Coal Ash-Composites

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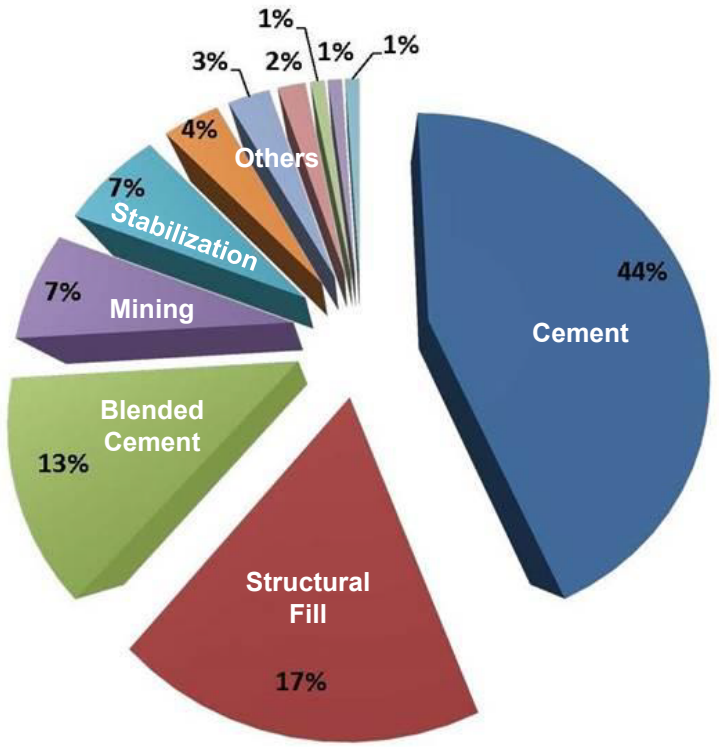
US Coal Ash Production and Utilization

Utilization

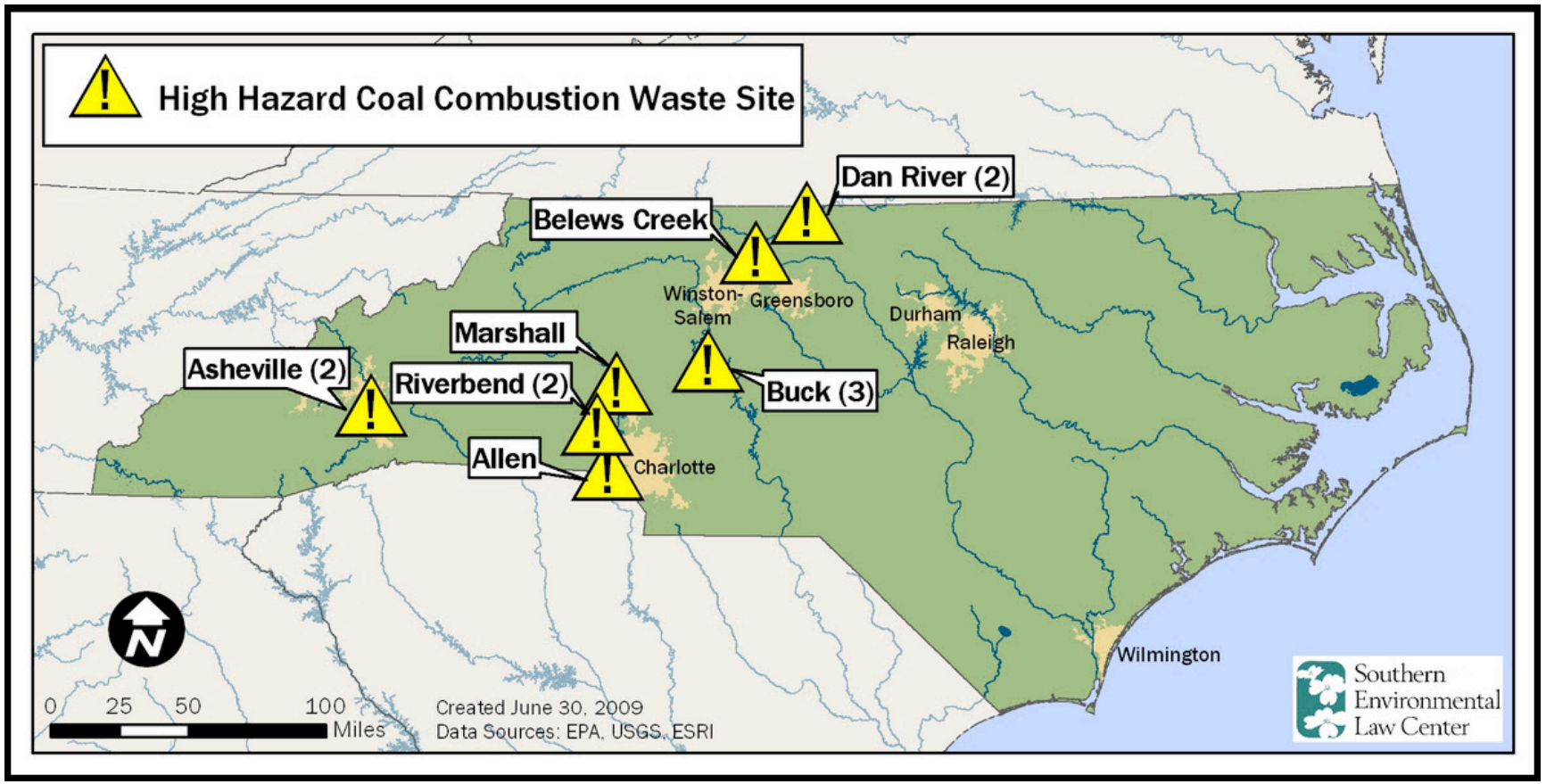


Unused Coal Ash: 45 mT/Yr

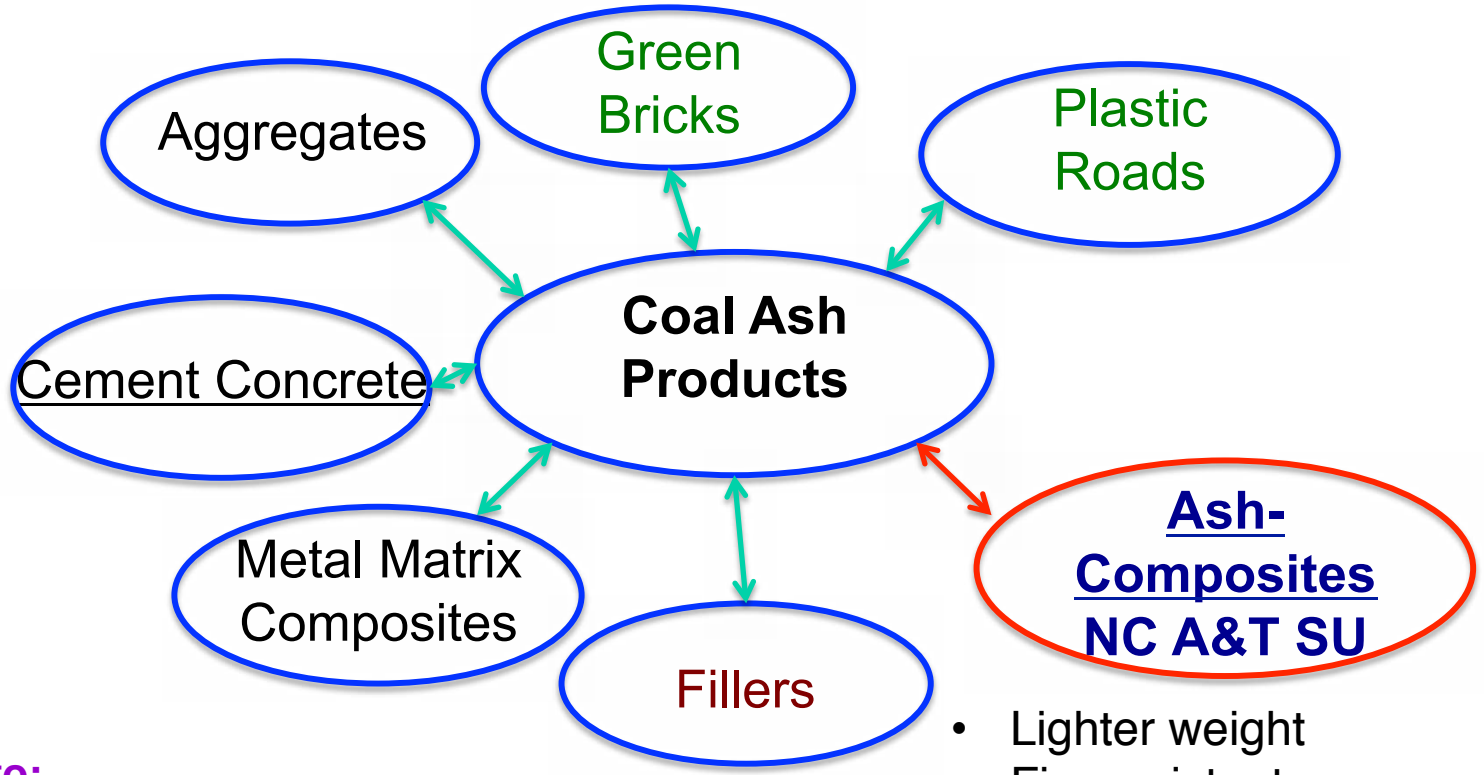
(1/2 of yearly Production)

Source: American Coal Ash Association

North Carolina Ash Ponds



Coal Ash Utilization and Products



- Lighter weight
- Fire resistant
- Large ash consumption
- Building products – Resistant to Insects & Pests
- Value >> concrete

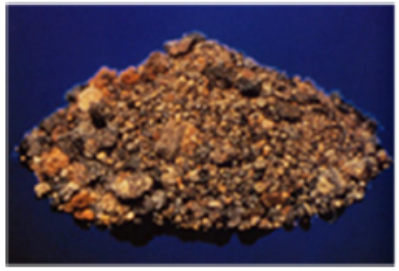
Thanks to:

Sen. Trudy Wade (District 27)
Sen. Andrew Brock (District 34)
Sen. Bill Cook (District 1)

Coal Fired Steam Plant and Residuals

Coal is a naturally formed material!

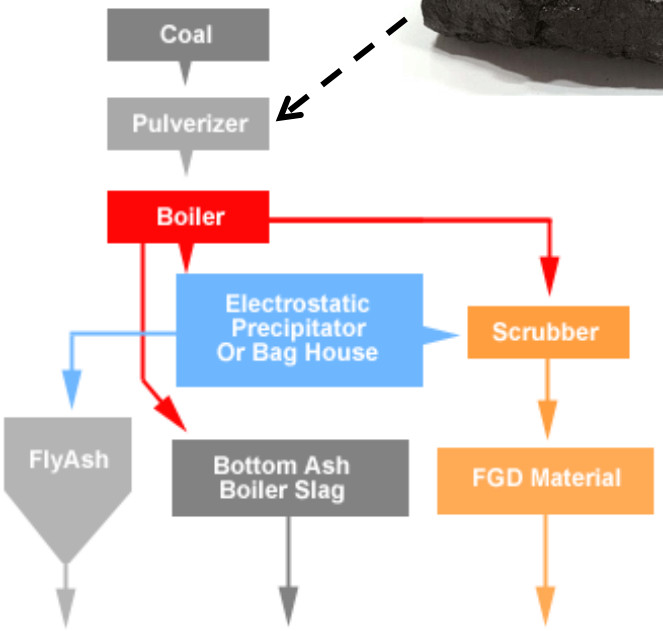
Fly Ash



Bottom Ash

Boiler Slag

FGD Gypsum



Coal Combustion Residuals

CCR: 5%-15% of Coal Weight

Chemical Composition of Fly Ash

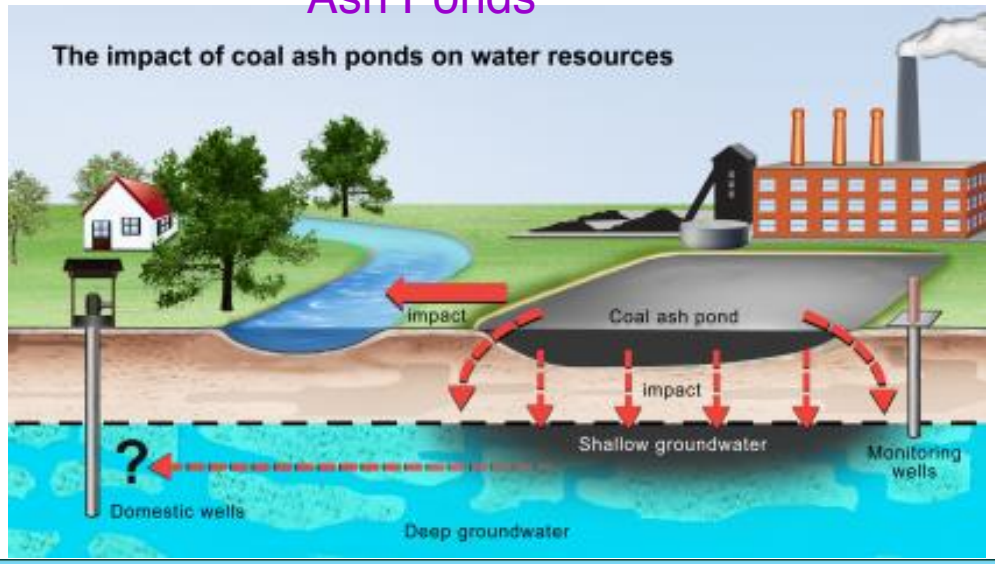
- Silica 55% - 65%
- Alumina 25% - 35%
- CaO 25%-35%
- F_2O_3 (Iron Oxide 1% - 5%

Air and Ground Water Pollution

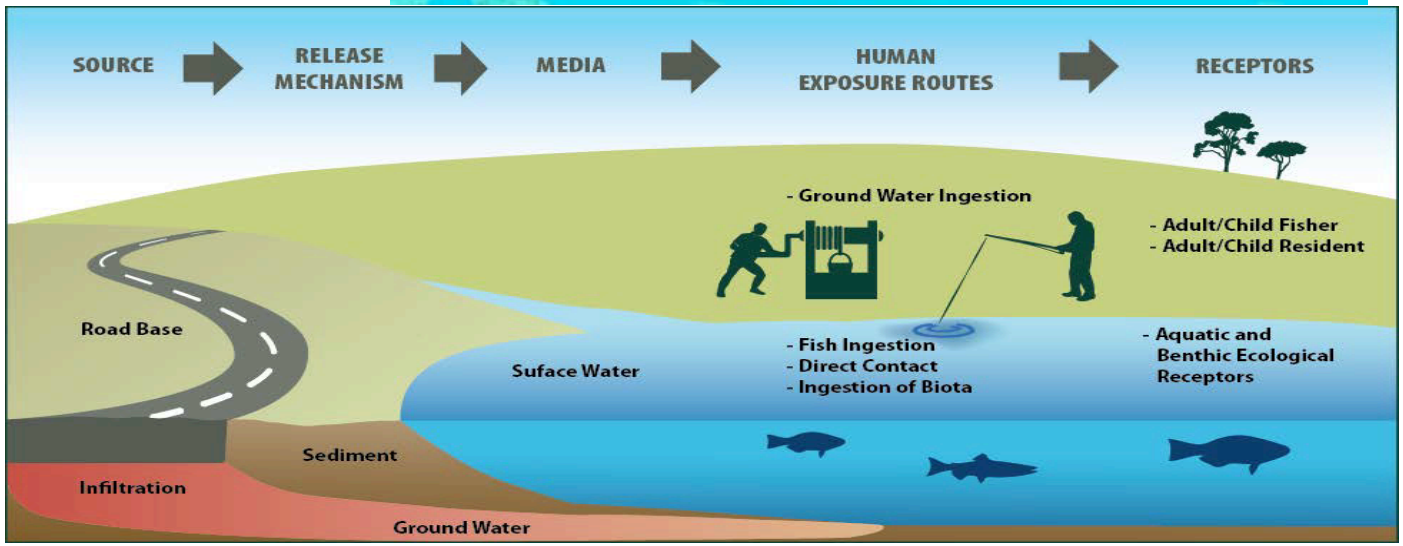
Air-Open Pits

Courtesy: China

Ash Ponds

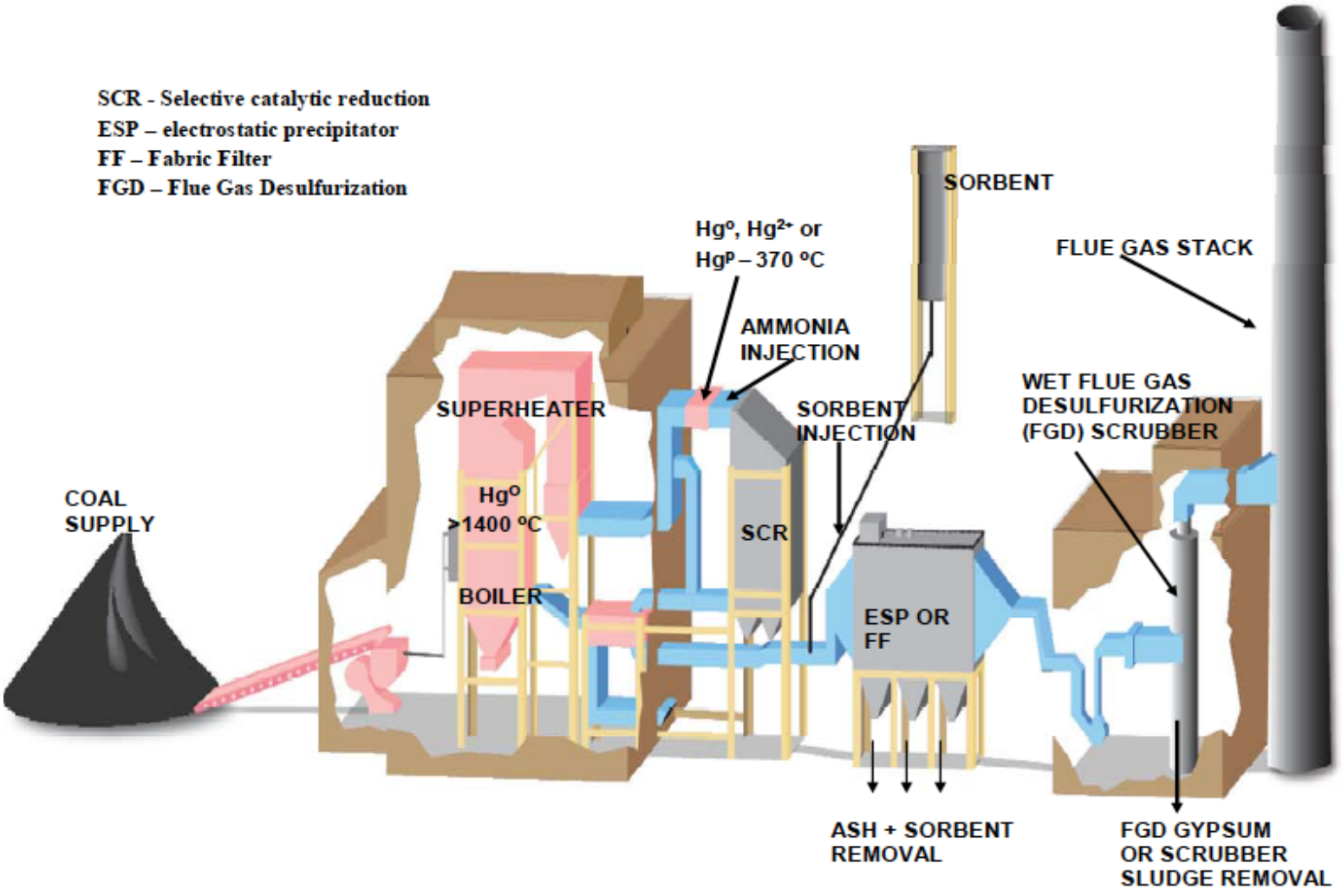


Road Base



Courtesy: EPA

Emission Controls
Hg, NOx, SO_2 & Particulate Matter



Leach Test Results
Fly Ash from 8 Plants(U.S. EPA, 2008)

	Hg	As	Se	Sb	Ba	B	Cd	Cr	Co	Pb	Mo	Tl
Total in Material (mg/kg)	0.04-0.6	70-90	2-30	3-15	600-1,500	NA	0.7-1.5	100-200	20-50	40-90	10-20	3-13
Leach results (µg/L)	<0.01 - 0.4	7-300	7-400	<0.3 - 200	90-4,000	200 - 300,000	<0.2 - 30	1-4,000	<0.3 - 200	<0.2 -2	100-40,000	<0.3 - 300
MCL[1] (µg/L)	2	10	50	6	2,000	7,000 DWEL2	5	100	-	15	200 DWEL	2
TC[3] (µg/L)	200	5,000	1,000	-	100,000	-	1,000	5,000	-	5,000	-	-
Variability relative to pH[4]	Low to High	Low to Med	Low to Med	Med to High	Low	Med to High	High	Low to Med	High	Med	Low to Med	Med

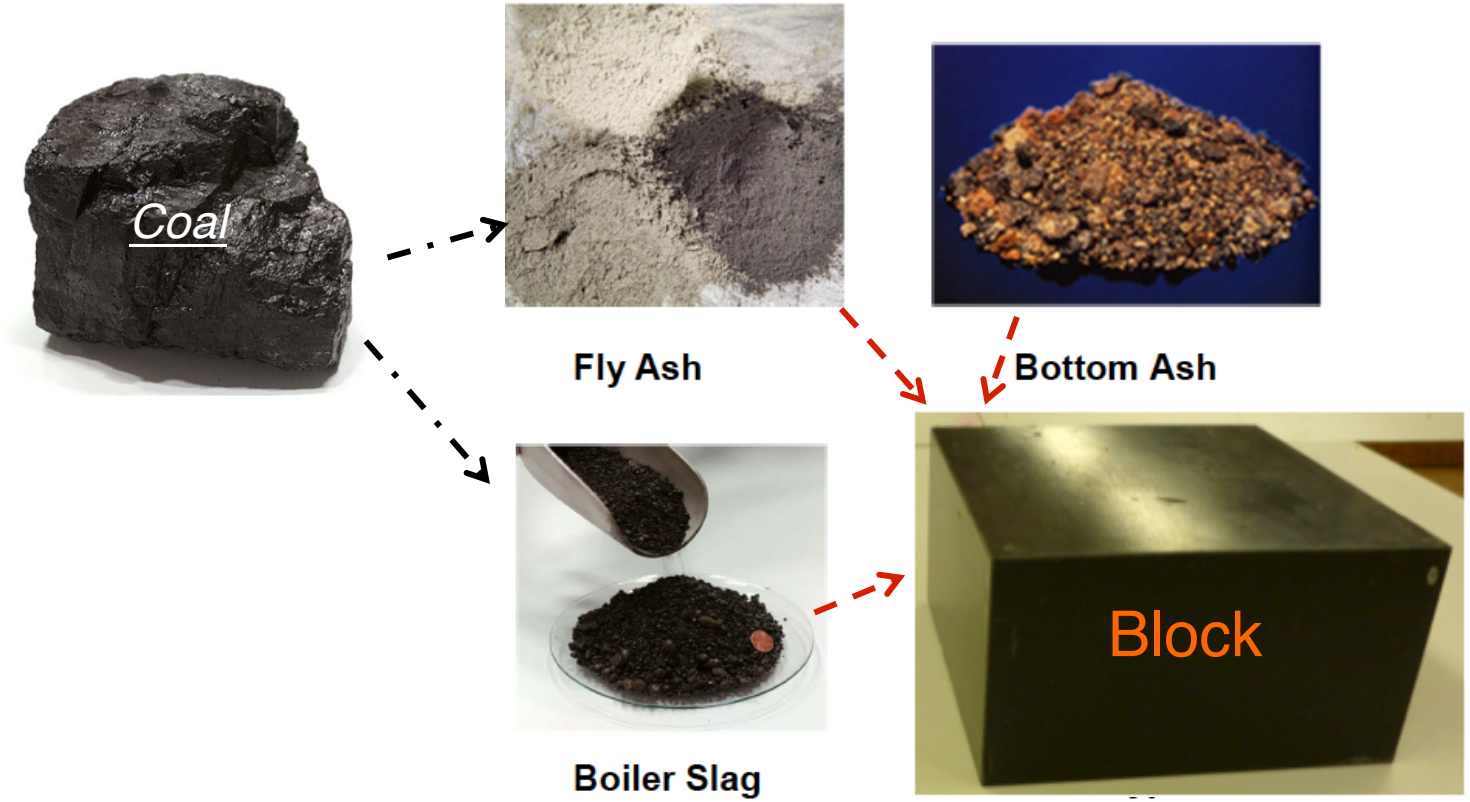
[1]MCL is the maximum concentration limit for drinking water.

[2]DWEL is the drinking water equivalent level.

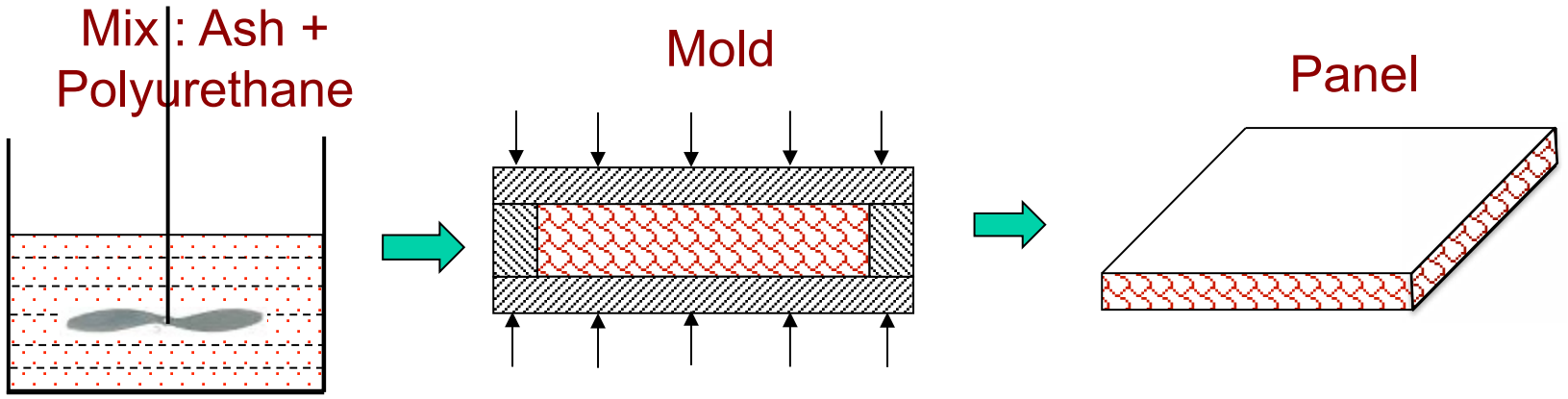
[3]TC is the toxicity characteristic and is a threshold for hazardous waste determinations.

[4]Variability defined as low is <1 order of magnitude difference; moderate is 1 to 2 orders of magnitude difference; and high is >2 orders of magnitude difference.

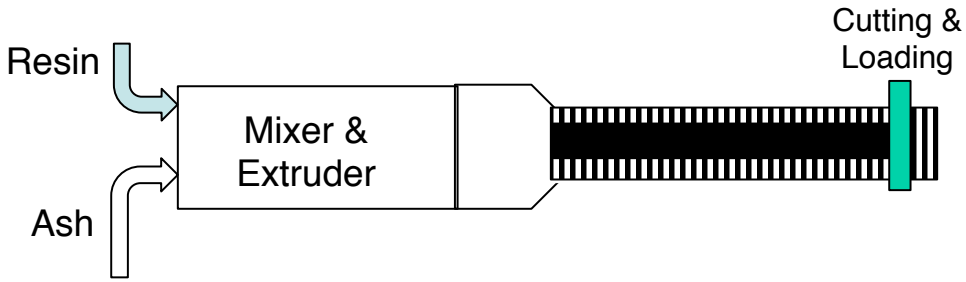
Reversal Process



Coal Ash-Composite



Concept

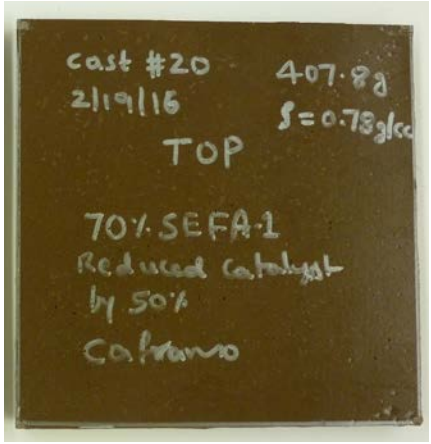


Typical Continuous Process
(Plan)

Ash-Composite Panels & Blocks

BC Steam Station Ash

STAR Processed Ash



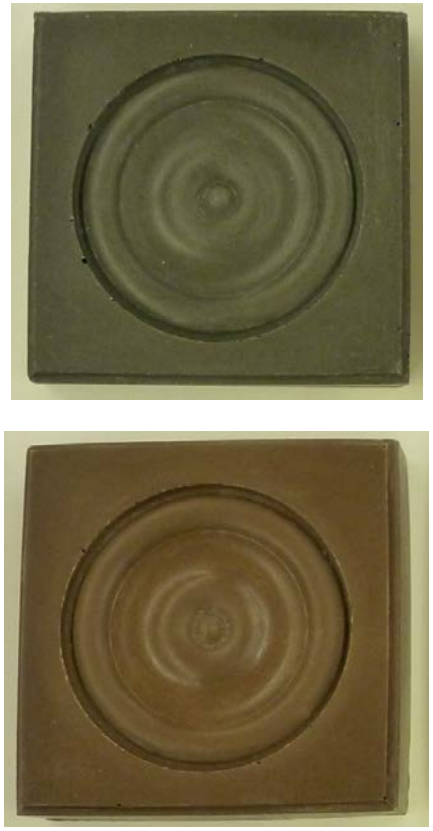
Reusable Ash-Composite Blocks

Ash Weight: 75% Composite; Potential to make >80%

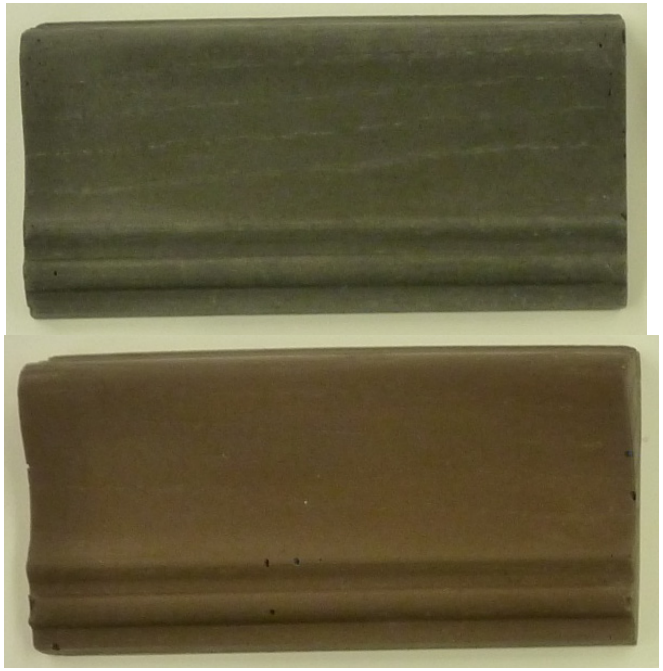
Examples of Building Products

Base Board

Decorative Mold

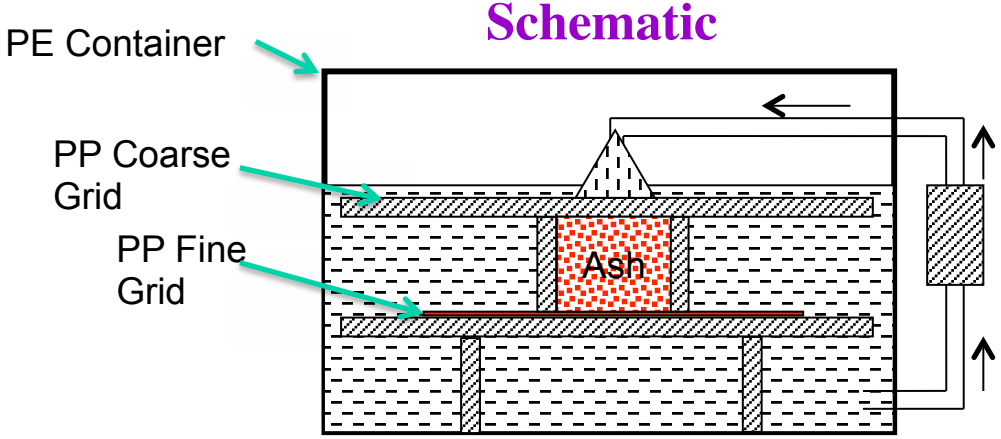


Chair Rail



Leach Test: Ash and Composite & Block

Schematic



EPA M1313

River flow model

Leachate from Ash

As per EPA M1313 (LEAF)

	Content in micogram/Liter; 2-Day Leaching				
			B_A_4_2_D	B_A_7_2_D	B_A_10_2_D
Mineral	EPA MCL	PQL	AC3717	AC3714	AC3718
Antimony by I	6	10.0	35	19	30
As by ICPMS	10	2.0	54	29	330
B by ICP	7,000	50.0	4,400	3,800	3,800
Ba by ICP	2,000	10.0	160	160	400
Be by ICP	4	5.0	5.0 U	12	5.8
Cd by ICPMS	5	0.5	6	16	3.7
Cr by ICPMS	100	5.0	28	34	220
Cu by ICPMS	1,300	2.0	65	680	170
Mn by ICPMS	50	10.0	82	180	83
Pb by ICPMS	15	2.0	12	16	140
Se by ICPMS	50	1.0	240	52	350
Thallium (Tl) I	2	2.0	8.4	24	12
V by ICP	200	10.0	160	69	550
Zn by ICPMS	5,000	10.0	260	760	380

Leachate from Ash Block

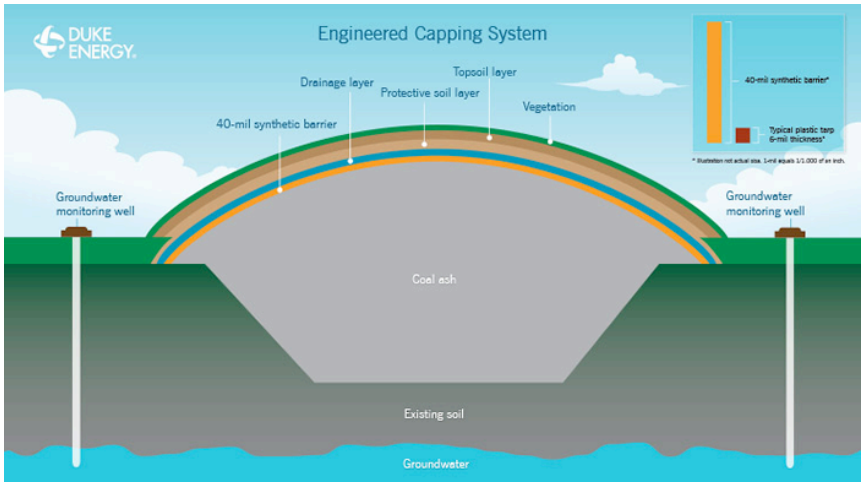
Circulating Water

	Content in micogram/Liter			
			Distilled Water	Block_7_37_S
Mineral	EPA MCL	PQL	AC3708	AC3710
Antimony by ICPMS	6	10.0	10 U	10 U
As by ICPMS	10	2.0	2.0 U	2.0 U
B by ICP	7,000	50.0	100	460
Ba by ICP	2,000	10.0	10 U	10 U
Be by ICP	4	5.0	5.0 U	5.0 U
Cd by ICPMS	5	0.5	0.5 U	0.5 U
Cr by ICPMS	100	5.0	5.0 U	5.0 U
Cu by ICPMS	1,300	2.0	2.0 U	9.2
Mn by ICPMS	50	10.0	10 U	10 U
Pb by ICPMS	15	2.0	2.0 U	2.3
Se by ICPMS	50	1.0	1.0 U	1.0
Thallium (Tl) ICPMS	2	2.0	2.0 U	2.0 U
V by ICP	200	10.0	10 U	10 U
Zn by ICPMS	5,000	10.0	10 U	690

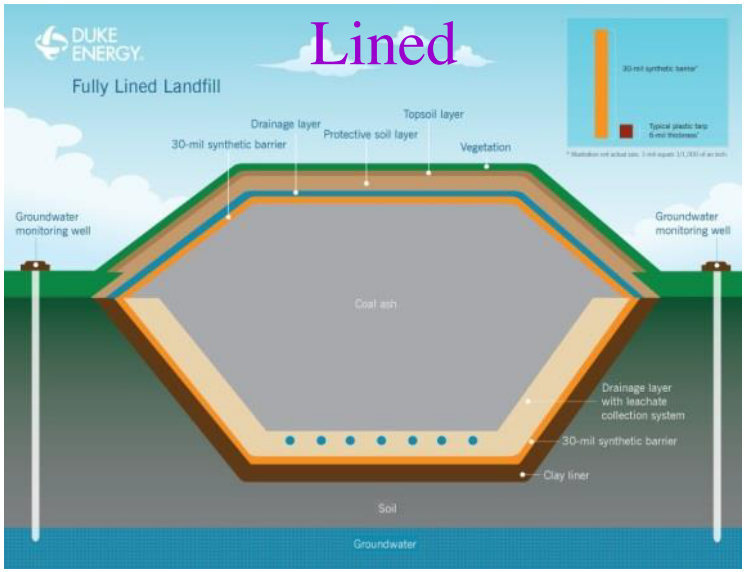
Thanks to: Dr. Roy Byrd, NCDEQ

Ash Storage

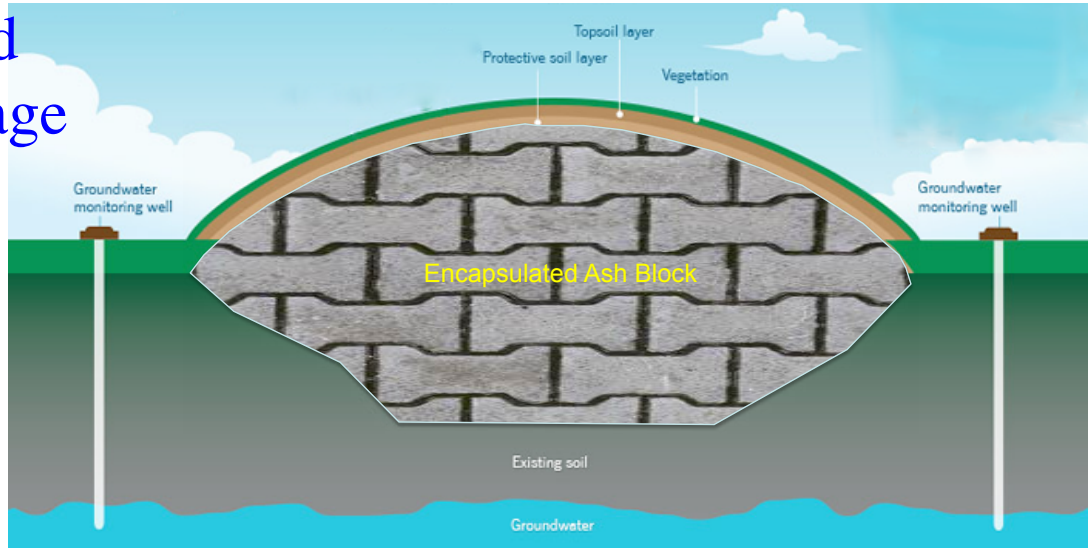
Unlined



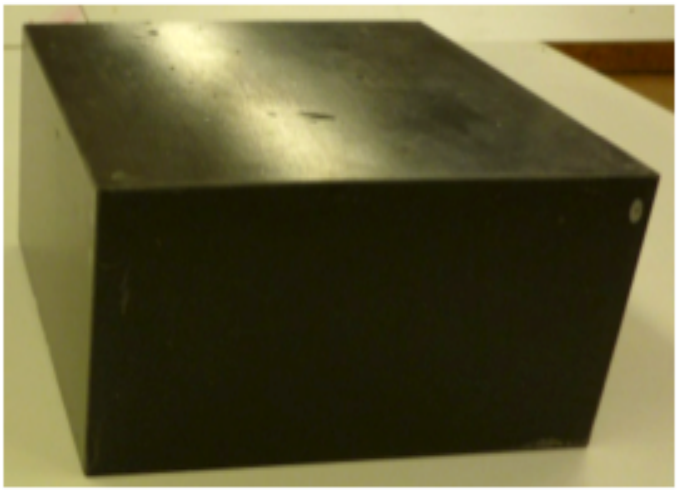
Lined



Block Filled Unlined Storage



Blocks are Reusable



Aggregates

Grounded to Powder
for Building Products

Summary

- **Coal Ash is not a Waste/Toxic; It is a Valuable Mineral!**
- Ash-Composite is a Solution to the Coal Ash Problem
  - Offers Short & Long Term solutions: Composite Blocks, Building & Infrastructure Products
  - Blocks are reusable
  - Minimizes landfill
  - Non-radioactive
  - No heavy metal leachate
- Ash-Composite Technology is:
  a. Safe; Reduces Natural Resource Consumption (Green Technology)
  b. Minimizes Air & Ground Water Pollution
  c. Uses High ash loading (≥80%)
  d. Requires little or no energy and water
  e. Suitable for In-situ manufacturing and storing in closing ash ponds
  f. All materials used are Commercial Available