VOC Reactivity & Eco-Efficiency of Architectural Coatings

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September 25, 2007

Architectural coatings have long been regulated to limit their VOC solvent content.

- Intent is to improve air quality.
- In the presence of NOx from combustion, VOCs may promote formation of ozone.
- Ozone is a key component of urban smog.

Regulatory compliance has often proved difficult and costly for the paint industry.

- Formulating or reformulating lower VOC coatings consumes R&D resources.
- VOC content reduction may impact coating performance.
- Coatings can lose competitive advantage to alternatives.

VOC content has become the primary indicator of environmental acceptability.

- This approach has serious limitations, and does not consider:
  - Relative reactivity of VOCs;
  - Atmospheric availability of VOCs;
  - Potential toxicity of VOCs; and
  - Coating performance.

Eco-Efficiency…

- Means the ability to satisfy human needs in ways that minimize adverse impacts on energy and material resources, environmental quality, and human health and safety.

Current regulations limit VOC content without regard to VOC “reactivity.”

- Reactivity is the ability of VOCs to promote ozone formation.
- Different VOCs have different degrees of reactivity.
- Lower limits can cause shift to VOC with higher reactivity.

VOC content is calculated without regard to VOC "availability."

- Availability is the degree to which a VOC volatilizes and persists in the atmosphere.
- Different VOCs have different degrees of availability.
- Approximately 50% of latex paint VOC is never emitted.

VOC content measures do not indicate potential toxicity of VOCs.

- Indoor air quality issues relate to potential toxicity, not ozone.
- Different VOCs have different degrees of toxicity.
- Personal exposure and response are important.

Performance is the key to eco-efficiency of coatings.

- Coverage: Volume of coating needed to cover a given amount of surface area.
- Durability: Interval between successive applications, i.e., service life of coating.

Accounting for reactivity, availability, toxicity, and performance is necessary to quantify eco-efficiency.

- Amount and kind of VOC emitted from coating.
- Volume of coating per surface area covered.
- Service life of coating.

How?

- **Investigate** the scientific issues relating to eco-efficiency.
- **Substantiate** the eco-efficiency of coatings with Life Cycle Analysis.
- **Innovate** to maximize coating eco-efficiency.

PACES Research Project

- PACES is the Paint & Architectural Coatings Environmental Study
- This will be the first comprehensive, multi-disciplinary research project to examine total environmental impacts of coatings usage, including:

…impacts on:

- Air Quality
- Water Quality
- Ecological Quality
- Resource Consumption
- Waste Generation
- Human Health & Safety

Overall Goal:

- To determine – by means of a collaborative, scientific approach involving industry, government, and academia – what kinds of coatings are best for the total environment.

Goal for Reactivity & Availability Component

- To allow coatings to fulfill their environmentally beneficial purpose in ways that support optimum air quality improvement, and prevent detriments to other environmental media and to public health.

Reactivity Metrics

- MOFP (Maximum Ozone-Forming Potential), expressed as maximum potential weight of ozone formed per volume of solids, per weight of solids, or per weight of product.
- RAVOC (Reactivity-Adjusted VOC Content), expressed as reactivity-adjusted weight of VOC per volume of coating, per volume of material, or per volume of solids.

Calculating RAVOC

- RAVOC = VOC x RAF

where:

VOC = VOC content

RAF = Reactivity Adjustment Factor

Calculating RAVOC, cont.

- $$RAF = \sum_{i=1}^{n} \frac{VOCi}{WT} \times \frac{MIRi}{MIRBC}$$

where:

VOCi = Weight of VOC (i)

WT = Total Weight of All VOC

MIR = MIR Value of VOC (i)

MIRBC = MIR Value of BCRM

Calculating RAVOC, cont.

- RAVOC Calculator Spreadsheet available – calculates VOC content and RAVOC from input of data readily accessible to coatings manufacturers.

Emerging Consensus

- Reactivity has scientific validity, and reactivity-based limits can achieve air quality benefits more efficiently than mass-based limits.
- In the future, VOC controls and standards will likely move in the direction of relying more on reactivity-based criteria.

A Path Forward

- Establish ongoing dialogue among members of the coatings industry, the regulatory community, and the scientific community.
- Complete PACES research and any additional studies needed.
- Develop eco-efficient regulatory and voluntary standards.

A Path Forward, cont.

- Focus on achieving our mutual goals for overall environmental and economic well-being.

Questions? Comments?

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