

# A Task Based Exposure Estimation Modeling Approach Used in Historical Exposure Reconstruction in the Chemical Industry

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P. Jones, T. Hall, M. Phillips, R. Lynch, H. Basara,  
University of Oklahoma Health Sciences Center,  
N. Esmen, University of Illinois, Chicago  
R. Leonard, Dupont

# Background

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- ❑ Large database developed as part of study conducted at the University of Oklahoma Health Sciences Center
  - ❑ Study included two plants in the US and two plants in Europe
  - ❑ Physical – chemical models were used to estimate exposures for employees over the entire study period
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# Validation Study

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- ❑ Purpose was to evaluate physical – chemical models as they are used to estimate historical exposures
  - ❑ Physical – chemical model was from the AIHA publication “Mathematical Models for Estimating Occupational Exposure to Chemicals”
  - ❑ Comparison data was a subset of larger study database
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# The Data Set

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- ❑ About 550 samples from one plant
  - ❑ All samples were collected from 1988-1996
  - ❑ Task information must have been recorded on the sample sheet
  - ❑ Workers recorded the amount of time and task completed while wearing a respirator
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# The Model

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- Used diffusion modeling
  - Appropriate for workers close to source
  - Boundary effects are minimal

$$C = \frac{M}{8 \cdot (\pi \cdot D \cdot t)^{1.5}} e^{-\frac{r^2}{4 \cdot D \cdot t}}$$

M = mass instantly released  
D = Eddy diffusion coefficient  
r = radial distance from source  
t = time from start of generation

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# Tasks

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- Process sampling
    - Polymer
    - Isomerization
    - DCB
  - Draining and clearing - polymer
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# Estimates

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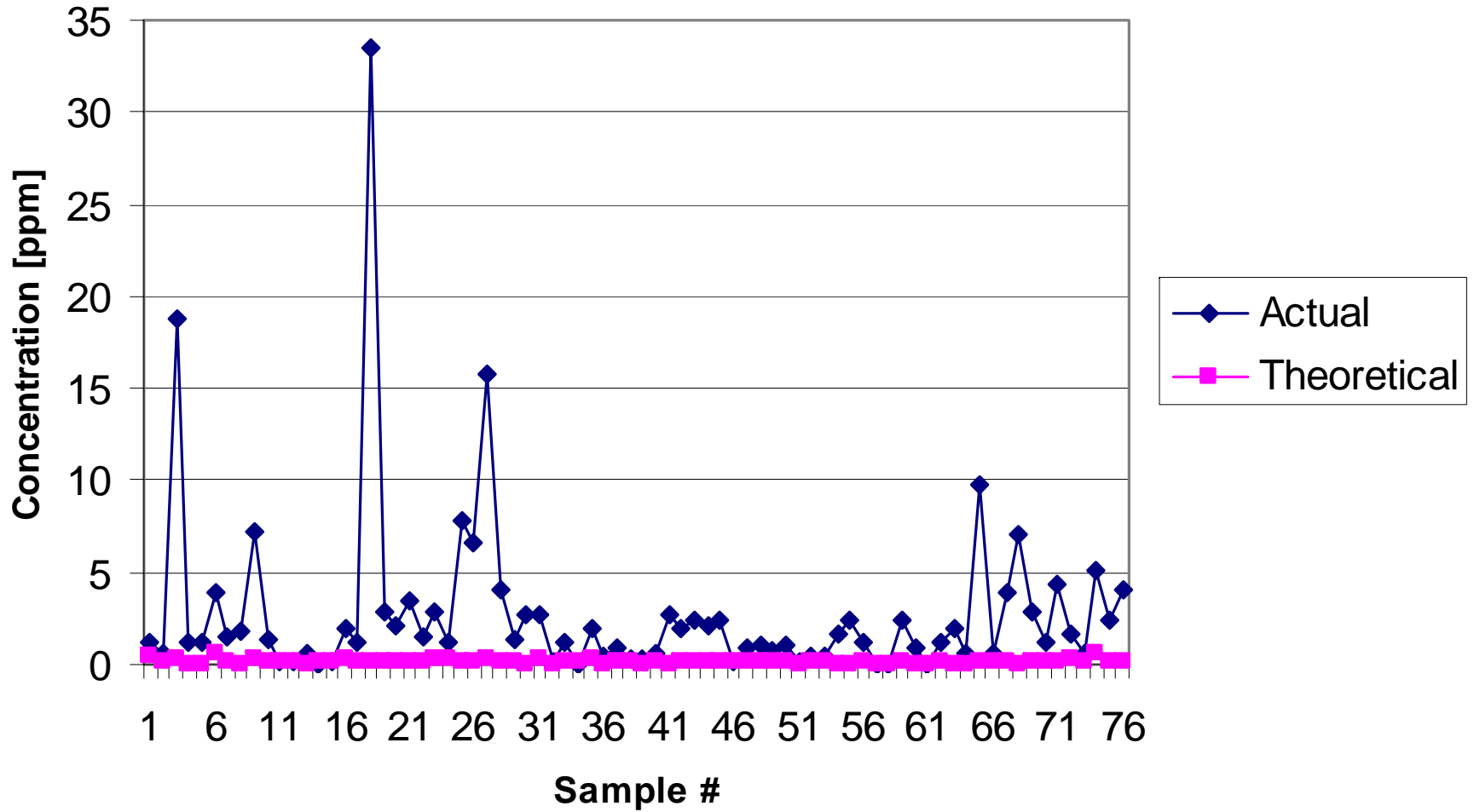
- ❑ Workers distance from the source – 1m
  - ❑ Eddy diffusion coefficient - 0.8
  - ❑ Vapor pressure – 280 mmHg
  - ❑ Sample bottle size – 500 mL
  - ❑ Liquid drained into drum - 1.5 gal
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# Assumptions

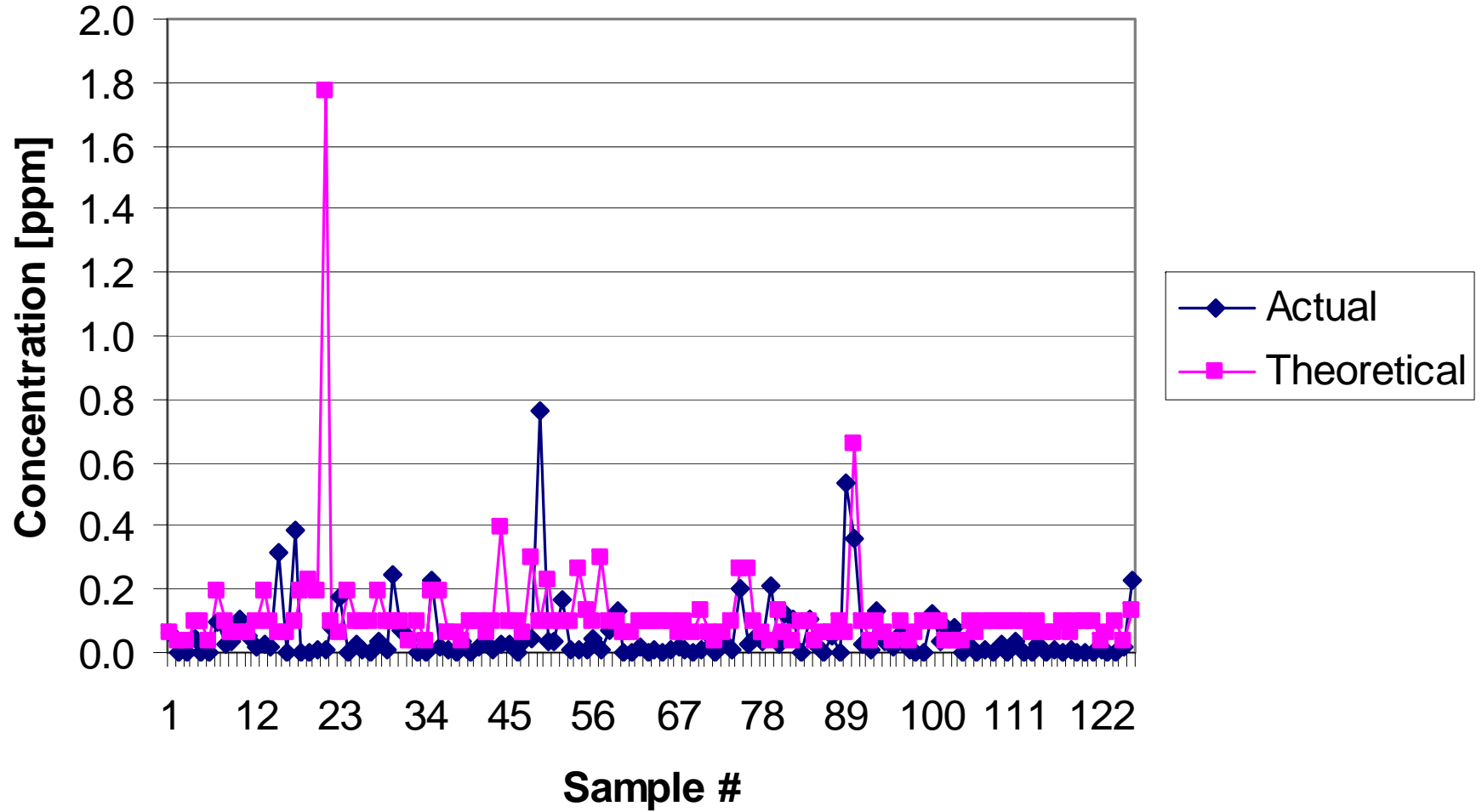
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- Saturation was reached
  - Background concentration very low approximating zero
  - Time to fill bottle was 1 minute
  - Bottle was filled twice for each sample taken
  - Tasks were accurately documented
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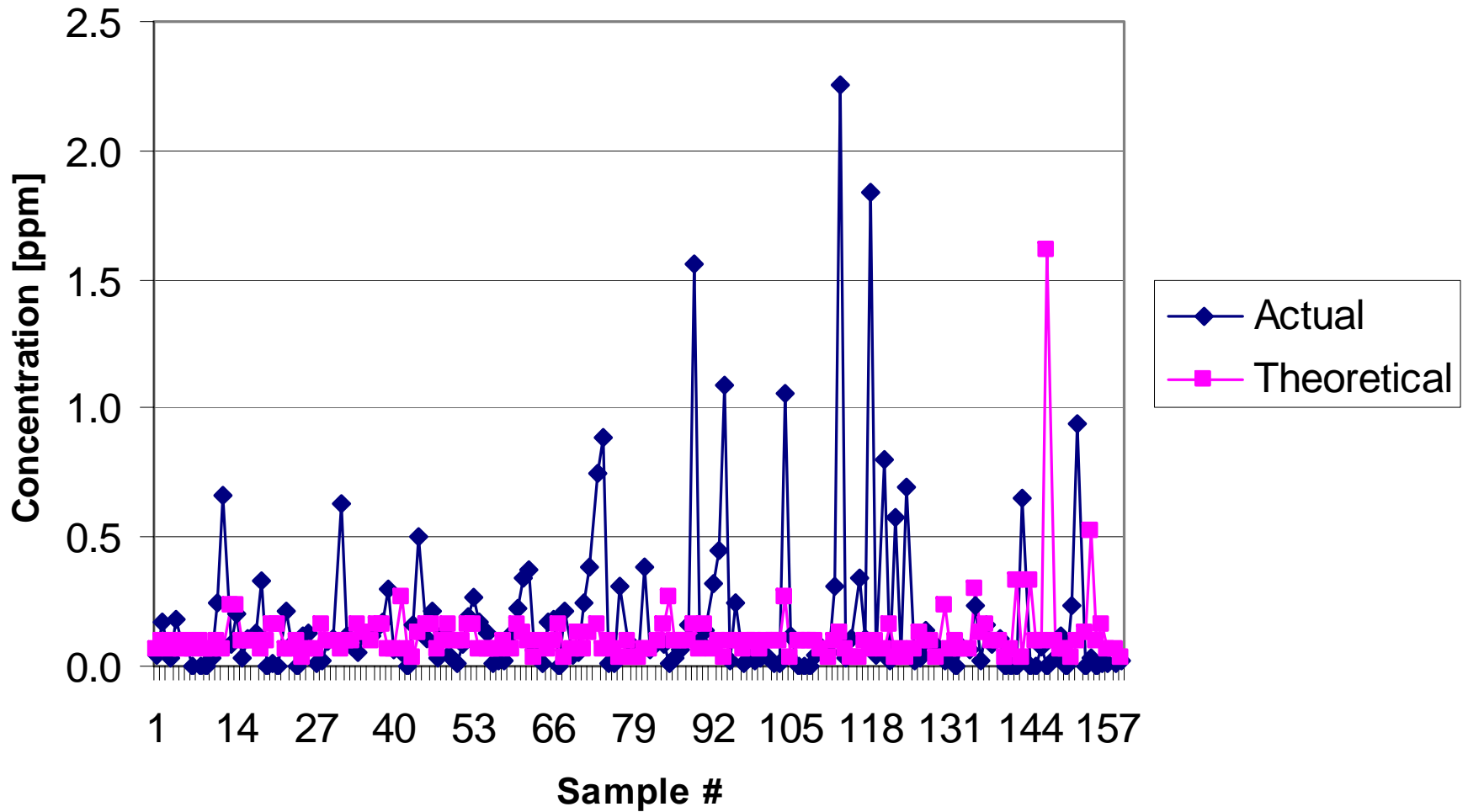
# Polymer Process Sampling



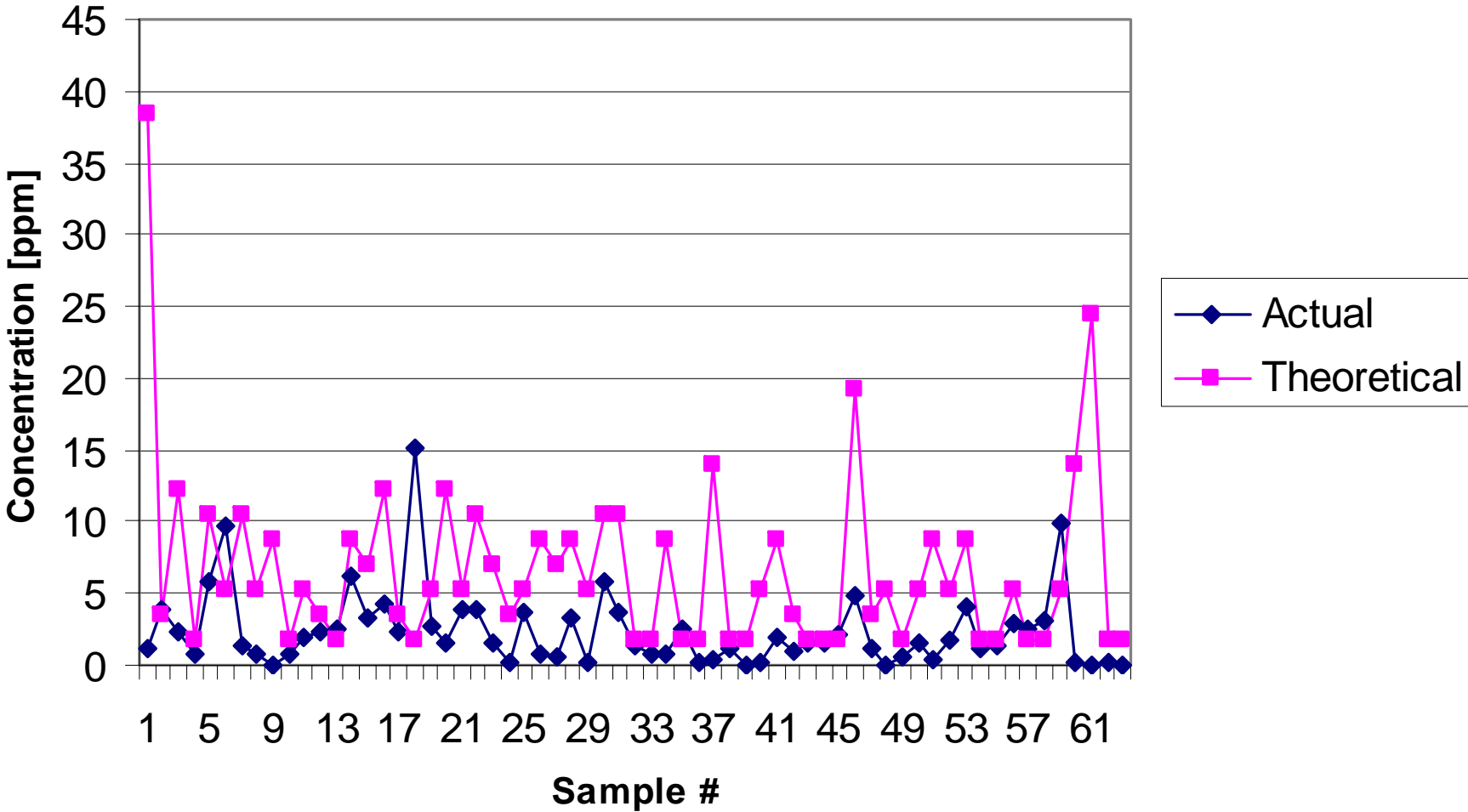
# Isomerization Process Sampling



# DCB Process Sampling



# Polymer Drained & Cleared



# Results

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- Polymer process sampling
    - Ratio average = 2.4
    - Range = 0.004 – 164.3
  - Isomerization process sampling
    - Ratio average = 12.1
    - Range = 0 – 197.2
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# Results (cont.)

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- DCB process sampling
    - Ratio average = 6.3
    - Range = 0 – 322.1
  - Polymer Drained and Cleared
    - Ratio average = 85.3
    - Range = 0.12 - 4072
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# Limitations

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- ❑ Quality of data recorded
  - ❑ Limited specificity of task description
  - ❑ Necessary generalizations – tasks could vary depending on location in the plant
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# In Summary...

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- Important to remember that employees were in respirators while conducting the tasks that were modeled
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# Questions?

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