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  Access Code: 6766

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• Handouts are posted in the “Materials” Tab.

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Billy Bullock, DHSc, MSPH, CIH, CSP, FAIHA  Dr. Bullock has practiced professionally and held academic and instructional positions for more than 30 years. His breadth of education, experience, and professional certifications have served the public, industrial, and commercial sectors, in the health, safety, exposure assessment science, and emergency response disciplines. Dr. Bullock is a board Certified Industrial Hygienist and a Fellow of the American Industrial Hygiene Association. Dr. Bullock served as an elected member of the Board of Directors for the American Industrial Hygiene Association. He is also a board Certified Safety Professional.

Andrew D. Perkins, MS, CIH, CSP, COHC  Mr. Perkins has worked in the Occupational Safety and Health field since 1999 and is currently Corporate, Senior Industrial Hygienist at Alabama Power a Southern Company. In his current role he provides Industrial Hygiene services to Alabama Power and Southern Company’s electrical generation, transmission, distribution and supporting organizations. His work has allowed him to have responsibility for company-wide quality and effectiveness of Safety and Health/Industrial Hygiene work being provided at over 700 locations in more than 30 states, the District of Columbia, Canada, the Bahamas and Mexico.

Access full bios here.
Processes Within Foundry

- Sand Mold
- **Shell Core**
- Oil Core
- Shake-out (front end)
- Shake-out (back end)
- Grinding
Shell Core

- 10.3 m x 6.7 m area
- 3 workers 8 hours/day (0500 – 1300 and 0000 – 0800)
- PPE
  - Ear plugs
  - Gloves
  - Safety glasses
Shell Core

• Process description
  – Sand containing phenolic resin is placed into a mold
  – The filled mold is heated to set the resin
  – The shell core is removed from the mold
  – The worker then files the shell core as needed
Shell Core

• Other process notes
  – Three shell core machines
  – LEV on each machine with low velocity (< 0.2 m/s)
  – Two floors fans operating
  – Worker also changed or repaired the molds, as needed
Step 1 – Foundry Information

• Foundry produces steel casting
  – Make parts based on orders; type of parts are changed day to day
• Foundry uses induction furnace to melt scrap iron and steel
• Two workers
  – Furnace operator: adds scrap steel and metal powders (a.k.a charging) and turn on furnace
  – Helper: takes samples once steel reaches proper temperature and consistency, tests in lab to determine steel’s makeup
  – Furnace operator will add steel, iron, and alloying metals until steel meets required specification
    • Once ready, it is poured from the surface to a transfer ladle
Step 1 – Foundry Information Cont.

- Transport ladle is moved to pouring floor, “Cope and Drag” on plant layout
- Ladles hang from overhead tracks, ladle operator pushes them from one area to another
- Six workers involved in pouring
  - Ladle operator and helper for each ladle
- Metal from transfer ladle is poured into 2 smaller ladles, then poured into the molds
  - Open top mold: manhole covers – easily poured like pouring water into a tank
  - Two-part (covered) mold: diesel engine mounts
    - Molten metal poured into an opening in top of mold (spur) until metal comes up through one or more small holes (raisers)
    - Binders and sealers in mold will begin to decay and release some decomposition, some of which are flammable
Plant Layout
Step 1 – Basic Characterization

• Identify the hazards recognized in the shell core foundry video clip
Step 1 – Basic Characterization

• Identify the worker roles, and whether those roles are exposures are distinct

1. Review the shell core video, facility map, SDSs, etc.
2. Complete Basic Characterization Blank Form for the shell core operation
3. Qualitatively consider/judge exposure profiles, complete initial exposure rating for the shell core operation
Step 1 – Basic Characterization

Questions to consider as you evaluate the video and data:

1. What common roles or tasks do you observe?
2. Do these tasks link clearly to hazards? Why or why not?
3. What SEGs have you created?
4. What was the basis of determining the need for further evaluation?
5. Which operations or environmental agents should be prioritized for additional investigation and/or exposure monitoring? Why?
Step 2 – Define and Judge Exposure Profiles

Using the isopleth maps provided, assign an AIHA category to the exposures for PM$_{10}$, PM$_{2.5}$, and CO.
Isopleth Map - PM$_{10}$

Isopleth Map of PM 10

PM-10 in mg/m$^3$ collected with a TSI handheld dust monitor
Isopleth Map - PM$_{2.5}$

Isopleth Map of PM 2.5

PM-2.5 in mg/m3 collected with a TSI handheld dust monitor
Isopleth Map - CO

Isopleth Map of Carbon Monoxide

CO data in ppm collected with an Industrial Scientific TMX412

Mean level of CO
Step 2 – Define and Judge Exposure Profiles

Using the AIHA IHSTAT spreadsheet, analyze data for the following compounds of interest and assign an AIHA category to each profile:

1. Respirable silica
2. Phenol
3. Formaldehyde
## 1. Respirable silica

### Personal Sample Results for Respirable Silica

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Employee Name</th>
<th>Location</th>
<th>Sample Date</th>
<th>Sample Time</th>
<th>Air Volume</th>
<th>cristobalite</th>
<th>quartz</th>
<th>respirable dust</th>
<th>tridymite</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-06</td>
<td>N/A</td>
<td>N/A</td>
<td>01-02-12</td>
<td>N/A</td>
<td>N/A</td>
<td>&lt;0.014</td>
<td>0.08</td>
<td>1.5</td>
<td>&lt;0.014</td>
</tr>
<tr>
<td>S-07</td>
<td>Esmar Tuck</td>
<td>Shell Core</td>
<td>01-03-12</td>
<td>442</td>
<td>717.8</td>
<td>&lt;0.017</td>
<td>0.24</td>
<td>2.4</td>
<td>&lt;0.017</td>
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<tr>
<td>S-08</td>
<td>Staban Tuck</td>
<td>Shell Core</td>
<td>01-03-12</td>
<td>422</td>
<td>574.5</td>
<td>&lt;0.017</td>
<td>0.072</td>
<td>1.7</td>
<td>&lt;0.017</td>
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<tr>
<td>S-09</td>
<td>Paul Atreides</td>
<td>Shell Core</td>
<td>01-03-12</td>
<td>423</td>
<td>576.1</td>
<td>&lt;0.011</td>
<td>0.047</td>
<td>1.1</td>
<td>&lt;0.011</td>
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<tr>
<td>S-10</td>
<td>Harkonnen</td>
<td>Shell Core</td>
<td>01-03-12</td>
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<td>911</td>
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<td>0.047</td>
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<td>&lt;0.011</td>
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# 2. Phenol

## Personal Air Sample Results for Phenol

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Employee Name</th>
<th>Location</th>
<th>Date</th>
<th>Flow rate (l/min)</th>
<th>Sampling time (min)</th>
<th>Treated Mass (µg)</th>
<th>Mass Concentration (mg/m³)</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-01</td>
<td>Esmar Tuek</td>
<td>Shell</td>
<td>01-01-12</td>
<td>0.1019</td>
<td>381</td>
<td>2.5</td>
<td>2.5</td>
<td>0.06</td>
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<tr>
<td>P-02</td>
<td>Staban Tuek</td>
<td>Core</td>
<td>01-01-12</td>
<td>0.1089</td>
<td>256</td>
<td>2.5</td>
<td>2.5</td>
<td>0.09</td>
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<tr>
<td>P-03</td>
<td>Esmar Tuek</td>
<td>Shell</td>
<td>01-01-12</td>
<td>0.0000</td>
<td>0</td>
<td>2.5</td>
<td>2.5</td>
<td>0.00</td>
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<tr>
<td>P-04</td>
<td>Esmar Tuek</td>
<td>Core</td>
<td>01-02-12</td>
<td>0.0992</td>
<td>454</td>
<td>6.8</td>
<td>2.5</td>
<td>0.15</td>
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<tr>
<td>P-05</td>
<td>Staban Tuek</td>
<td>Core</td>
<td>01-02-12</td>
<td>0.1073</td>
<td>393</td>
<td>5.3</td>
<td>2.5</td>
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<tr>
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<td>Paul Atreides</td>
<td>Core</td>
<td>01-02-12</td>
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<td>Shell</td>
<td>01-02-12</td>
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<td>2.5</td>
<td>2.5</td>
<td>0.00</td>
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<tr>
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<td>Esmar Tuek</td>
<td>Core</td>
<td>01-03-12</td>
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<td>2.5</td>
<td>0.09</td>
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<td>Core</td>
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<tr>
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<td>P-12</td>
<td>Paul Atreides</td>
<td>Core</td>
<td>01-03-12</td>
<td>0.0000</td>
<td>0</td>
<td>2.5</td>
<td>2.5</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Note: None detected

## Personal Wipe Sample Results for Phenol

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Employee Name</th>
<th>Location</th>
<th>Date</th>
<th>Sample Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-13</td>
<td>Esmar Tuek</td>
<td>Shell</td>
<td>01-01-12</td>
<td>ND</td>
</tr>
<tr>
<td>P-14</td>
<td>Staban Tuek</td>
<td>Core</td>
<td>01-01-12</td>
<td>ND</td>
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</tbody>
</table>

Note: ND = none detected
### 3. Formaldehyde

#### Personal Sample Results for Formaldehyde

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Employee Name</th>
<th>Location</th>
<th>Date</th>
<th>Flow rate (l/min)</th>
<th>Sampling time (min)</th>
<th>TWA Result (ppm)</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-01</td>
<td>Esmar Tuke</td>
<td>Shell</td>
<td>01-01-12</td>
<td>0.1019</td>
<td>445</td>
<td>0.30</td>
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<tr>
<td>F-02</td>
<td>Staban Tuke</td>
<td>Core</td>
<td>01-01-12</td>
<td>0.1089</td>
<td>443</td>
<td>0.10</td>
<td></td>
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<tr>
<td>F-03</td>
<td>(Blank)</td>
<td>Shell</td>
<td>01-01-12</td>
<td>0.0000</td>
<td>0</td>
<td>None detected</td>
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<tr>
<td>F-04</td>
<td>Esmar Tuke</td>
<td>Core</td>
<td>01-02-12</td>
<td>0.0992</td>
<td>454</td>
<td>0.30</td>
<td></td>
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<tr>
<td>F-06</td>
<td>Staban Tuke</td>
<td>Shell</td>
<td>01-02-12</td>
<td>0.1073</td>
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<td>0.11</td>
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<tr>
<td>F-07</td>
<td>Paul Atreides</td>
<td>Core</td>
<td>01-02-12</td>
<td>0.1003</td>
<td>462</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>F-08</td>
<td>(Blank)</td>
<td>Shell</td>
<td>01-02-12</td>
<td>0.0000</td>
<td>0</td>
<td>None detected</td>
<td></td>
</tr>
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</table>

*Note: Report limit 1 microgram*
### Completed Worksheet

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
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<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>SEG ID</td>
<td>Process</td>
<td>Job</td>
<td>Task</td>
<td>Agent</td>
<td>Quantity</td>
<td>Duration</td>
<td>Frequency</td>
<td>Manual vs. Automated Operation</td>
<td>PPE</td>
<td>Engineering Controls</td>
<td>Exposure Rating</td>
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<tr>
<td>2</td>
<td>SC-1</td>
<td>Produce Cast</td>
<td>Operator</td>
<td>Operate Core Machine</td>
<td>Formaldehyde</td>
<td>(off-gas Product)</td>
<td>6 hr/shift</td>
<td>Daily</td>
<td>Both</td>
<td>Thermal gloves</td>
<td>Canopy hood</td>
<td>CAT - 4</td>
<td>Irr, Sen, Ca</td>
<td>0.1 ppm</td>
</tr>
<tr>
<td>3</td>
<td>SC-1</td>
<td>Produce Cast</td>
<td>Operator</td>
<td>Operate Core Machine</td>
<td>Phenol</td>
<td>(off-gas Product)</td>
<td>6 hr/shift</td>
<td>Daily</td>
<td>Both</td>
<td>Thermal gloves</td>
<td>Canopy hood</td>
<td>CAT - 2</td>
<td>Irr</td>
<td>19 mg/m³</td>
</tr>
<tr>
<td>4</td>
<td>SC-1</td>
<td>Produce Cast</td>
<td>Operator</td>
<td>Operate Core Machine</td>
<td>PNOR</td>
<td>(off-gas Product)</td>
<td>6 hr/shift</td>
<td>Daily</td>
<td>Both</td>
<td>Thermal gloves</td>
<td>Canopy hood</td>
<td>CAT - 3</td>
<td>Resp Sys</td>
<td>5 mg/m³</td>
</tr>
<tr>
<td>5</td>
<td>SC-1</td>
<td>Produce Cast</td>
<td>Operator</td>
<td>Operate Core Machine</td>
<td>RCS</td>
<td>(off-gas Product)</td>
<td>6 hr/shift</td>
<td>Daily</td>
<td>Both</td>
<td>Thermal gloves</td>
<td>Canopy hood</td>
<td>CAT - 4</td>
<td>Pul Fib, Ca</td>
<td>50 ug/m³</td>
</tr>
<tr>
<td>6</td>
<td>SC-2</td>
<td>Clean-up</td>
<td>Operator</td>
<td>Blow-down</td>
<td>PNOR</td>
<td>(off-gas Product)</td>
<td>15 min/shift</td>
<td>Daily</td>
<td>Manual</td>
<td>Thermal gloves</td>
<td>None</td>
<td>CAT - 2</td>
<td>Resp Sys</td>
<td>5 mg/m³</td>
</tr>
<tr>
<td>7</td>
<td>SC-2</td>
<td>Clean-up</td>
<td>Operator</td>
<td>Blow-down</td>
<td>RCS</td>
<td>(off-gas Product)</td>
<td>15 min/shift</td>
<td>Daily</td>
<td>Manual</td>
<td>Thermal gloves</td>
<td>None</td>
<td>CAT - 3</td>
<td>Pul Fib, Ca</td>
<td>50 ug/m³</td>
</tr>
<tr>
<td>8</td>
<td>SC-2</td>
<td>Clean-up</td>
<td>Operator</td>
<td>Sweep</td>
<td>PNOR</td>
<td>(off-gas Product)</td>
<td>30 min/shift</td>
<td>Daily</td>
<td>Manual</td>
<td>Thermal gloves</td>
<td>None</td>
<td>CAT - 2</td>
<td>Resp Sys</td>
<td>5 mg/m³</td>
</tr>
<tr>
<td>9</td>
<td>SC-2</td>
<td>Clean-up</td>
<td>Operator</td>
<td>Sweep</td>
<td>RCS</td>
<td>(off-gas Product)</td>
<td>30 min/shift</td>
<td>Daily</td>
<td>Manual</td>
<td>Thermal gloves</td>
<td>None</td>
<td>CAT - 3</td>
<td>Pul Fib, Ca</td>
<td>50 ug/m³</td>
</tr>
</tbody>
</table>

AIHA
Protecting Worker Health
IHSTAT – PNOR_Resp
IHSTAT – Formaldehyde_PEL
IHSTAT – Formaldehyde_TLV
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## Upcoming Sessions

<table>
<thead>
<tr>
<th>Date</th>
<th>Time (ET)</th>
<th>Session</th>
<th>Speaker(s)</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>Monday, March 11, 2019</td>
<td>12:00 - 1:00 pm</td>
<td>Integrating AIHA Sampling Strategy Principles Into Your Industrial Hygiene Data Management Systems - LIVE</td>
<td>Andrew Perkins</td>
<td>1</td>
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<tr>
<td>Thursday, March 14, 2019</td>
<td>12:00 - 1:00 pm</td>
<td>Survey Strategy and Data Statistics</td>
<td>Tom Armstrong</td>
<td>1</td>
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<tr>
<td>Tuesday, March 19, 2019</td>
<td>1:00 - 2:30 pm</td>
<td>Case-Based Introduction to Mathematical Modelling</td>
<td>Chris Keil</td>
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<tr>
<td>Wednesday, March 20, 2019</td>
<td>2:00 - 3:00 pm</td>
<td>Easy Tools for Mathematical Modeling for Exposures</td>
<td>Tom Armstrong</td>
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<tr>
<td>Thursday, March 21, 2019</td>
<td>1:00 - 2:30 pm</td>
<td>Further Applications for Mathematical Modelling Exposure Assessment - LIVE</td>
<td>Chris Keil</td>
<td>1.5</td>
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* please note time change