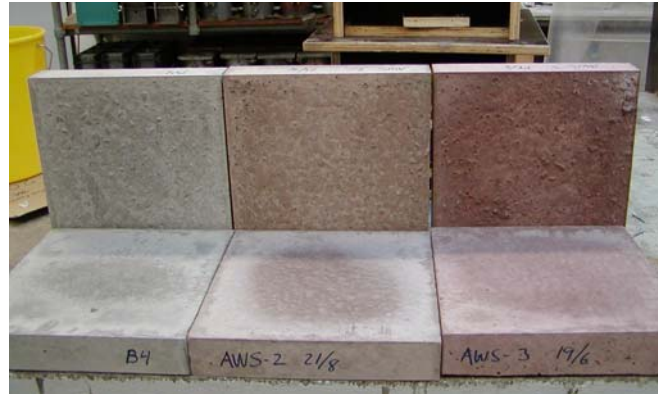




The use of sludge incinerator ash in the production of concrete



The project



Purpose: Increase the reuse of sludge ash for concrete production

Budget: 720,000 €. Partners (58%) and the EU-LIFE programme (42%)

Partners: Two wastewater treatment plants and a concrete producer

Consultant: Danish Technological Institute

Period: June 2005 - December 2007

Acronym: BioCrete



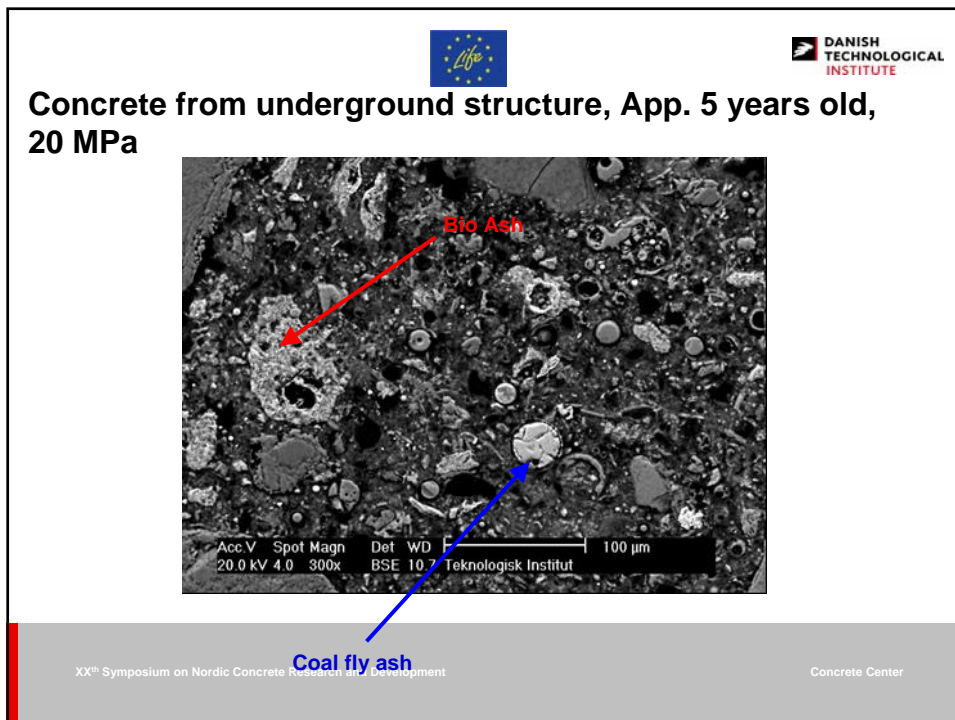
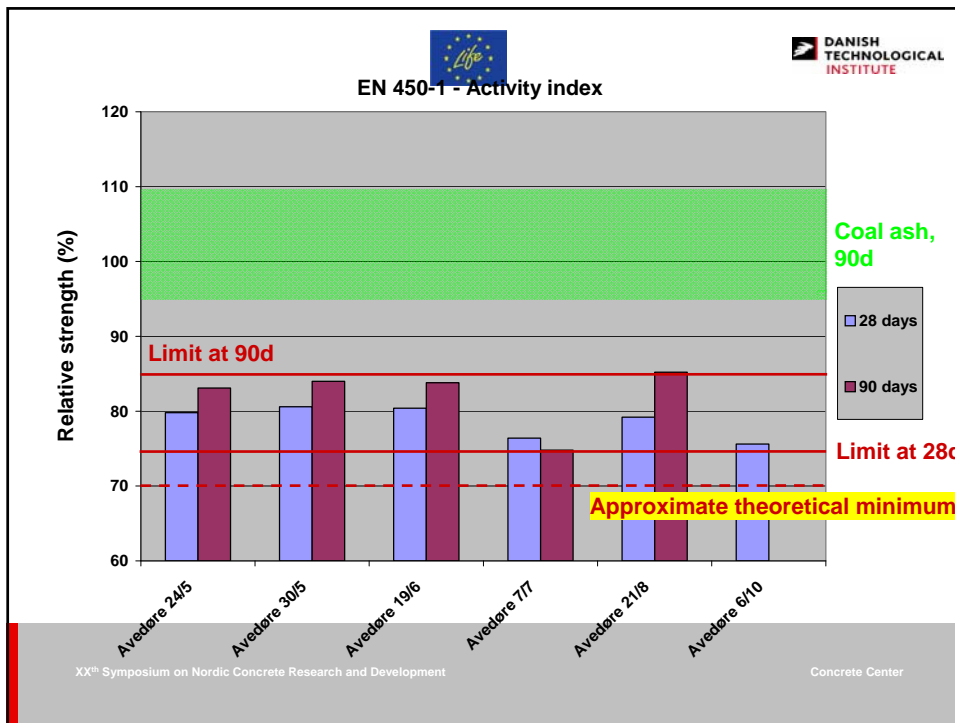


- Facilities at the incineration plant and concrete production plant
- “White” bio ash
- Environmental impact
- Documentation of the quality of ashes and concrete
- Collecting data from existing bioash constructions
- Production of bioash concrete

Results



- The ash properties are dependent on oven type
- The leaching of heavy metals is comparable to “ordinary concrete”
- Higher setting time, lower activity index
- If the colour is a problem, use smaller amounts (20 – 40 kg/m³ for “white” bio ash og 5 – 10 kg/m³ for ordinary)
- Used in Denmark: low exposure class and strength classes. (2007: 12.000 m³ concrete / 710 tonnes)



More information



<http://www.biocrete.dk/english/>

Laymans report

Bio ash in concrete - a guideline



Concrete Center

Resultater



- Optimale miks opnås ved at erstatte ca. halvdelen af flyveaske med bio aske, øvrig sammensætning er som almindelig anvendt praksis i Danmark.
- Betonens farve påvirkes ved tilsætning af bio aske. Den rødlige farve adskiller sig en del fra normal grå beton. Hvis dette udgør et problem, kan det elimineres ved at begrænse doseringen til 20 – 40 kg/m³ for lys bio aske og 5 – 10 kg/m³ for rød bio aske.
- Tilsætning af bio aske påvirker den friske betons luftindhold, hvorfor mængden af luftindblandings-middel bør justeres ved indledende prøvning.
- Betonens vandbehov øges ved tilsætning af bio aske.



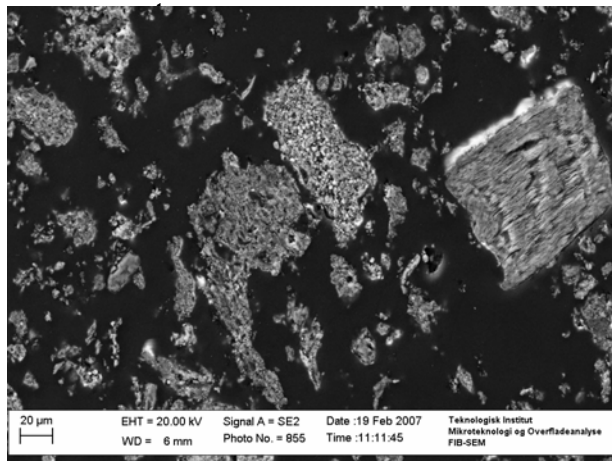
Bio ash and Fly ash. Chemical parameters

Analytical parameter			Bio ash	Fly ash for concrete	
Name	Unit	Method	Range	Typical value	Requirement
Loss on ignition (950 °C)	%	EN 196-2	1.5 - 2	2.1	< 5 (Category A)
Soluble phosphate	mg/kg*	Annex C*	70 - 85	27	< 100
Phosphorus as P ₂ O ₅	%	WDXRF	26 - 27	0.3	
Silicon dioxide (SiO ₂)	%	EN 196-2	21 - 24	51	
Reactive silicon dioxide (SiO ₂)	%	EN 197-1	11 - 13	36	> 25
Free calcium oxide (CaO)	%	EN 451-1	< 0.01	0.4	< 2.5
Calcium oxide (CaO)	%	EN 196-2	19 - 20	7.1	
Iron oxide (Fe ₂ O ₃)	%	EN 196-2	14 - 16	8	
Aluminium oxide (Al ₂ O ₃)	%	EN 196-2	6.2 - 6.8	22	
Sum of SiO ₂ , Al ₂ O ₃ & Fe ₂ O ₃	%	EN 196-2	42 - 47	81	> 70
Magnesium oxide (MgO)	%	EN 196-2	3.0 - 3.1	2.5	< 4.0
Sulfuric anhydride (SO ₃)	%	EN 196-2	1.3 - 1.7	1.1	< 3.0
Chloride (Cl ⁻)	%	EN 196-21	0.005 - 0.02	0.015	< 0.10
Total content of alkalis (as Na ₂ O)	%	EN 196-21	1.0 - 1.2	2.3	< 5.0

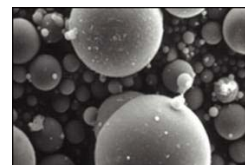
* Annex C in EN-450-1:2005; the analysis expresses mg "available phosphorus pentoxide" (P₂O₅) per kg ash
XXth Symposium on Nordic Concrete Research and Development



Bio ash and Fly ash characterization. Physical



Bio ash



Fly ash

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Concrete Production Data

	Unit	Bio ash concrete	Reference concrete
<i>8 MPa concrete</i>			
Cement (C)	kg/m ³	114	101
Fly ash	% of C	75	100
Bio ash	% of C	33	0
Water	% of eqC*	97	100
Compressive strength 28 d	MPa	12	10
<i>12 MPa concrete</i>			
Cement (C)	kg/m ³	148	138
Fly ash	% of C	50	66
Bio ash	% of C	22	0
Water	% of eqC*	82	86
Compressive strength 28 d	MPa	17	16

* eqC = equivalent cement,
calculated using an activity factor of 0.5 for fly ash as well as bio ash



Results and Conclusions

It is technically acceptable to use bio ash for concrete production

- Present reuse approx. 1000 t/y
- Concrete of lower strength and exposure classes
- Bio ash content in the bio ash concrete approx. 2,5 % w/w

There are many differences between bio ash and fly ash.
Does bio ash have pozzolanic properties?

Aluminium based bio ash seems advantageous – compared to iron based bio ash

Bio ash from a multiple hearth oven has to be pre-treated (milled)