The Basics on Supplementary Cementing Materials (SCMs)

The use of Supplementary Cementing Materials, or SCMs, is becoming the norm in concrete construction in Canada, though the benefits and challenges of SCM use are not always well understood. Therefore, a recent survey was developed to assess changes in the use of SCMs as well as get a better idea of stakeholders' positions and concerns.

In addition to the survey, an industry-government collaboration developed a list of references and resources on the use of SCMs. These resources are intended to provide helpful information to the ready-mixed concrete, construction and design industries, as well as federal, provincial and municipal agencies across Canada.

The following document was compiled by EcoSmart Foundation with the assistance of the Cement Association of Canada (CAC), the Canadian Ready-Mixed Concrete Association (CRMCA), the Association of Canadian Industries Recycling Coal Ash (CIRCA), the National Research Council (Institute for Research in Construction), Public Works & Government Services Canada, Environment Canada and Natural Resources Canada.

This document concisely explains the technical and environmental benefits of SCM use, as well as the limitations, applications and specifications. Links to additional resources are also provided.

This information is also available with links to additional sources online at:

www.ecosmartconcrete.com/facts_scmbasics.cfm

or

www.scm.gc.ca/primer.html

Supplementary Cementing Materials (SCMs)

Supplementary cementing materials (SCMs) are materials that when used with Portland cement contribute to the properties of the hardened concrete through hydraulic or pozzolanic activity or both. The most commonly used SCMs are fly ash, ground granulated blast furnace slag (GGBFS) and silica fume.

The proper use of SCMs help produce more durable and sustainable concrete infrastructure. Parameters to consider include appropriate levels of SCM use for given applications, compatibility of different SCMs, and specific practices for various on-site conditions. This document is intended to provide access to resources developed to assist the successful application of SCM concrete.

Technical benefits
The incorporation of SCMs into a concrete mixture generally tends to improve the workability, and to reduce the water requirement at a given consistency. It can be used to enhance the ultimate strength of concrete and improve both the impermeability and durability of concrete to chemical attack. It can also be used to mitigate thermal cracking by lowering the heat of hydration. To learn more about the technical benefits of fly ash, slag, and silica fume please consult: *Use of Fly Ash and Slag in Concrete: A Best Practice Guide*, *Silica Fume User's Manual*, *The Durability of Concrete Containing High Levels of Fly Ash*, *Supplementary Cementing Materials for Use in Concrete* and *Design and Control of Concrete Mixtures*.

Environmental Benefits
For every portion of Portland cement replaced by SCMs there is an improvement in the environmental footprint of concrete, including a reduction in GHGs and air pollutants. Moreover, because SCMs are by-products of other industrial processes and are typically directed to landfills, recycling these materials as raw materials for another process reduces waste. Overall, the use of SCM contributes to enhanced sustainability in the construction industry.

Use of SCMs contributes to achieving LEED credits with the Canada Green Building Council. The LEED building rating system recognizes design, construction and operational practices that combine healthy, high-quality and high-performance advantages with reduced environmental impacts.

Limitations
The use of some SCMs can reduce early age strengths (7 day) of concrete, and often results in a concrete that is more sensitive to curing, finishing and scaling. The carbonation of concrete incorporating SCMs tends also to increase which can lead to corrosion of reinforcement. Specifications, tools and guidelines to ensure SCM concrete is applied effectively have been developed.

To learn more about the mitigation of challenges associated with concrete using fly ash and slag, please consult: *Use of Fly Ash and Slag in Concrete: A Best Practice Guide*, the Cement Association of Canada's *Design and Control of Concrete Mixtures*, and the specifications below. For silica fume, please consult the *Silica Fume User's Manual*.

Applications
SCMs have been used for decades in all kinds of concrete applications in Canada. Many high-profile concrete structures across the country were made with SCMs to achieve concrete technical benefits and longer service life, such as the Hibernia concrete platform, Confederation Bridge, UBC's Liu Centre, Toronto's Scotia Plaza and York University, Calgary's Bankers Hall 2, Winnipeg's Manitoba Hydro Head Office, Montreal's Pavillons Lassonde, Halifax's Bell Tower and many government buildings.

Specifications
The requirements for concrete made with and without SCMs are covered by the CSA A23.1 Standard. Specifications are provided for mixing, handling, placing and curing concrete. Specific concrete classifications are listed for a variety of exposure conditions. Special requirements for concrete incorporating high volumes of SCMs

have recently been added in an appendix dealing with this type of concrete. A summary of these requirements is provided in the above mentioned Use of *Fly Ash and Slag in Concrete: A Best Practice Guide*. The 2006 edition of the National Master Specification (NMS) refers to best practice guidelines on the use of fly ash and slag in concrete in which recommended percentages of SCMs are given.

Please note all specifications are available for a fee from the Canadian Standards Association (CSA) and the National Master Specification (NMS).

Resources
For more information on the use of SCMs in concrete, please refer to the following websites and documents:

- CAC – Cement Association of Canada: www.cement.ca
  The CAC home page has links to a number of issues, including Climate Change, Environment and Sustainable Development. Also see the CAC's *Guide to Sustainable Design with Concrete* and the Portland Cement Association Web site.

- CaGBC - Canada Green Building Council: www.cagbc.org
  CaGBC is the developer and administrator of the LEED green building rating system. The use of SCMs contributes to LEED Canada credits.

- CIRCA – Association of Canadian Industries Recycling Coal Ash: www.circainfo.ca
  CIRCA's Resources page provides access to introductory videos, a web-based Learning Module on Coal Combustion Products, Technical Fact Sheets, industry statistics, Seminar Proceedings and other information (including presentations by industry experts on regional experience with SCM concrete, such as a Guide to Sustainable Design with Concrete).

- CRMCA – Canadian Ready Mix Concrete Association: www.crmca.ca
  CRMCA's home page provides links to regional member associations that provide technical training, Position Statements, Fact Sheets/Technical Tips and other resources addressing practices, issues and industry development.

- CSA – Canadian Standards Association: www.csa.ca
  The requirements for concrete made with and without SCMs are covered by the CSA A23.1 Standard.

- EcoSmart Concrete: www.ecosmartconcrete.com (an EcoSmart Foundation website)
  The EcoSmart Concrete Knowledge Base is a website offering in-depth information on SCM concrete technology and the results of numerous case studies on high volume SCM concrete.

- NMS – National Master Specification: www.pwgsc.gc.ca/nms/content/index-e.html
  The National Master Specification (NMS) is the most comprehensive master specification in Canada; each section serves as an easy-to-use framework for writing construction project specifications.

- Silica Fume Association: www.silicafume.org
  The home page includes general information on silica fume concrete for specifiers, concrete producers and contractors. The site also provides a link to the *Silica Fume User's Manual* that may be down-loaded for free.

- Slag Cement Association: www.slagcement.org
  The home page includes information on benefits and applications of slag cement.

- Supplementary Cementing Materials: www.scm.gc.ca (a Government of Canada website)
  This site provides reports, videos and other resources developed under Action Plan 2000 on Climate Change. More resources may be found on the SCM website's Resources and Links pages.