



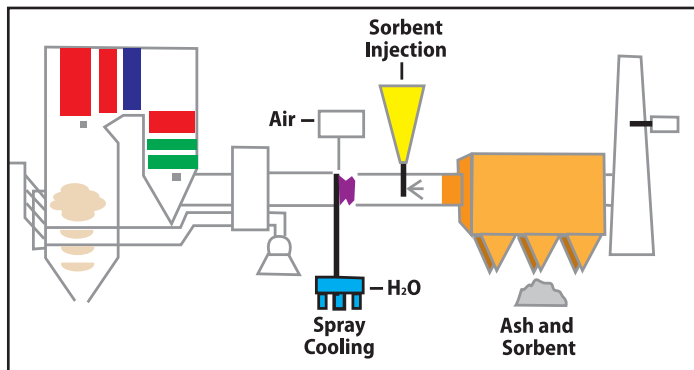
# POTENTIAL IMPACT OF POWDERED ACTIVATED CARBON FLY ASH IN CONCRETE

## Mercury Emission Reduction is Legislated

Legislation coming into effect January 1, 2011, will require some coal power plants to reduce mercury emissions [9]; all Alberta plants are affected. The mercury capture technology selected for each plant, together with how it is implemented, determines the nature of any impact to the Fly Ash.

A technology commonly used by power plants is the injection of Powdered Activated Carbon (PAC) or Brominated Activated Carbon (BAC) into the flue gas. Activated carbon absorbs the mercury, effectively removing it from the exhaust stream.

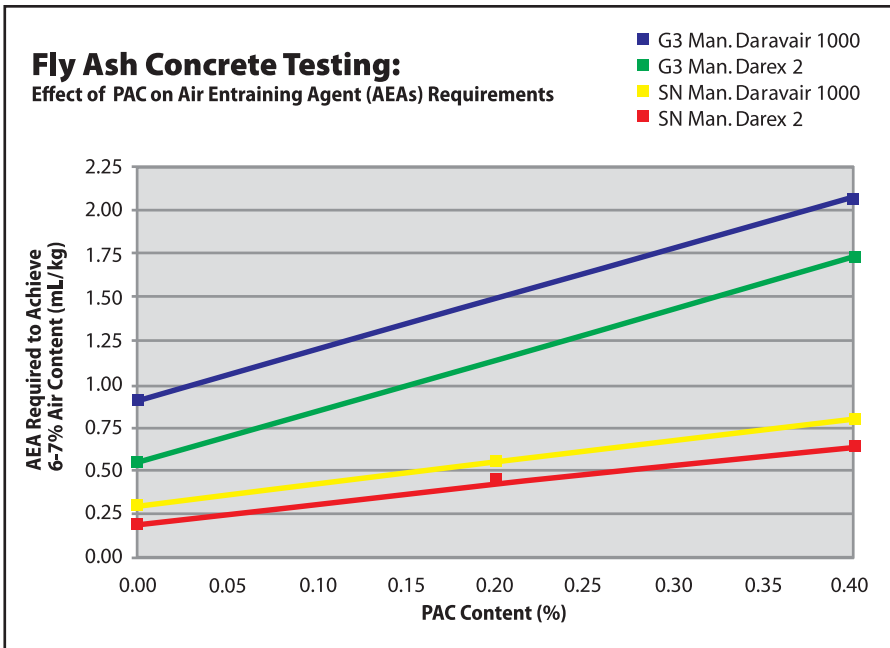
There is no impact to the ash when PAC is injected *after* the pollution control equipment. Alternatively, when PAC is injected *prior* to pollution control equipment (i.e. electrostatic precipitator (ESP) or fabric filter (FF)) as illustrated below [1], the mercury and carbon contents in the Coal Ash are increased.



Graphic courtesy of Institute of Clean Air companies [1]

## How may PAC Fly Ash impact concrete?

Ash marketers have tested PAC/Fly Ash to ascertain the effect of PAC Fly Ash in concrete. [2] The impact on air demand is a function of the PAC injection rate into the flue gas stream and the power producer's choice of sorbent, as some sorbents are more "concrete friendly" than others.



Graph courtesy of Heidelberg Technology Center [3]

With some technologies or processes, the impact of PAC on Fly Ash is similar to that of unburned carbon: higher dosages of air entraining admixture (AEA) may be needed to entrain air in concrete. This will require testing and adjustment of AEA dosages: the same quality control measures taken when adjusting any material in concrete.

The above graph shows a typical impact on air demand by adding PAC at various dosage rates.

*The potential impact in concrete is increased dosage in AEA and/or a change of AEA-based chemistry.*

Concrete producers may receive PAC Fly Ash as early as January 1, 2011. As with any new Ash source, good quality control practices will assess material properties to determine that the material meets project requirements.

*Ongoing supplier/customer communication will enable a smooth transition to utilization of PAC Fly Ashes.*

Continued...

[9]The Alberta Mercury Emissions from Coal Fired Regulation Act, #34/2006, requires Alberta's power producers to install mercury emission reduction technology by December 31, 2010 and capture 70% of mercury by January 1, 2011. Proposals to capture 80% of mercury from coal combustion by are to be submitted December 31, 2012.

As of January 1, 2011, provincial requirements pertaining to New Brunswick under the Canadian Ministers of the Environment (CCME) Canada Wide Standard for Mercury Emissions from Coal Fired Electric Power Generating Plants has been incorporated in the "Approval to Operate", under New Brunswick Air Quality Regulation (97-133) Clean Air Act.

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## POTENTIAL IMPACT OF POWDERED ACTIVATED CARBON FLY ASH IN CONCRETE

### Will PAC Fly Ash be useable with Air Entrained Concrete?

Concrete producers should not have issues with strength development, set time, workability, placing or finishing attributable to PAC Fly Ash.

### How will PAC Fly Ash in concrete impact the environment?

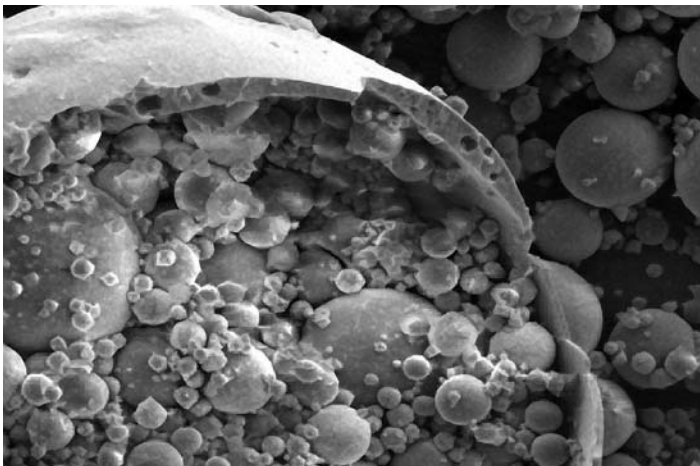
Both Fly Ash and Fly Ash encapsulated within a concrete matrix have been tested for the potential for mercury to leach from the Ash. In 2006, the US EPA determined "mercury is strongly retained by coal combustion products and is unlikely to be leached at levels of environmental concern." [4]

The chemical reaction between cement and Fly Ash reduces the permeability of concrete and chemically binds constituents, thus reducing their solubility.

*When PAC Fly Ash is combined with Portland Cement in concrete, the leaching potential of mercury is further reduced.*

A 2005 study, evaluating gaseous mercury from curing concretes containing Fly Ash and mercury-loaded PAC, found that "release of mercury from all samples was less than 0.1% of total mercury content over the initial curing period, implying that nearly all of the mercury was retained in the concrete." [5]

A 2008 study reported mercury flux from exposed concrete surfaces did not exceed mercury fluxes from soils. The study concluded that "less than 0.022% of the total quantity of mercury present from all sources in concrete was released during the curing process." [6]



Graphic courtesy of **Natural Resources Canada**

Such studies indicate there is no danger of mercury release from concretes containing PAC Fly Ash.

As experience with Ash containing Activated Carbon develops, CIRCA will issue future Updates as required.

### References

- 1] "Sorbent Injection Technology For Control Of Mercury Emissions From Coal-Fired Boilers", Institute of Clean Air Companies: [http://www.icac.com/files/public/ICAC\\_Sorbent\\_Injection\\_Fact\\_Sheet\\_051506.pdf](http://www.icac.com/files/public/ICAC_Sorbent_Injection_Fact_Sheet_051506.pdf)
- 2] "Interference of Hg Adsorbents in Fly Ash with Concrete Properties", V. Bingdinavile, University of Alberta, NSERC/CAC, unpublished.
- 3] "Mini-Concrete Testing Evaluating Fly Ash with added Activated Carbon" Heidelberg Technology Center, January 2007
- 4] "Characterization of Mercury-Enriched Coal Combustion Residues from Electric Utilities Using Enhanced Sorbents for Mercury Control", F. Sanchez, et. al., US EPA No. EPA-600/R-06/008, Feb., 2006: <http://www.epa.gov/nrmrl/pubs/600r06008/600r06008.pdf>
- 5] "Gaseous Mercury Release from Curing Concretes that Contain Fly Ash: Laboratory Measurements", D.W. Golightly, et al, Ohio State Univ., Environmental Sciences Technology, Aug., 2005 1;39(15): 5689-93. <http://www.ncbi.nlm.nih.gov/pubmed/16124303>
- 6] "Gaseous Mercury Release during Steam Curing of Aerated Concretes that Contain Fly Ash and Activated Carbon Sorbent", D.W. Golightly et. al., Ohio State Univ., Environmental Sciences Technology, Aug., 2008: <http://www.pubs.acs.org/doi/abs/10.1021/ef800297y>

**For more information, please contact your local Fly Ash marketing Representative.**

**[www.circainfo.ca](http://www.circainfo.ca)**

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