

A Marketers Perspective on Changes Influencing Ash Utilization Now and In the Future

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CURRENT FLY ASH ARENA

- **Current Market**
- **Historic Trends**
- **Social Viewpoint**
- **Service Life**
- **Why Change is Needed**
- **Why the Concrete Industry**

Current Market

**Hand full of large marketers representing
the power plants with a small group of
independents.**

HEADWATERS *Adding Value to Energy™*

HEADWATERS Facilities Serve Customers Coast to Coast

720 Coal Plants in the U.S.

60-70% of all Energy Produced

Over 100 Coal Burning Power Plants on the Books.

HEADWATERS *Adding Value to Energy™*

Historic Utilization Trends

Engineer, Architect & Governing Officials

Steady increase in utilization of all CCP's

Utilization growth lagging in supply

CCP Production & Use in USA

Year	Total CCP Use (%)	Total CCP Production (%)
1966	10	20
1970	15	35
1975	20	50
1980	25	65
1985	30	75
1990	35	85
1995	45	95
1998	55	105

SOURCE: American Coal Ash Association

“LEED” Leadership in Energy & Environmental Design

Design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants in five broad areas:

- Sustainable site planning (22%)
- Safeguarding water and water efficiency (8%)
- Energy efficiency and renewable energy (27%)
- Conservation of materials and resources (20%)
- Indoor environmental quality (23%)

Social Viewpoint

Being driven by World opinion and environmental stewardship

Kyoto Protocol

A global accord that attempts to reduce the emission of greenhouse gases to prevent global warming.



Clear Skies Initiative

Service Life

Leaving the throw away mentality



As low as 17 year average in some states



Wacker Drive in Chicago – 80/100 years
Confederation Bridge in Canada 100 years
BAPS Temple & Hindu Temple 1000 years

Why Change is Needed

If the true societal costs of energy use, resource consumption, pollution from manufacturing, and waste disposal were incorporated into the costs of our building materials, using recycled content materials wouldn't be an altruistic, feel-good practice. It would simply be the most economically attractive option.

American Lung Association calculated that the healthcare costs of automobile caused air pollution in the U.S totaled about \$100 billion per year, or roughly a \$1.00 per gallon



**Societal costs of petroleum
Is est. at \$5.00 gallon**

Environmental Building New Feb 05

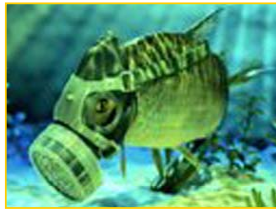
Societal and Industry must change together because it is not just one segment of a market being affected, its all of them...

**Current total annual cost
For corrosion in U.S. 276 billion**

2005 TEA-21 Reauthorization Bill

Obligation level

**\$241 to \$284 billion over the
Next five years.**



40% of Corrosion can be prevented by existing technologies and best known practices. Battelle Memorial Institute.

Direct Cost Savings Indirect Cost Savings

▪ 110 billion annually ■ 139 billion annually

The production of every ton of Portland cement contributes about one ton of CO2 into the atmosphere.

Expert estimate that Cement production contributes about 7 percent of carbon dioxide emissions from human sources.

If all the fly ash generated each year were used in concrete production, the reduction of carbon dioxide released through substitution of Cement and fly ash would be equivalent to eliminating 25 percent of the world's vehicles. **500 BILLION SOCIETY REDUCED TO 375 BILLION OR 125 BILLION SAVINGS**

Why the Concrete Industry?

“Concrete is second only to water as the world's most heavily consumed substance”

John Sedgewick
Atlantic Monthly, April 1991

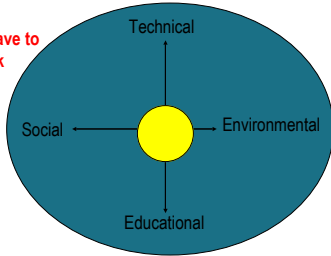


The U.S. Market 2004

- **Cement Consumption** • **108 Million Tons**
- **Cement Production** • **78 Million Tons**
- **Cement Shortfall** • **30 Million Tons**
- **GGBFS Consumption** • **3 Million Tons**
- **GGBDS Production** • **1.8 Million Tons**
- **Total BFS** including air cooled • **9-12 Million Tons**
- **Fly Ash consumption** • **13 Million Tons/concrete**
- **Fly Ash all application** • **28 Million Tons/other**
- **Fly Ash Disposed** • **39 Million Tons**
- **Total Fly Ash Produced** • **80 Million Tons**

What the Future has for CCP's

All elements will have to synergize and work together.



We must learn from the past & not make the same mistakes

- Change Definition
- Change Perception
- Educate Specifiers
- Address Head on Elements Driving Change
 - A. Prescriptive- VS – Performance
 - B. LEED/ USGBC Programs
 - C. Material Selection or Changes
 - D. Social Costs
 - E. Processes and Systems being used

Change Definition

POZZOLAN

- A siliceous or siliceous and aluminous material which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.

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- A siliceous or siliceous and aluminous **industrial recovered product which by its self or in combination with other cement enhancing materials influences the properties of ordinary portland cement to produce a concrete with a sustainable service life three and four times that of ordinary portland cement.**

Perception of CCP's

Technical



Few Understand

Cause and Effect



Relate to the Masses

Education of the Specifiers

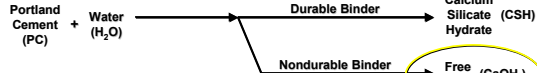
- 85% of the Engineering Schools, one course is taught in concrete construction and that is with a structural class.
- 10% of the Engineering Schools give one course in concrete technology. (Free elective)
- 4% of the Engineering Schools give two classes.
- 1% of the Engineering Schools specialize in concrete technology.

Chemistry

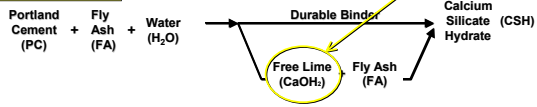
Chemical Compound	Pozzolans				Cement
	Class F	Class C	Class N	Slag	
SiO ₂	54.90	39.90	58.20	38.0	22.60
Al ₂ O ₃	25.80	16.70	18.40	7.9	4.30
Fe ₂ O ₃	6.90	5.80	9.30	Tr.	2.40
CaO	8.70	24.30	3.30	41.90	64.40
MgO	1.80	4.60	3.90	6.89	2.10
So ₃	0.60	3.30	1.10	--	2.30
Na ₂ O & K ₂ O	0.60	1.30	1.10	4	0.60

HYDRATION PRODUCTS OF CEMENTING BINDERS

Portland Cement



Portland Cement + Fly Ash



Through Pozzolanic Activity, Fly Ash Combines with Free Lime to Produce the Same Cementitious Compounds Formed by the Hydration of Portland Cement



Elements Driving Change

The Concrete Construction Industry is changing and is going to continue.

Prescriptive VS Performance

LEED & BEE's Leadership in Energy & Environmental Design®

Material Selection

ASR, CO₂'s, Chlorides, Corrosion.....

Social Costs.

Prescriptive VS Performance Mixes

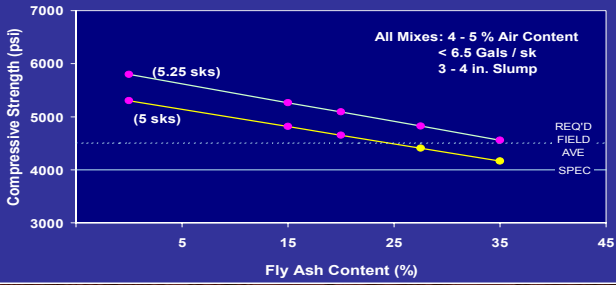
▪ What is better for concrete and the environment?

Less Cement is that best????????????????????

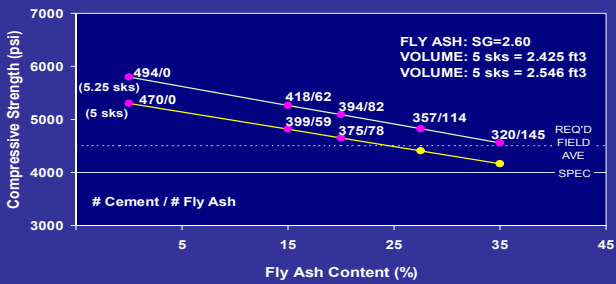
Less Cement in a mix always reduces CO₂'s,

or does it????????????????????

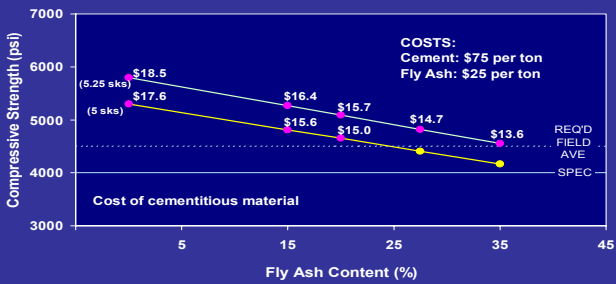
TRIAL MIX RESULTS



TRIAL MIX RESULTS



TRIAL MIX RESULTS



Which is a better mix design?

	<u>Cost of cementitious material</u>	<u>Strength*</u>
5 sks w/o fly ash	▪\$15.0	▪OK
5.25 sks w/ 35% fly ash	▪\$13.6	▪OK

* Compared to required field average

Better?

- \$1.40/cy Savings
- Lower Temperature
- Better Finishing
- Better Pumpability
- Better Consolidation
- More Durable
- Lower Permeability
- Less Cracking





Material Selection


CHANGING PRODUCTS

LEED

**HIGH VOLUME /
PERFORMANCE**

 Adding Value to Energy™					
COMPRESSIVE STRENGTH					
CEMENT #	658	658	530	530	611
FLY ASH #	0	75	130	260	275
W/(C+P)	0.41	0.37	0.38	0.33	0.28
AIR%	6.6	6.2	5.9	5.4	4.7
COMP – 3 DAY	NONE	NONE	NONE	NONE	NONE
7 DAY	4765	4675	4295	4325	NONE
14 DAY	5480	5630	5185	5330	8015
28 DAY	6140	6580	6020	6315	8995
148 – 157 DAY	6730	7420	7360	8390	11995
300 DAY	6800	7780	8070/6900	8950	12430

 Adding Value to Energy™				
COULOMB RANKING				
MIX	COULOMB	COULOMB RANGE	CHLORIDE PERM.	TYPICAL OF
658 / 0	4509	> 4000	HIGH	W/C > 0.6 PCC
658 / 75	2404	2000 - 4000	MODERATE	W/C 0.4 - 0.5 PCC
530 / 130	1497	1000 - 2000	LOW	W/C < 0.4 PCC
530 / 260	797	100 - 1000	VERY LOW	SILICA FUME
611 / 275	639	100 - 1000	VERY LOW	SILICA FUME

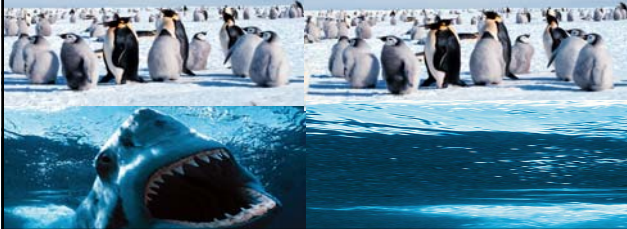
 Adding Value to Energy™	
Water Reduction – Future focus within LEED	
<ul style="list-style-type: none"> ▪ U.S. consumes 400,000,000 Yards of Concrete ▪ With 470 lbs of cement per cubic yard ▪ At a Water to cement ratio of .45 or 211 lbs/25 gallons. 	
<ul style="list-style-type: none"> ▪ Fly ash reduces water by 2-10% 	
<p>10,000,000,000 BILLION gallons of water is consumed in U.S. R/M market 200 MILLION to 1 BILLION gallons of water can be saved by utilization of fly ash into every cubic yard of concrete concrete.</p>	

The Processes and Systems in which we use

- Not learning from past mistakes or successes?

Processes and Systems in which we use?

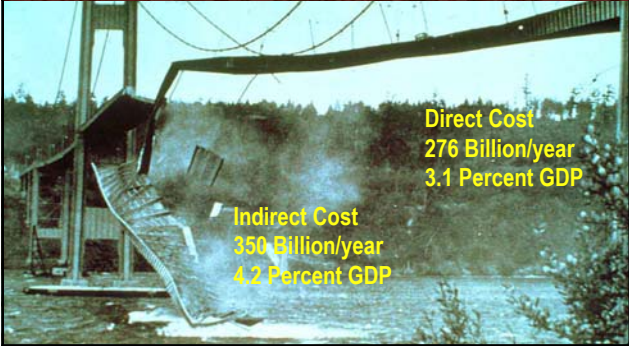
Penguin Theory of Advancement



It's done this way because that is how we have always done it.



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Direct Cost
276 Billion/year
3.1 Percent GDP

Indirect Cost
350 Billion/year
4.2 Percent GDP

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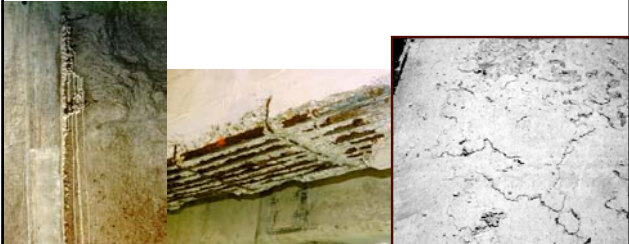
Approximately 600,000 bridges in the U.S. and half were build between 1950 and 1994.

Although there is a downward trend in the % of structurally deficient bridges- decrease from 18% to 15% the cost of replacing the bridges has increased 12% during the same time period.

In addition, there has been an significant increase in the required maintenance to the 183,000 aging bridges.

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What Is the Social Cost?



Cost to Repair of Concrete

- Vertical Patching (\$35.00 - 50.00/sf)
- Horizontal Patching (\$10.00-20.00/sf)
- Epoxy Injection (\$20.00-100.00/LF)
- Foam Injection (\$60.00-80.00/LF)
- Corrosion Inhibitors (\$60.00-6.00/Cubic Yard)
- (\$1.75-2.00/SF)

Significant Environmental Benefits

- **Because fly ash use displaces cement production, environmental benefits are substantial.**
- **Just One Ton of Fly Ash Usage Equals...**
 - Landfill Space Conserved: **Enough for 455 days of solid waste produced by an average American.**
 - CO₂ Emissions Reduced: **Equal to two months of emissions from an automobile.**
 - Energy Saved: **Enough to provide electricity to an average American home for 24 days.**

BLENDED CEMENTS & TERNARY MIXES

- Performance, energy conservation, environmental impact and economics can be improved for the cement producer through the use of pozzolans as part of the cementitious materials.
- Materials may be blended or interground with portland cement.
- Type 1P cement has a pozzolan content of 15% to 40%.
 - Performance similar to Type 1 cement.
- Type 1(PM) cement has a maximum pozzolan content of 15%.

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Thank You

☞ Gentoo Swimming.