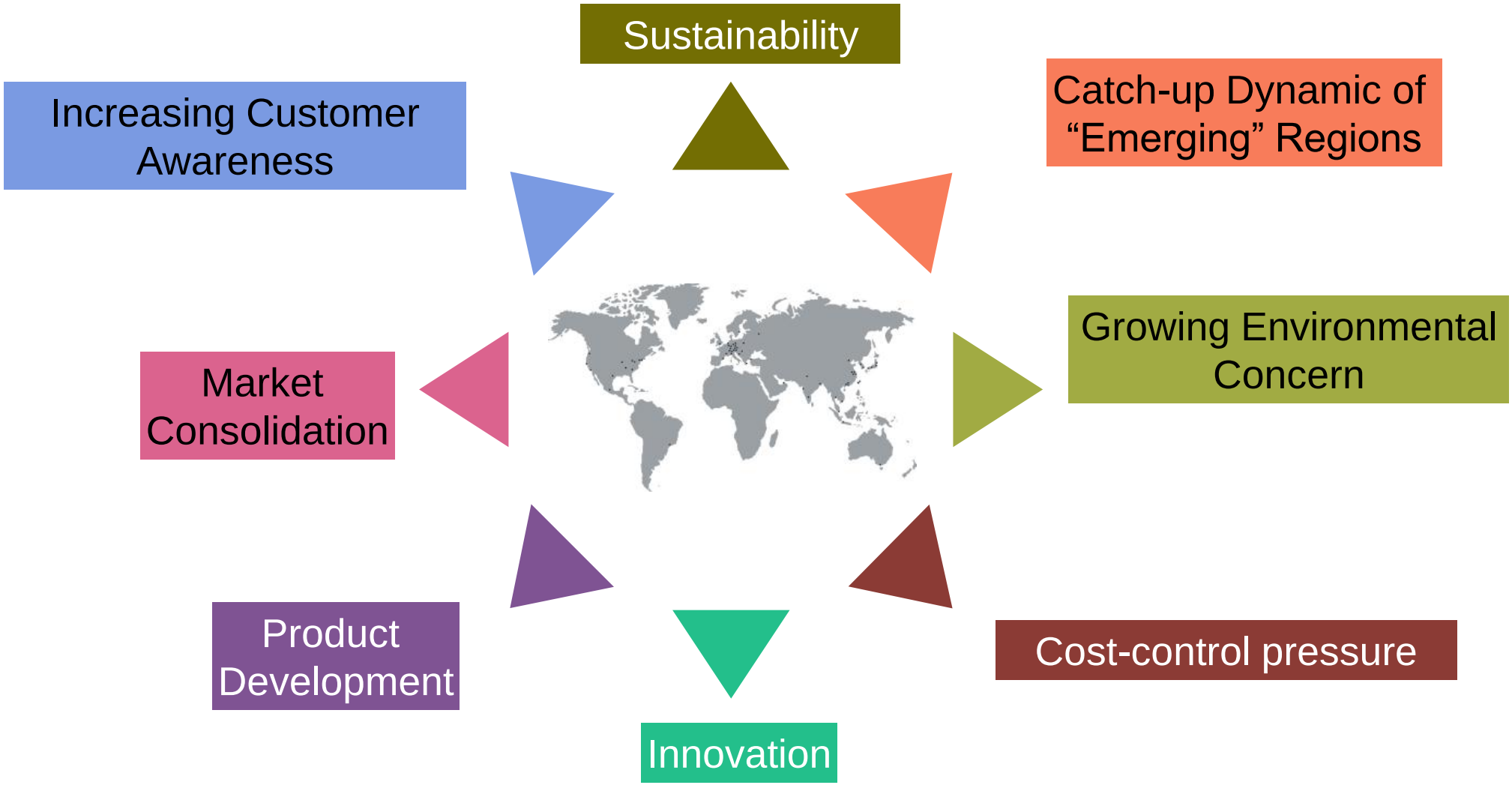
TRENDS & DRIVERS IN THE ARCHITECTURAL PAINT INDUSTRY



THE MANY SHADES OF ‘GREEN’ IN THE EUROPEAN & US COATINGS MARKET

EUROPE

DGNB®
Deutsche Gesellschaft für Nachhaltiges Bauen e.V.
German Sustainable Building Council

1978 1989 1991 1992 1996 1998 1999 2006 2007 2008 2010

USA

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WHY ARE SOLVENTS & VOC A CONCERN?

UV

NO_x VOC

Photochemical activity →
Ground-level ozone →
Summer smog

- Combination of
  - UV coming from sun activity
  - NOx produced by combustion
  - Solvents from various chemicals

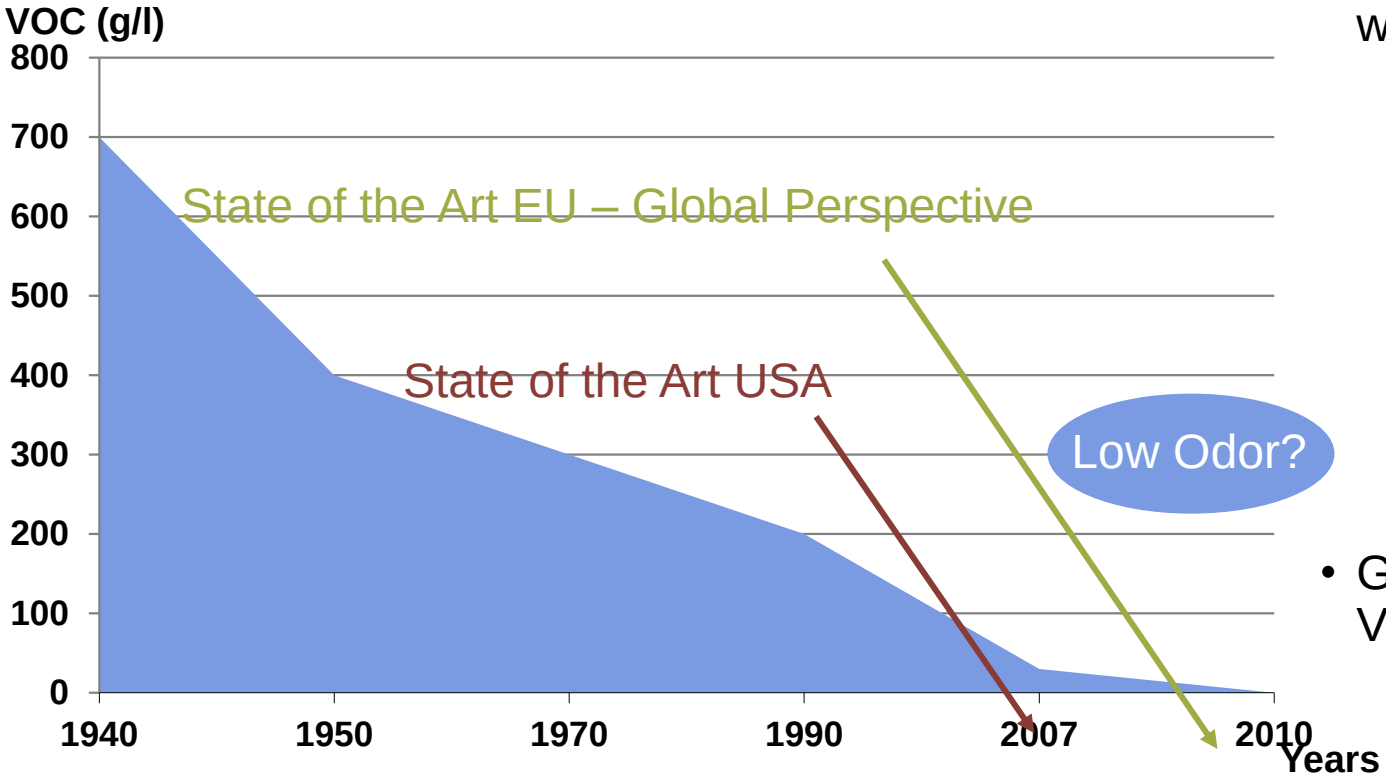
  lead to formation of summer smog (ozone building up in troposphere)

- Ozone very harmful to humans
  - e.g. allergy, asthma, heart attacks and other cardio-pulmonary issues

- Program to decrease amount of solvent in deco paints initiated long time ago across the world

WHY ARE SOLVENTS & VOC A CONCERN?

Evolution of VOC Reduction of Architectural Coatings



Solvent Borne | Latex | Clean Air Act | Amendment | CA | Blue Angel

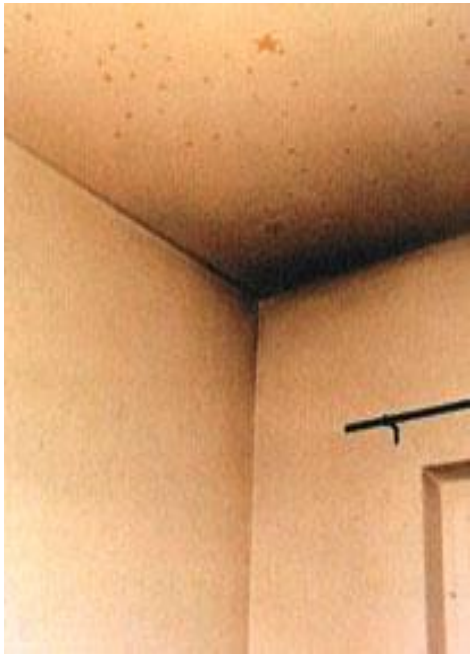
- Today more than 80% of total architectural paint production is water based
  - Strong regional differences regarding ration water-based & solvent-based
  - Strong regional differences regarding level of VOC / solvent used in formulation
  - Different understanding about definition of solvent
- Global trend toward less solvent & VOC however undisputable

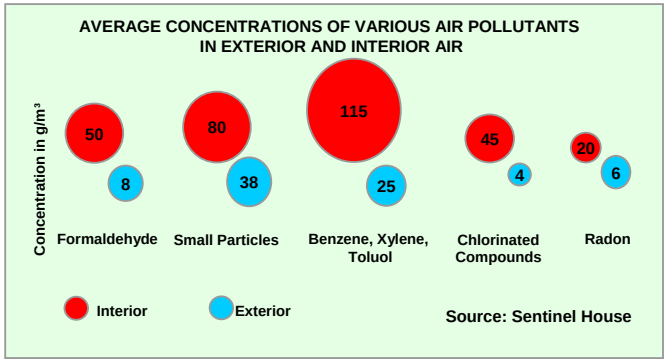
Source: Wacker Chemie AG

INDOOR AIR QUALITY …: NOT NEUTRAL FOR HUMAN HEALTH

Most important sources of organic indoor pollutants

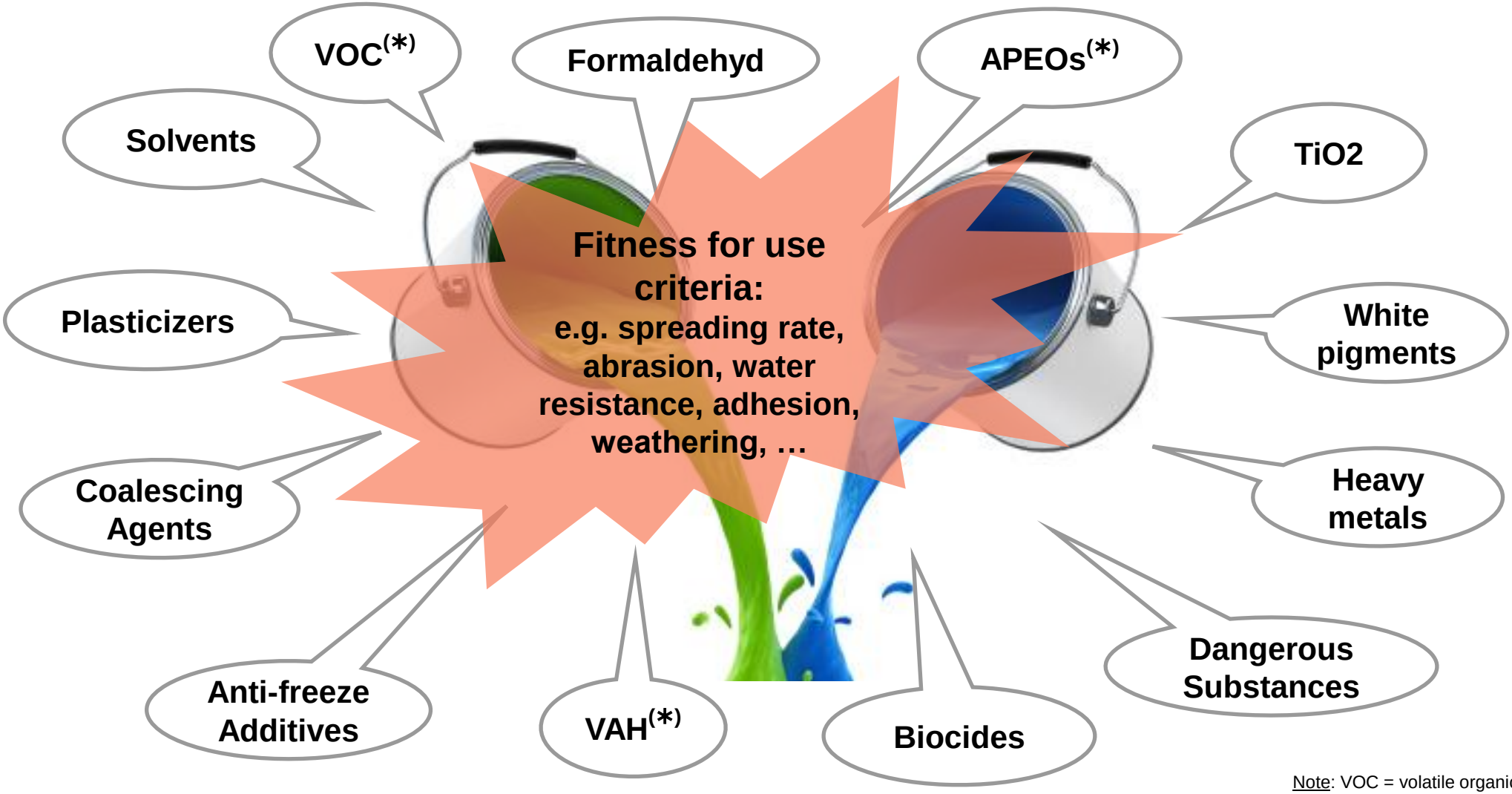
- Outdoor environment
- Man & his activities
- Materials Equipments (adhesives, caulks, floor covering, sealants, furniture, paints, wall covering, particle board, ….)





- Indoor smoke containing many dangerous pollutants produced by heating / cooking / cleaning activities
- High & efficient insulation system prevents from good aeration / ventilation leading to accumulation of these pollutants in the house
- Most heaviest pollutants accumulate on surfaces due to migration of solvent & plasticizer, creating “fogging” effect

LABELS / REGULATIONS FOCUSED MAINLY ON SOLVENT CONTENT …. BUT NOT ONLY



Note: VOC = volatile organic compound
VAH = volatile aromatic hydrocarbon
APEO = alkyl phenol ethoxylate

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WACKER VINNAPAS® VAE(*) DISPERSIONS …. A PART OF THE SOLUTION?

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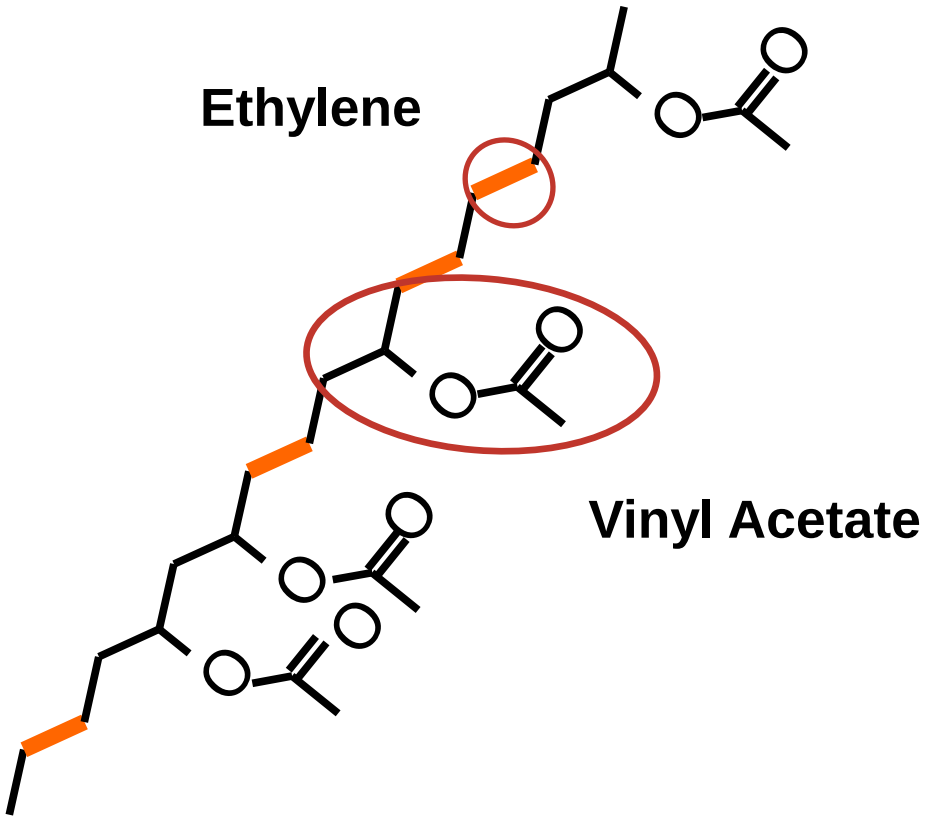
A LITTLE BIT OF CHEMISTRY
STRUCTURE OF A VAE(*) POLYMER DISPERSION



- Vinyl Acetate Monomer (VAM)
  - Based on Carbon, Hydrogen & Oxygen
  - Hard (Tg ~ 32°C)
  - Hydrophilic Character
  - Toughness
- Ethylene (E)
  - Based on Carbon & Hydrogen
  - Very soft (Tg ~ -125°C)
  - Hydrophobic Character
  - Flexibility
  - High hydrolysis resistance
- **The ideal couple**: Vinyl Acetate & Ethylene Copolymer
  - Good compatibility
  - Good reactivity
  - Good stability
  - No major toxic by-products

A LITTLE BIT OF CHEMISTRY
TWO MAIN PROPERTIES OF VAE COPOLYMER DISPERSIONS

- MFT = MFFT
  - Minimum Film Forming Temperature,
  - Characteristic of the liquid dispersion
  - Temperature at which the dispersion is able to form a cohesive & consistent film

- The lower the MFT is
  - the better the film formation
  - the least solvent or film forming agent needed
  - hence the lowest the VOC

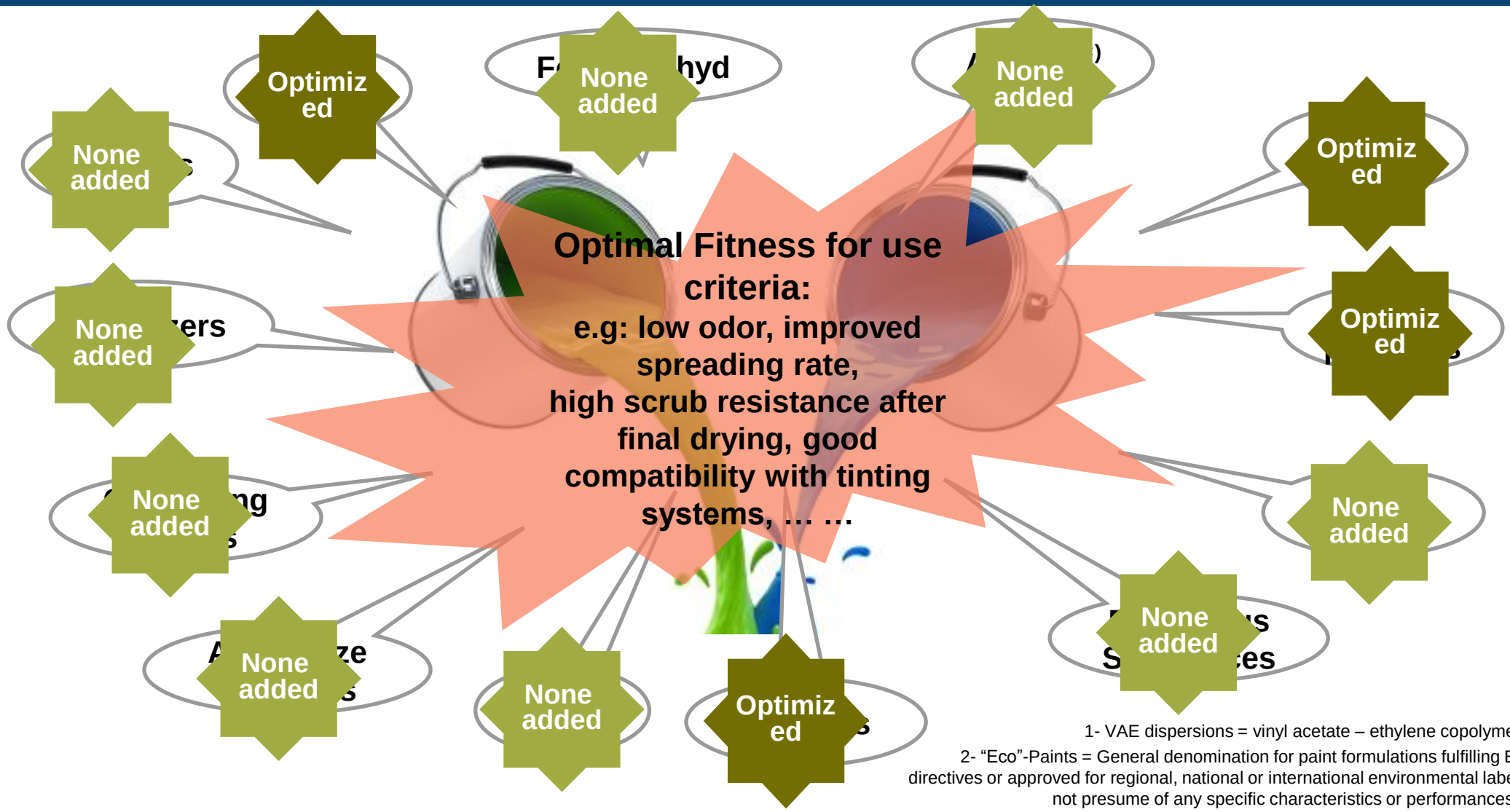
- Tg
  - Glass Transition Temperature
  - Characteristic of the solid polymer
  - Temperature at which polymer from a glassy / vitreous state turn into a rubbery / plastic state (E.g chewing gum)

- The higher the Tg
  - The higher the mechanical performance (E.g. tensile strength, cohesiveness, scrub, clean-ability)
  - The higher the blocking resistance
  - The lower the dirt pick-up

OUR DAILY ANTONYMIC CHALLENGE
DEVELOP BINDER WITH LOWEST MFT AND HIGHEST Tg

- WACKER R&D teams developed over years knowledge, competencies & extensive experience to bridge this critical but essential gap.
- WACKER VINNAPAS® VAE(*) dispersions display significantly higher Tg than Acrylic or Styrene Acrylic binder technology at low MFT …
- …. therefore better performance in low VOC paint formulations can be achieved with WACKER VINNAPAS® VAE(*) dispersions

VINNAPAS VAE(*) DISPERSIONS OFFER A COMBINATION OF BENEFITS FOR FORMULATION OF INTERIOR "ECO"-PAINTS(*)



(*) Note:

1- VAE dispersions = vinyl acetate – ethylene copolymer dispersions

2- "Eco"-Paints = General denomination for paint formulations fulfilling EU deco paint directives or approved for regional, national or international environmental labels. This does not presume of any specific characteristics or performances at that stage

3- None added: to be understood as "we do not use these chemicals during production"

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SUSTAINABILITY AT WACKER

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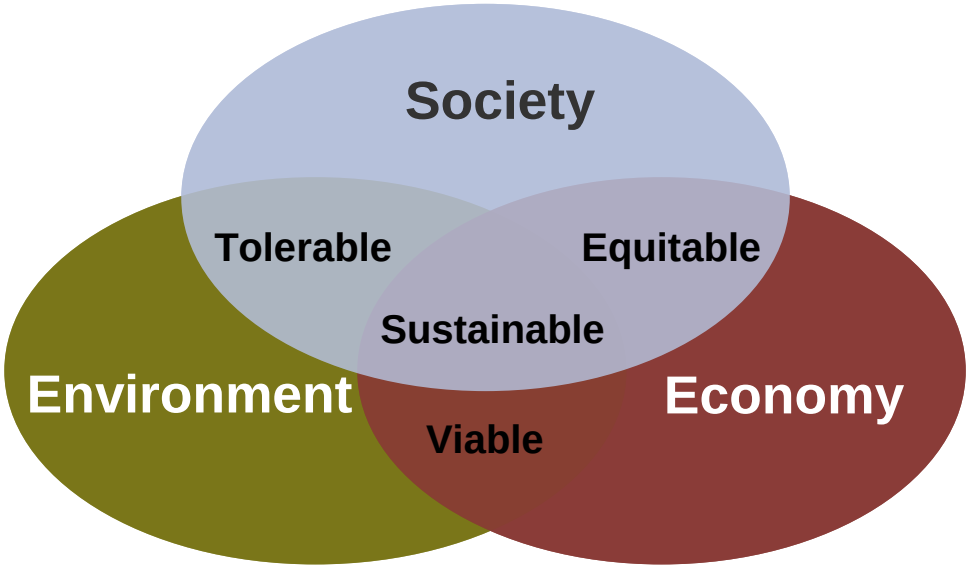
SUSTAINABILITY: A CORE ELEMENT OF OUR CORPORATE STRATEGY

- **We are convinced that chemistry makes a vital contribution to global progress and sustainable development**
- **Our aim is to balance economic, environmental and social goals**



- Ongoing high spending on environmental protection
- Safe operation of plants
- Product safety
- Open dialog with all stakeholders
- Transparency through reporting

WACKER CONSISTENTLY IMPLEMENTS THE PHILOSOPHY OF RESPONSIBLE CARE® AND GLOBAL COMPACT

- WACKER has been committed to the Responsible Care® Initiative to improve environmental protection, health and safety in manufacturing and product use exceeding legal requirements
- WACKER supports the Global Compact's 10 principles on Human rights, Labor standards, Environmental protection and Anti-corruption

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CONCLUSION

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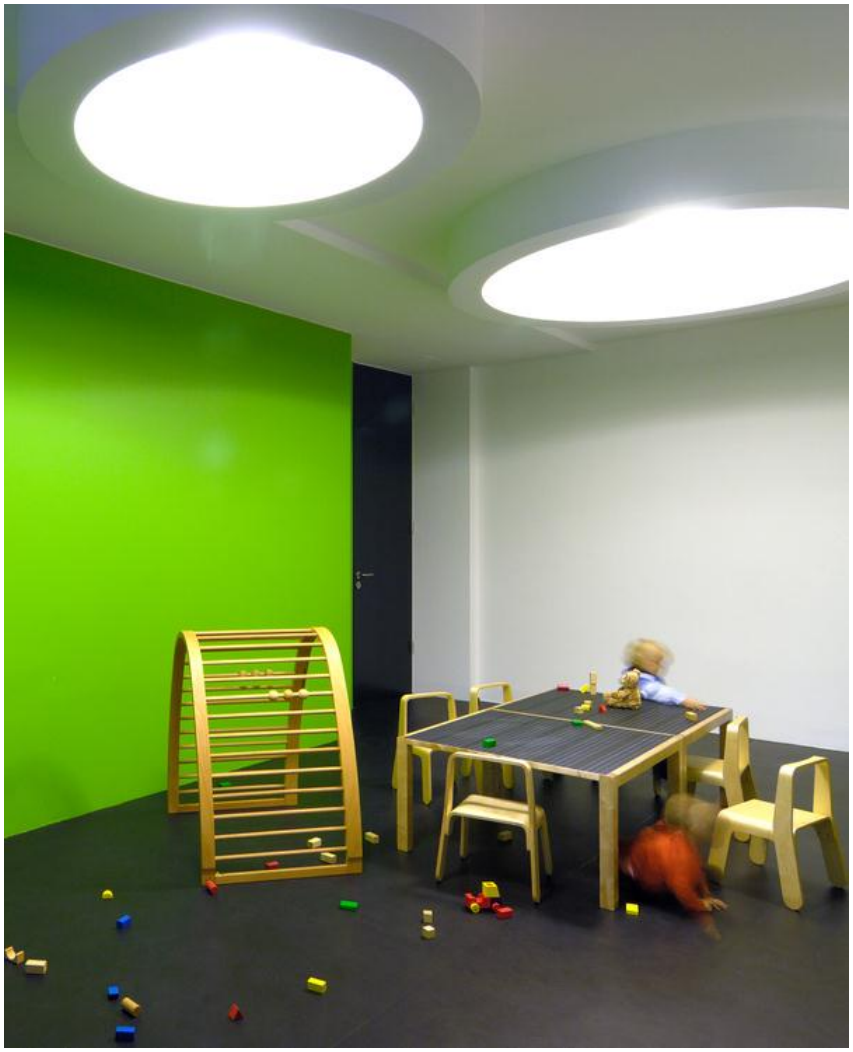
VAE(*)- VINNAPAS DISPERSION: IDEAL BINDER TECHNOLOGY FOR INDOOR ARCHITECTURAL "ECO"-PAINTS(*)



- **WACKER proposes a broad range of dispersions for architectural paints and coatings**
- **WACKER VINNAPAS® VAE(*) dispersions offer unmet balance of performance level in paint formulations designed to fulfill most stringent eco-labels, enhancing indoor air quality**
- **WACKER POLYMERS proposes also outstanding capabilities in**
  - **R&D Polymerization**
  - **Analytic**
  - **Paint formulations & testing**

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THANK YOU FOR YOUR ATTENTION

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