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National Institute for  
Occupational Safety and Health

# History and Overview of the Titanium Dioxide Current Intelligence Bulletin

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# Titanium Dioxide ( $\text{TiO}_2$ )

- High production volume chemical
- 1.42 million tons produced in U.S. in 2005
- Widely used as a pigment in numerous products

# Titanium Dioxide ( $\text{TiO}_2$ )

- $\text{TiO}_2$  is non-mutagenic in most genotoxicity assays
- Often used as a negative control in toxicity assays
- Widely regarded as an inert particle

# Titanium Dioxide (TiO<sub>2</sub>)

- Epidemiologic studies of TiO<sub>2</sub> provide no clear evidence of elevated risks of lung cancer
- Neither NTP, EPA, nor FDA classify TiO<sub>2</sub> as a known or probable human carcinogen
- IARC is changing its TiO<sub>2</sub> classification to possible human carcinogen (class 2B)

# Titanium Dioxide ( $\text{TiO}_2$ )

- In 1985 it was found that pigment-grade (fine)  $\text{TiO}_2$  at  $250 \text{ mg/m}^3$  produces lung tumors in rats
- In 1995 it was found that nano-sized (ultrafine)  $\text{TiO}_2$  is much more tumorigenic than fine  $\text{TiO}_2$

# Titanium Dioxide (TiO<sub>2</sub>)

- NIOSH has classified TiO<sub>2</sub> as a potential occupational carcinogen since 1988
- Based on Lee et al. rat study
- Consistent with OSHA/NIOSH carcinogen classification policy
- Did not establish a numeric REL for TiO<sub>2</sub>

# OSHA/NIOSH Cancer Policy

"Potential occupational carcinogen" means any substance... which causes an increased incidence of benign and/or malignant neoplasms... in humans or in one or more experimental mammalian species...

29 CFR 1990.103 (1980)

# Titanium Dioxide (TiO<sub>2</sub>)

- In 1991 the Chemical Manufacturer's Association (now the American Chemistry Council) requested that NIOSH remove the carcinogen designation from TiO<sub>2</sub>
- Request based on the idea that TiO<sub>2</sub> tumors in the rat are due to lung overload, and not relevant to humans



# Titanium Dioxide (TiO<sub>2</sub>)

- In 1995 the CMA sent a team of representatives and consultants to NIOSH to present new data on TiO<sub>2</sub>
- The request to review the classification of TiO<sub>2</sub> was renewed in 2002

# Titanium Dioxide (TiO<sub>2</sub>)

- In 2002 NIOSH established an internal team to re-evaluate the data on TiO<sub>2</sub>
- Team was directed to focus on the scientific data, not policy

# Titanium Dioxide (TiO<sub>2</sub>)

- NIOSH performed a quantitative risk assessment for TiO<sub>2</sub>
- Both fine and ultrafine forms considered
- The next talk will present an overview of the TiO<sub>2</sub> risk assessment

# Titanium Dioxide ( $\text{TiO}_2$ )

- The draft NIOSH recommendations for  $\text{TiO}_2$  are dependent on the particle size.
- Different RELs for fine (pigment-grade)  $\text{TiO}_2$  and ultrafine  $\text{TiO}_2$

## Fine (pigment-grade) $\text{TiO}_2$

- Occupational exposures to low concentrations of  $\text{TiO}_2$  produce a negligible risk of lung cancer in workers
- REL =  $1.5 \text{ mg/m}^3$  for fine  $\text{TiO}_2$

## Ultrafine TiO<sub>2</sub> (<100 nm)

- Greater mass-based potency for ultrafine TiO<sub>2</sub>, compared to fine TiO<sub>2</sub>, associated with the greater surface area of ultrafine particles for a given mass
- REL = 0.1 mg/m<sup>3</sup> for ultrafine TiO<sub>2</sub>

# Titanium Dioxide (TiO<sub>2</sub>)

- Having different RELs for the same chemical in different particle-size ranges may complicate workplace monitoring
- The final NIOSH presentation will be an overview of the exposure measurement and control issues for TiO<sub>2</sub>



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Comments should be submitted to:

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or by email to: [niocindocket@cdc.gov](mailto:niocindocket@cdc.gov)

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