Coal Combustion by Product Toxicity

Mary Sanders, Haley & Aldrich
Hazard Classification of Coal Combustion Products under OSHA HCS 2012

Maryann Sanders
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Agenda

1. UN Global Harmonization System for Classification and Labelling
3. Defining the Composition of a Typical Coal Combustion Product
4. Hazard Classifications Associated with Typical Coal Combustion Products
5. Carcinogenicity Classification Determination
6. Conclusions
United Nations
Global Harmonization System (GHS) for Classification and Labelling
History and Background

• **What is it...  ** _A Guideline_
  – Initially published in 2003, 6\textsuperscript{th} version just released
  – Combines an approach for defining and classifying chemical hazards with a means for conveying those hazards
  – Labels and Safety Data Sheets.

• **What it is not...  ** _A Regulation!_
  – Must be implemented to become legally binding
  – Different versions may be implemented in various jurisdictions.
  – Different parts and pieces may be enacted.
GHS: Scope

All Hazardous Chemicals (substances and mixtures)
- Physical hazards
- Human health hazards
- Environmental hazards

Workplace use
- Production;
- Storage;
- Transportation; and
- Disposal
GHS Objective: Uniformity

Hazards symbols
- [Image of hazard symbols]

Signal words
- Danger or Warning

Precautionary Statements
- Prevention;
- Response;
- Storage; and
- Disposal
- OSHA Implementation of GHS
GHS vs. OSHA HCS 2012

- Implements GHS Revision 3 (2009)
- Evaluates Physical and Health Hazards only
- OSHA did not implement environmental sections of GHS
- Sixteen Section Safety Data Sheets (SDS) required by June 1, 2015
Hazard Classification Determination

• A.0 General Classification Considerations
• A.1 Acute Toxicity
• A.2 Skin Irritation/Corrosion
• A.3 Serious Eye Damage/Eye Irritation
• A.4 Respiratory and Skin Irritation
• A.5 Germ Cell Mutagenicity
• A.6 Carcinogenicity
• A.7 Reproductive Toxicity
• A.8 Specific Target Organ Toxicity – Single Exposure
• A.9 Specific Target Organ Toxicity – Repeated or Prolonged Toxicity
• A.10 Aspiration Hazard
For most hazard classes, the recommended process of classification of mixtures is based on the following sequence:

(a) Where test data are available for the complete mixture, the classification of the mixture will always be based on those data;

(b) Where test data are not available for the mixture itself, the bridging principles designated in each health hazard chapter of this appendix shall be considered for classification of the mixture;

(c) If test data are not available for the mixture itself, and the available information is not sufficient to allow application of the above-mentioned bridging principles, then the method(s) described in each chapter for estimating the hazards based on the information known will be applied to classify the mixture (e.g., application of cut-off values/concentration limits).

Note: For purposes of the CCP evaluation, Coal Combustion products were evaluated following mixture rules
A.0.4.2 An exception to the above order or precedence is made for Carcinogenicity, Germ Cell Mutagenicity, and Reproductive Toxicity. For these three hazard classes, mixtures shall be classified based upon information on the ingredient substances, unless on a case-by-case basis, justification can be provided for classifying based upon the mixture as a whole.

• For Carcinogenicity, and Reproductive Toxicity...

A.0.5.1 Where the mixture itself has not been tested to determine its carcinogenic hazard, but there are sufficient data on both the individual ingredients and similar tested mixtures to adequately characterize the hazards of the mixture, these data shall be used in accordance with the following bridging principles, subject to any specific provisions for mixtures for each hazard class. These principles ensure that the classification process uses the available data to the greatest extent possible in characterizing the hazards of the mixture.
# Hazard Classification Determination
## - Carcinogenicity

**Factors to be taken into consideration**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Additional factors which may increase or decrease the level of concern include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Tumor sites and background incidences</td>
<td>(e) Responses are in single or both sexes;</td>
</tr>
<tr>
<td>b) Multisite responses;</td>
<td>(f) Responses are in a single species or several species;</td>
</tr>
<tr>
<td>c) Progression of lesions to malignancy;</td>
<td>(g) Structural similarity or not to a substance(s) for which there is evidence of carcinogenicity;</td>
</tr>
<tr>
<td>d) Reduced tumor latency;</td>
<td>(h) Routes of exposure;</td>
</tr>
<tr>
<td></td>
<td>(i) Toxicokinetics comparison between test animals and humans.</td>
</tr>
<tr>
<td></td>
<td>(j) Confounding effect of excessive toxicity at test doses.</td>
</tr>
<tr>
<td></td>
<td>(k) Mode of action and its relevance for humans, such as mutagenicity.</td>
</tr>
</tbody>
</table>
A.6.4.1 ...**may** treat the following sources as establishing that a substance is a carcinogen or potential carcinogen for hazard communication purposes in **lieu of applying the criteria described herein**:

A.6.4.1.1 National Toxicology Program (NTP), "Report on Carcinogens" (latest edition);

A.6.4.1.2 International Agency for Research on Cancer (IARC) "Monographs on the Evaluation of Carcinogenic Risks to Humans" (latest editions)

A.6.4.2 Where OSHA has included cancer as a health hazard to be considered by classifiers for a chemical covered by 29 CFR part 1910, Subpart Z, Toxic and Hazardous Substances, chemical manufacturers, importers, and employers shall classify the chemical as a carcinogen.
Defining the Composition of a Typical Coal Combustion Product (CCP)
Defining CCPs

– Chemical Abstract Services (CAS), a division of the American Chemistry Society:

“Ashes (residues) as well as the following alternate names for Ash(es); Ashes; Ash; Ash residues; Ashes, residues, bottom; Bottom ash; Bottom ash residues; Waste solids, ashes” by the CAS number 68131-74-8.

– EPA TSCA:

This CAS# is defined as, “A residuum from the burning of a combination of carbonaceous materials. The following elements may be present as oxides: aluminum, calcium, iron, magnesium, nickel, phosphorus, potassium, silicon, sulfur, titanium, and vanadium.”
Defining CCPs

Fly ash, bottom ash, circulating fluidized bed (CFB) fly ash, and CFB bed ash are defined as a singular substance of unknown or variable composition (UVCB substance) with a CAS # of 68131-74-8 based on similarity of composition and 29 CFR 1910.1200 (g)4.
Typical CCP Composition

• Derive compositional analysis using data from:
  o ACAA member data
    o Safety Data Sheets
    o Analytical data
  o Electric Power Research Institute (EPRI)
  o United Kingdom Quality Ash Association
  o Scientific literature
  o Standard organizations
## Typical CCP Composition

<table>
<thead>
<tr>
<th>Substance</th>
<th>Range Identified in CCP Compositions Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminosilicates</td>
<td>$\leq 95%$</td>
</tr>
<tr>
<td>Calcium oxide (CaO)</td>
<td>$\leq 41%$</td>
</tr>
<tr>
<td>Silicon dioxide ($\text{SiO}_2$); Silica, crystalline, cristobalite; Silica, crystalline, quartz</td>
<td>$\leq 36%$</td>
</tr>
<tr>
<td>Iron minerals ($\text{Fe}_2\text{O}_3$, $\text{Fe}_3\text{O}_4$)</td>
<td>1-35%</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>$\leq 10%$</td>
</tr>
<tr>
<td>Calcium sulfate</td>
<td>$&lt; 6%$</td>
</tr>
<tr>
<td>Carbon</td>
<td>$\leq 6%$</td>
</tr>
<tr>
<td>Magnesium oxide (MgO)</td>
<td>$\leq 6%$</td>
</tr>
<tr>
<td>Titanium dioxide ($\text{TiO}_2$)</td>
<td>1 - 5%</td>
</tr>
<tr>
<td>Potassium oxide ($\text{K}_2\text{O}$)</td>
<td>$\leq 5%$</td>
</tr>
<tr>
<td>Silica, crystalline respirable (RCS)</td>
<td>$&lt; 4%$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Substance</th>
<th>Range Identified in CCP Compositions Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bromide Salts (various) (including NaBr)</td>
<td>$\leq 2%$</td>
</tr>
<tr>
<td>Chloride salts (various)</td>
<td>$\leq 2%$</td>
</tr>
<tr>
<td>Magnesium sulfate</td>
<td>$\leq 2%$</td>
</tr>
<tr>
<td>Sodium sulfate</td>
<td>$\leq 2%$</td>
</tr>
<tr>
<td>Sodium oxide ($\text{Na}_2\text{O}$)</td>
<td>$&lt; 2%$</td>
</tr>
<tr>
<td>Phosphorus pentoxide ($\text{P}_2\text{O}_5$)</td>
<td>$&lt; 1%$</td>
</tr>
<tr>
<td>Halide salt (not further specified)</td>
<td>$&lt; 1%$</td>
</tr>
<tr>
<td>Barium oxide ($\text{BaO}$)</td>
<td>$&lt; 1%$</td>
</tr>
<tr>
<td>Manganese dioxide ($\text{MnO}_2$)</td>
<td>$&lt; 1%$</td>
</tr>
<tr>
<td>Ammonium bisulfate</td>
<td>$&lt; 0.01%$</td>
</tr>
<tr>
<td>Ammonium sulfate</td>
<td>$&lt; 0.01%$</td>
</tr>
</tbody>
</table>
Typical CCP Classification

Only compositions that contain the substances identified at levels within the ranges in a typical CCP composition are definitively covered by the CCP hazard classification determinations.

– If individual component percentages are exceeded the CCP *may* not fall into the classifications defined.

– If additional substances are identified at levels of 0.1% or greater, the CCP *may* not fall into the classifications defined and additional substance disclosure on the SDS *may* be required.
Typical CCP Composition
- Silica dioxide

- The bulk of the silica is amorphous;
- Amorphous silica is formed during the combustion process where the temperature within the boiler exceeds the melting point of the inorganic fraction of the coal, resulting in vitrification of a large priority of the crystalline silica (quartz) present in the fuel (coal).
- The level of residual crystalline silica in the ash is dependent on the amount of crystalline silica in the pre-combustion coal, the combustion process, and emission control technologies.
Hazard Classifications Associated with Typical CCPs
Hazard Classification Determination

Consistent with OSHA HCS, 2012, we considered the following in assigning the hazard classification(s) based on a Weight of Evidence approach:

- Data on CCP
- Data on similar products (bridging principle)
- Data on individual hazardous components above OSHA defined thresholds

Eight distinct CCP compositions were identified following the process.
Hazard Classification Determination

The GHS Guideline specifies that:

• For some hazard classes, classification may be based directly on available data on the final mixture”

• For other classes, classification is made on the total weight of evidence. This requires that available information that has a bearing on the toxicity determination is considered together, including the results of:
  – in vitro tests
  – relevant animal data; and human exposures (i.e., epidemiological data)

It further specifies that Expert Judgment may be required where a weight of evidence determination is required.
CCP Hazard Classification(s)

Classifications that **may** apply to typical CCP compositions:

- Specific Target Organ Toxicity – Single Exposure (Respiratory Irritation)
- Eye Irritant, Category 2A
- Reproductive Toxicity, Category 2
- Specific Target Organ Toxicity – Repeat Exposure, Category 2 (Lungs)

The overall hazard classification(s) are dependent on the CCP composition.
Specific Target Organ Toxicity – Single Exposure: Category 3 (Respiratory Irritation)

• CCPs consist of substances present in a dust matrix
  – Especially apparent during handling and use.

• Member company MSDS and SDS indicate a potential for mechanical irritation

• Dust matrices in general may result in mechanical irritation of the respiratory tract
Reproductive Toxicity, Category 2

• Bromide salts may be present in the final CCP at up to 2% due to the use of bromide based pollution control additives.

• No data available on finished products containing bromide salts.

• Sodium bromide (as a representative inorganic bromide salt) may result in reproductive toxicity as well as developmental effects:
  – Bromide salts are classified as Toxic to Reproduction, Category 2.

• CCP classification based on:
  – Available data on the component substance; and
  – A lack of data on CCPs or other similar compounds containing bromide.
Eye Irritant, Category 2A

• Finished product testing on three CCPs showed no skin corrosion/irritation and variable eye irritation.
  – CCPs with levels of CaO below 20% total or 8% free showed no skin or eye irritation.
  – CCPs with levels of CaO above 20% total or 8% free would be classified as an Eye Irritant, Category 2A.
Establish Classification based on Weight of Evidence

- Finished Product Testing
  - Final CCPs tested for REACH registration
    - Level of Respirable Crystalline Silica (RCS) in tested products was not reported.
    - Results do not support a STOT-RE classification (n=3)
  - Final fly ash results detailed in EPRI report
    - Minor adaptive effects in the lungs identified.
    - The levels required to elicit effects would not result in classification for STOT-RE.
Specific Target Organ Toxicity – Repeat Exposure Category 2 (Lungs)

- Testing on mixtures containing RCS
  - Epidemiological data indicate that exposure to RCS in various industrial mixtures result in silicosis.
  - A review commissioned by the Industrial Minerals Association indicates that RCS in mixtures at $\geq 1\%$ but $\leq 10\%$ would result in a STOT-RE Category 2 classification.

- Individual component data:
  - Animal data on RCS indicate that a classification for STOT-RE Category 1 (Lungs) is appropriate.

Data on the potential for RCS to result in primary carcinogenicity is not universally accepted. After a review of available data, typical CCPs containing less than 4% RCS were not classified for carcinogenicity based on weight of evidence and professional judgment as specified in OSHA HCS 2012.
## CCP Hazard Classifications

<table>
<thead>
<tr>
<th>CCP</th>
<th>Classifications</th>
<th>Compositional Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCP 1</td>
<td>• STOT-SE Category 3 (Respiratory Irritation)</td>
<td>Ashes with:</td>
</tr>
<tr>
<td></td>
<td>• STOT-RE Category 2</td>
<td>• Undetermined or ≥1 to &lt; 10% respirable crystalline silica;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Total calcium oxide levels ≤20%; or if determined, free calcium oxide ≤8%; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Inorganic bromide salts less than 0.1%.</td>
</tr>
<tr>
<td>CCP 2</td>
<td>• STOT-SE Category 3 (Respiratory Irritation)</td>
<td>Ashes with:</td>
</tr>
<tr>
<td></td>
<td>• Eye Irritant Category 2A</td>
<td>• Undetermined or ≥1 and &lt; 10% respirable crystalline silica;</td>
</tr>
<tr>
<td></td>
<td>• STOT-RE Category 2</td>
<td>• Total calcium oxide levels &gt;20% and ≤40%; or if determined, free calcium oxide &gt;8%; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Inorganic bromide salts less than 0.1%.</td>
</tr>
<tr>
<td>CCP 3</td>
<td>• STOT-SE Category 3 (Respiratory Irritation)</td>
<td>Ashes with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;1% respirable crystalline silica;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Total calcium oxide levels ≤20%; or if determined, free calcium oxide ≤8%; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Inorganic bromide salts less than 0.1%.</td>
</tr>
<tr>
<td>CCP 4</td>
<td>• STOT-SE Category 3 (Respiratory Irritation)</td>
<td>Ashes with:</td>
</tr>
<tr>
<td></td>
<td>• Eye Irritant Category 2A</td>
<td>&lt;1% respirable crystalline silica;</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>• Inorganic bromide salts less than 0.1%.</td>
</tr>
<tr>
<td>CCP</td>
<td>Classifications</td>
<td>Compositional Specifications</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>CCP 5</td>
<td>• STOT-SE Category 3 (Respiratory Irritation)</td>
<td>Ashes with:</td>
</tr>
<tr>
<td></td>
<td>• STOT-RE Category 2</td>
<td>• Undetermined or ≥1 and &lt; 10% respirable crystalline silica;</td>
</tr>
<tr>
<td></td>
<td>• Toxic to Reproduction Category 2</td>
<td>• Total calcium oxide levels &gt;20% and ≤40%; or if determined, free calcium oxide levels &gt;8%;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Inorganic bromide salts ≥ 0.1%.</td>
</tr>
<tr>
<td>CCP 6</td>
<td>• STOT-SE Category 3 (Respiratory Irritation)</td>
<td>Ashes with:</td>
</tr>
<tr>
<td></td>
<td>• Toxic to Reproduction Category 2</td>
<td>• &lt;1% respirable crystalline silica;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Total calcium oxide levels less than or equal to 20%; or if determined, free calcium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>oxide levels less than or equal to 8%; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Inorganic bromide salts ≥ 0.1%.</td>
</tr>
<tr>
<td>CCP 7</td>
<td>• STOT-SE Category 3 (Respiratory Irritation)</td>
<td>Ashes with:</td>
</tr>
<tr>
<td></td>
<td>• Eye Irritant Category 2A</td>
<td>• Undetermined or ≥1 and &lt; 10% respirable crystalline silica;</td>
</tr>
<tr>
<td></td>
<td>• STOT-RE Category 2</td>
<td>• Total calcium oxide levels &gt;20% and ≤40%; or if determined, free calcium oxide levels &gt;8%;</td>
</tr>
<tr>
<td></td>
<td>• Toxic to Reproduction Category 2</td>
<td>• Inorganic bromide salts ≥ 0.1%.</td>
</tr>
<tr>
<td>CCP 8</td>
<td>• STOT-SE Category 3 (Respiratory Irritation)</td>
<td>Ashes with:</td>
</tr>
<tr>
<td></td>
<td>• Eye Irritant Category 2A</td>
<td>• &lt;1% respirable crystalline silica;</td>
</tr>
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</tr>
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<td></td>
<td></td>
<td>• Inorganic bromide salts ≥ 0.1%.</td>
</tr>
</tbody>
</table>
Carcinogenicity Classification Determination
Carcinogenicity Hazard Classification Determination

OSHA HCS, 2012 specific carcinogenicity classification of mixture includes:

– Classifying the finished product considering the classification of ingredient/component substances; unless

– Justification can be provided for classifying based upon the mixture as a whole.

These principles ensure that the classification process uses available data to the greatest extent possible in characterizing the hazards of the final product.
Carcinogenicity Hazard Classification Process

OSHA HCS, 2012 Appendix A states that:

• NTP and IARC carcinogenicity determinations **MAY** be used in lieu of the standard classification process.

• OSHA carcinogenicity determinations **SHALL** be used to establish the carcinogenic potential of a substance.
Carcinogenicity
- Individual Component Data
Carcinogenicity Classification Determination

Crystalline Silica

• IARC: Inhaled Crystalline Silica in the form of quartz and cristobalite from occupational sources is carcinogenic to humans (Group 1).

• NTP: Crystalline Silica as a known human carcinogen.
  – Heavily references the 1997 IARC monograph.

• OSHA: Does not classify crystalline silica as a carcinogen.
  – Proposed Silica Rule (published 2013), primarily focuses on OELs to mitigate hazards from RCS.
Carcinogenicity Classification Determination – IARC (1997)

• IARC concluded: Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1).
  – Sufficient evidence in experimental animals for the carcinogenicity of quartz.
  – Sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica in the form of quartz or cristobalite from occupational sources:
    • The IARC Working Group noted that carcinogenicity in humans was not detected in all industrial circumstances studied.

Coal dust containing silica was evaluated in a separate monograph. IARC concluded that coal dust could not be classified for carcinogenicity (Group 3).
Carcinogenicity Classification Determination
– IARC
- Animal testing (crystalline silica)

Testing in rats

• Inhalation of quartz results in chronic inflammation and fibrosis in the lungs
  – These fibrotic processes may result in an increased risk of cancer.
  – Rats with silica induced lung cancers appear always to have fibrosis
  – Rats may have decreased respiratory clearance capacity

• Carcinogenic effects were considered to be a secondary result of silicotic fibrosis.

Testing in other rodents

• Inhalation of quartz did not result in carcinogenic effects in other species
Carcinogenicity Classification Determination - IARC

- The IARC monograph notes that not all epidemiological studies were consistent, and the carcinogenic potential of silica may be affected by the physical properties of the silica particles.
  - Data suggest that unfractured, occluded or polycrystalline silica may not have the same carcinogenic potential

- Confounding factors such as silicosis, smoking and socio-economic status were often identified.

- The Working Group noted that:
  - “Carcinogenicity in humans was not detected in all industrial circumstances studied, carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs.”
One working group member indicated that there was:

- “considerable difficulty in reaching a decision”. After the working group debate it was stated that the meeting “finally end[ed] in a narrow vote, reflecting the majority view of the experts present at that particular time.”

These data and statements reflect the ambiguity in the underlying data and underscored the lack of consensus on this issue.
Carcinogenicity
- Data on Mixtures
Carcinogenicity Classification Determination – Toxicological data

• Data submitted for EU REACH registrations of fly ash and CFB ash:
  – Negative for mutagenicity
  – Long-term animal studies did not result in any classification for Specific Target Organ Toxicity – Repeated Dose
  – Carcinogenicity studies not required as precursors to carcinogenicity were not identified (mutagenicity and hyperplasia after long term exposure)

• EPRI examined the response of ashes in various in vitro/in vivo studies (EPRI, 2006)
  – Fly ashes (pulverized coal and fluidized bed combustion) were compared with quartz. The ashes were not toxic while quartz demonstrated a clear dose-response relationship. Hill and Hobbs (1982)
  – Mixed mutagenicity responses were identified
    • May be due to a response to other toxic elements in the ashes (i.e., elevated arsenic or ashes coated in VOCs)
Carcinogenicity Classification Determination - Epidemiological Data

• Workers exposed to pulverized fly ash between 1950 and 1961 did not reveal the existence of any pneumoconiosis (occupational lung disease) except in men with an occupational history of coal mining.

• In a mortality study of 1,772 workers at three coal fueled power plants in northern Italy, the overall mortality was lower than expected and there was a non-significant increase in the deaths observed from Lung cancer (8 vs. 6.9).

• A study of the respiratory health of workers at six coal-fueled power plants included data from 60 industrial hygiene measurements of total dust. The author states: “No definite relationship between exposure and x-ray changes was established.”
Carcinogenicity Classification Determination - Epidemiological Data

• Exposure-response studies on mixtures containing crystalline silica fail to consistently confirm that the excess lung cancer risk in silica-exposed workers is exposure to quartz.
  – These studies were sufficiently powerful to demonstrate relationships of silica exposure with silicosis and silico-tuberculosis, so it is unlikely that they would have missed any small risk for or weak relationship with lung cancer.

• Descriptive studies frequently but not invariably suggest an excess lung cancer risk in silica-exposed workers (compared with the general population).
Carcinogenicity Classification Determination

• The IARC Working Group noted that "carcinogenicity in humans was not detected in all industrial circumstances studied, carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs."

• IARC also noted that not all studies were consistent, and the carcinogenic potential of silica might be affected by the physical properties of the silica particles.

• CCPs are generated from the combustion of coal.

• Coal dust, which may contain up to 15% crystalline silica was not classified as carcinogenic by IARC.
Carcinogenicity
- Overall Evaluation
RCS is not classified for carcinogenicity by OSHA, therefore a Weight of Evidence approach was used to assess typical CCPs containing $\leq 10\%$ RCS. Typical CCPs would not be classified for primary carcinogenicity.

Limited animal data crystalline silica, final product testing and data on similar mixtures suggests that silica-related cancer risk may not be applicable to silica containing mixtures and when present may be affected by other confounding factors such as silicosis.
Conclusions
## CCP Hazard Classification Process

1. Define CCPs as UVCB substances. Treat as a mixture for classification purposes.

2. Assess typical CCP composition to identify substances that may effect the product hazard classification.

3. Assign the product hazard classifications based on the composition, not CCP type (i.e., fly ash, bottom ash, CFB ash).

4. Develop hazard classifications following OSHA Guidelines using a Weight of Evidence approach taking into consideration finished product testing, data on similar materials and component data.
CCP Hazard Classification

Using Weight of Evidence approach the hazard classifications for typical CCPs compositions were assessed taking the following into consideration:

- Finished Product Testing
- Data on similar mixtures
- Data on individual components
Hazard Classifications of typical CCP compositions

Classifications that **may** apply:

- Specific Target Organ Toxicity – Single Exposure: Category 3 (Respiratory Irritation)
- Eye Irritant, Category 2A
- Reproductive Toxicity, Category 2
- Specific Target Organ Toxicity – Repeat Exposure, Category 2 (Lungs)

Classification that **DO NOT** to apply:

- Carcinogenicity
Questions?

Thank you!

Maryann Sanders
Sr. Regulatory Compliance Specialist
248-378-3957
msanders@haleyaldrich.com