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ELECTRONIC CHEMICALS

NEW MATERIAL EH&S CHALLENGES: A SUPPLIER'S PERSPECTIVE

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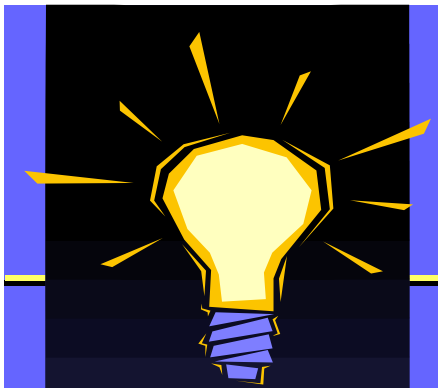
Engineering Research Center for Environmentally Benign Semiconductor Manufacturing

WHY ARE WE HERE?



- The semiconductor industry's rapid pace of technology advances.
- Use of existing chemicals is close to optimization from technology perspective.
- New materials must be introduced to semiconductor manufacturing to achieve future technology advances.

NEW MATERIAL EH&S CONCERNS

- **Data gaps may exist**
- **Discomfort due to unfamiliarity with new materials**
- **Suitability of existing facilities**
  - Equipment
  - Processes (I.e. compatibility of by-products)
- **Potential need for regulatory approvals**

NEW MATERIAL EH&S CONCERNS

- **Acceptable Risk?**
  - Inherent material hazards
  - Worker exposure controls
    - **Engineering controls**
    - **PPE**

- **Intellectual Property (IP) Concerns**

NEW PRODUCT DEVELOPMENT PROCESS

- **Initial Interest**
  - Originates with
    - **In-house technology group**
    - **OEM tool manufacturer**
    - **Device manufacturer**
  - Research available information
  - Assess/address data gaps
    - **If air/moisture sensitive consider use of information on by-products.**
    - **Consider use of attributes common to the chemical family.**
    - **Perform small scale qualitative experiments in-house.**
    - **Confirm with technology group that hazard assessment makes sense.**

NEW PRODUCT DEVELOPMENT PROCESS

- **Initial Interest**
  - Consider capabilities of manufacturing facility.
    - **Open/closed system**
    - **Adequacy of engineering/administrative controls**
    - **Building codes**
    - **PPE**

  - Global regulatory Status and related issues

REGULATORY ISSUES FOR NEW CHEMICALS

- **Key Domestic Regulatory Agencies**
  - EPA
    - **Risk Managment Program (CAA)**
    - **SARA Title III**
    - **TSCA**
  - OSHA
    - **Process Safety Management**
    - **Hazard Communication Standard**
  - Department of State
    - **Chemical Weapons Convention**
  - Drug Enforcement Administration
  - State Agencies

REGULATORY ISSUES FOR NEW CHEMICALS

- **United States - TSCA**
  - Low Volume Exemption - 30 day review
  - Pre-manufacturing Notice - 90 day review
  - Various rules exist which EPA may utilize.

REGULATORY ISSUES FOR NEW CHEMICALS

- **European Union - 67/548/EEC (New Chemical Substances Directive)**
  - Different levels of notification are volume based.
  - Levels of notification include:
    - **Annex VIIC**
      - **Supply at 10 - 100 kg/year**
      - **2-3 months**
    - **Annex VIIB**
      - **Supply at 100 - 1000 kg/year**
      - **9-12 months**
    - **Annex VIIA (The Base Set of data points required)**
      - **Supply at > 1000 kg/year**
      - **12-18 months**
    - **Level 1 and Level 2 – Cumulative volume triggers**
      - **The quantity supplied**
      - **The results of the base set tests**
      - **The degree of exposure to man and the environment**

REGULATORY ISSUES FOR NEW CHEMICALS

- **European Union - 67/548/EEC (con't.)**
  - All levels of notification require a risk assessment.
  - Toxicity, physico-chemical data requirements vary with the level of notification.
  - Several exemptions exist.

REGULATORY ISSUES FOR NEW CHEMICALS

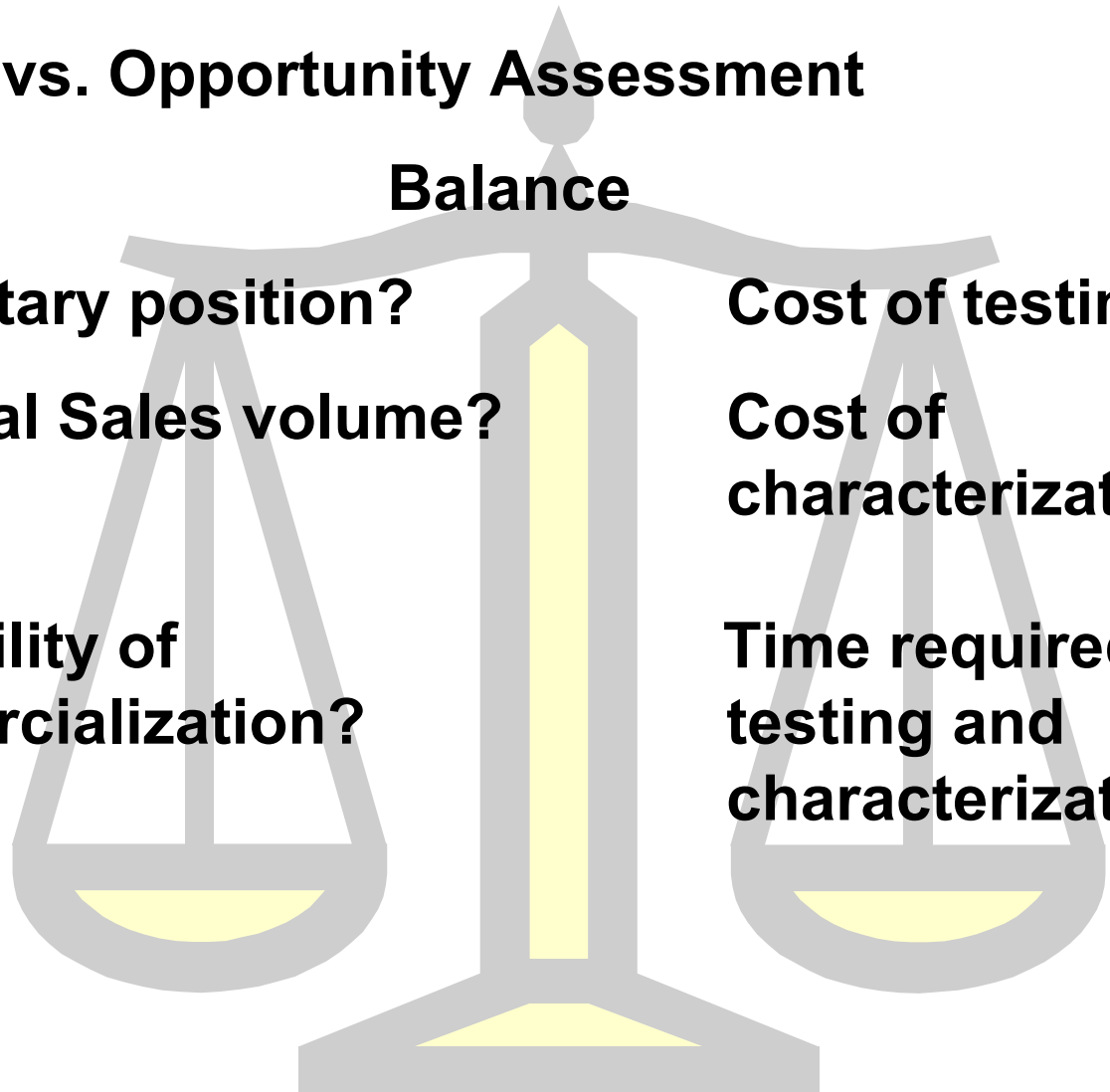
- **Chemical Control Regulations**
  - Japan
    - **MITI's Shin-Kashin-ho (New chemical substances control law)**
      - **Biodegradation scheme**
    - **MOL's Roan-ho**
      - **Modified Ames**
  - Other Countries with Chemical Control Regulations include:
    - **Korea**
    - **China**
    - **Australia**
    - **New Zealand**
    - **Phillipines**

REGULATORY ISSUES FOR NEW CHEMICALS

- **Industry Concerns**
- **PFOS: Traditional chemicals may also be subject to increased scrutiny.**
  - Proposed SNUR
  - EU White Paper proposes a testing scheme for existing chemicals, similar to that of HPV/NCSN (EU)

COMMERCIAL CONCERNS

- Cost vs. Opportunity Assessment



Balance

Proprietary position?

Potential Sales volume?

Probability of commercialization?

Cost of testing

Cost of characterization

Time required for testing and characterization

COMMERCIAL CONCERNS

- **Example: Hi K Precursors**
  - Low volume
  - Low cost
  - Multiple candidates

DATA DEVELOPMENT CONSIDERATIONS

Product Risk

- Risk (Defined by APCI): The likelihood and severity of adverse effects occurring.
- The magnitude of *Risk is a function of Hazard (H) and Exposure (E)*

Risk = (hazard) (exposure)

DATA DEVELOPMENT CONSIDERATIONS

- **Exposure Assessment:**
  Most probable operations to result in exposure?
  What type of exposure?
  - Manufacturing
  - Transport
  - Point of Use Handling

EXAMPLE: CVD PRECURSORS

- **Handling at Facility**
  - Closed system
  - IH monitoring shows no detectable exposure.
- **Handling at End Use**
  - No exposure expected during routine handling.
  - Worker exposure during equipment PM would be an area of consideration.
- **Most Common Studies Sponsored for CVD Precursors**
  - Acute toxicity
  - Flammability Studies
    - **Flash Point**
    - **AIT (Autoignition Temperature)**
    - **LEL/UEL (Lower Explosive Limit/Upper Explosive Limit)**
  - Materials Compatibility Experiments
  - Joint Work with Detector / Glove Manufacturers

WRAP UP: CRITICAL FACTORS TO DATA DEVELOPMENT

- **Time**
  - Product Testing
  - Preparation of Product related documents
    - **MSDSs**
    - **Training packages**
    - **Promotional literature**
  - Preparation of Regulatory Application
  - Gov't review of application
- **Cost**
  - Product Testing
  - Manpower in testing and coordination, document preparation.
  - Manpower in application submissions

WRAP UP: CRITICAL FACTORS TO DATA DEVELOPMENT

- **Time**
  - Coordination of obtaining EH&S info in a manner that allows the semiconductor industry to keep up with technology advances and still allow for good EH&S decision making.

WHERE DO WE GO FROM HERE?

- **More and more dialogue is occurring with stakeholders on how to address these issues.**
- **Supplier/End-User Dialogue**
  - one-on-one
  - mediated by industry groups
- **Must be multi-disciplinary effort**
  - EH&S
  - Technology
  - Process
  - Commercial

LESSONS LEARNED

- New Product Development Takes Team Work!
- Partnering with Colleagues is very valuable.