



North Carolina Department of Administration

Pat McCrory, Governor
Bill Daughtridge, Jr., Secretary

State Construction Office
Gregory A. Driver, P.E., Director

State Construction Office Policy Related to Beneficial Reuse of Coal Combustion Products

January 23, 2015

Introduction:

In the course of generating electrical power, coal-fired power plants produce waste materials known as Coal Combustion Products (CCP). CCP include fly ash, bottom ash, boiler slag, and flue gas desulfurization materials. For many decades, portions of these materials have been beneficially utilized in the construction process in North Carolina and nationwide.

Despite the longstanding beneficial reuse of CCP by the construction industry and other industries, a majority of annually produced CCP are stockpiled as waste at or near coal-fired power plants, most often wet-stored in ponds. In its 2014 session, the NC Legislature passed Senate Bill 729 (GS 130A-309.200, the "Coal Ash Management Act of 2014"), a comprehensive effort to address environmental concerns related to stored CCP and CCP produced in the future. SB729 tasked the Department of Transportation (NCDOT) and the State Construction Office (SCO) with encouraging the beneficial reuse of CCP through consistent and coordinated policies and specifications. The SCO affirms its support for the beneficial reuse of CCP in state capital improvement projects.

Within the realm of construction, the two greatest consumers of CCP tonnage are concrete products (fly ash) and structural fill (fly ash & bottom ash). This policy focuses on those reuses.

Concrete:

NCDOT has revised [pending as of 1/23/2015] its "Standard Specifications for Roads and Structures" to increase the limit of replacement-of-cement-by fly-ash to 30% (from 20%) and to replace the cement with fly ash at a rate of 1 lb. of fly ash for each 1 lb. of cement. SCO concurs with these criteria and adopts them, along with other NCDOT fly ash related specifications, for its state capital improvement projects.

Because demand for electricity is seasonally variable, fly ash production tonnage is similarly inconsistent. Therefore, though the SCO encourages the use of fly ash in concrete mixes, *the use of fly ash is not mandatory* for projects administered by SCO. Project-specific specifications and evaluation of proposed mixes shall consider the project schedule and local availability of fly ash.

Structural Fills:

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Beneficial Reuse of Coal Combustion Products

State capital improvement projects, with proposed sitework entailing significant net importation of fill material, shall be evaluated for the possible use of CCP structural fill versus conventional soil fill. This evaluation shall be provided to the SCO during the Design Development Phase of review. The evaluation shall address costs of CCP structural fill regulatory elements such as liners, caps, site closure, and groundwater monitoring as applicable (see below).

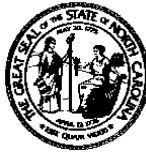
CCP structural fill used in state capital improvement projects must comply with the requirements of GS 130A-309.218 through .229.

These statutes differentiate 'Small' structural fill projects from 'Large' structural fill projects based upon a threshold of 8000 tons of CCP per acre or 80,000 tons of CCP in total per project. The project size drives the design, submittal, permitting, construction, and reporting requirements for each CCP structural fill project. The NC Department of Environment and Natural Resources (NCDENR) is the review, permitting, and enforcement agency for CCP structural fill that may be part of a state capital improvement project.

Small projects "are deemed permitted" (when in compliance with applicable requirements) while Large projects are permitted individually by NCDENR.

Large and small projects share common fundamental design, submittal, and closure requirements while large projects have significant additional requirements for liners, leachate collection systems, caps, and groundwater monitoring systems. Large projects also entail financial assurance provisions and expanded project closure & post-closure requirements.

Owning agencies and design firms shall carefully review and consider the cited general statutes when incorporating CCP structural fill into a state capital improvement project. ASTM E2277, "Standard Guide for Design and Construction of Coal Ash Structural Fills", should also be consulted for guidance. CCP structural fill shall not be used within a 100-year floodplain.



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MEMORANDUM:

TO: Joint Legislative Commission on
Governmental Operations

FROM: Gregory A. Driver, PE
Director, State Construction Office

SUBJECT: Specifications for the Use of Coal Combustion Products
Senate Bill 729

Senate Bill 729, Section 16 amended Article 3 of the General Statutes to read:

§ 143-58.6. Specifications for use of coal combustion products.

(a) State Construction Office to Develop Technical Specifications. - The State Construction Office shall develop recommended technical specifications for the use of coal combustion products that may be utilized in any construction by all State departments, institutions, agencies, community colleges, and local school administrative units, other than the Department of Transportation. The technical specifications shall address all products used in construction, including, but not limited to, the use of coal combustion products in concrete and cement products and in construction fill.

(b) Department of Transportation to Develop Technical Specifications. - The Department of Transportation shall develop recommended technical specifications for the use of coal combustion products that may be utilized in any construction by the Department of Transportation. The technical specifications shall address all products used in construction, including, but not limited to, the use of coal combustion products in concrete and cement products and in construction fill.

(c) Specification Factors. - The State Construction Office and the Department of Transportation shall consider safety, best practice engineering standards, quality, cost, and availability of an in-State source of coal combustion products in developing the recommended technical specifications pursuant to this section.

(d) Consultation. - The State Construction Office and the Department of Transportation shall consult with each other in the development of the recommended technical specifications pursuant to the provisions of this section in order to ensure that the recommended technical standards are uniform for similar types of construction. The goal of the Department of Administration and the Department of Transportation shall be to increase the usage and consumption of coal combustion products in their respective construction projects.

(e) Report of Recommended Specifications. - The State Construction Office and the Department of Transportation shall report the recommended technical specifications developed pursuant to this section to the Environmental Review Commission and the Joint Legislative Transportation Oversight Committee on or before February 1, 2015.

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1024-1 DESCRIPTION

This section addresses Portland cement concrete to be used for pavement, structures and precast and incidental construction. Produce Portland cement concrete composed of Portland cement, fine and coarse aggregates, water and pozzolans (optional). Include chemical admixtures as required or needed. Ground granulated blast furnace slag, fly ash or silica fume may be substituted for a portion of the Portland cement. Type IL, IP, IS or IT blended cement may be used instead of Portland cement.

Mixes for all Portland cement concrete shall be designed by a Certified Concrete Mix Design Technician or an engineer licensed by the State of North Carolina.

If any change is made to the mix design, submit a new mix design (with the exception of an approved pozzolan source change).

If any major change is made to the mix design, also submit new test results showing the mix design conforms to the criteria. Define a major change to the mix design as:

- (1) A source change in coarse aggregate, fine aggregate or cement.
- (2) A pozzolan class or type change (e.g. Class F fly ash to Class C fly ash)
- (3) A quantitative change in coarse aggregate (applies to an increase or decrease greater than 5%), fine aggregate (applies to an increase or decrease greater than 5%), water (applies to an increase only), cement (applies to a decrease only), or pozzolan (applies to a decrease only).

Use materials which do not produce a mottled appearance through rusting or other staining of the finished concrete surface.

1024-2 PORTLAND CEMENT CONCRETE FOR PAVEMENT

(A) Composition and Design

Submit concrete paving mix design in terms of saturated surface dry weights on Materials and Tests Form 312U for approval at least 30 days before proposed use. Use a mix that contains at least 526 lb of cement per cubic yard, a maximum water cement ratio of 0.559, an air content in the range of 4.5% to 5.5%, a maximum slump of 1.5", a minimum flexural strength of 650 psi at 28 days and a minimum compressive strength of 4,500 psi at 28 days.

The cement content of the mix design may be reduced by no more than 30% and replaced with fly ash at a minimum rate of 1.0 lb of fly ash to each pound of cement replaced.

The cement content of the mix design may be reduced by no more than 50% and replaced with blast furnace slag pound for pound.

Include in the mix design the source of aggregates, cement, fly ash, slag, water and admixtures; the gradation and specific gravity of the aggregates; the fineness modulus of the fine aggregate; and the dry rodded unit weight and size of the coarse aggregate. Submit test results showing that the mix design conforms to the criteria, including the 1, 3, 7, 14 and 28-day strengths of the average of two 6" x 6" x 20" beams and the average of two 6" x 12" cylinders for each age made and tested in accordance with AASHTO R 39, T22 and T97. Design the mix to produce an average strength sufficient to indicate that a minimum strength of 650 psi in flexure and 4,500 psi in compression will be achieved in the field within 28 days. Where concrete with a higher slump for hand methods of placing and finishing is necessary, submit an adjusted mix design for approval to provide a maximum slump of 3" and to maintain the water-cementitious material ratio established by the original mix design.

1024-3 PORTLAND CEMENT CONCRETE FOR STRUCTURES AND INCIDENTAL CONSTRUCTION

(I) Use of Fly Ash

The cement content of the mix design may be reduced by no more than 30% and replaced with fly ash at a minimum rate of 1.0 lb of fly ash to each pound of cement replaced. Use Table 1000-1 to determine the maximum allowable water-cementitious material (cement + fly ash) ratio for the classes of concrete listed.

SECTION 1024 MATERIALS FOR PORTLAND CEMENT CONCRETE

1024-1 PORTLAND CEMENT

Supply Portland cement that meets AASHTO M 85 for Type I, II or III except that the maximum fineness requirements of AASHTO M 85 do not apply to cement used in precast concrete products. Throughout these Specifications Types I and II cement are referred to as regular Portland cement and Type III as high early strength Portland cement.

Certain combinations of cement and aggregate exhibit an adverse alkali-silica reaction. The alkalinity of any cement, expressed as sodium-oxide equivalent, shall not exceed 1.0%. For mix designs that contain non-reactive aggregates and cement with an alkali content less than 0.6%, straight cement or a combination of cement and fly ash, cement and ground granulated blast furnace slag or cement and microsilica may be used. The pozzolan quantity shall not exceed the amount shown in Table 1024-1. For mixes that contain cement with an alkali content between 0.6% and 1.0% and for mixes that contain a reactive aggregate documented by the Department, use a pozzolan in the amount shown in Table 1024-1.

Obtain the list of reactive aggregates documented by the Department at the Materials and Tests Unit website.

TABLE 1024-1 POZZOLANS FOR USE IN PORTLAND CEMENT CONCRETE	
Pozzolan	Rate
Class F Fly Ash	20% - 30% by weight of required cement content with 1.0 lb Class F fly ash per lb of cement replaced
Ground Granulated Blast Furnace Slag	35%-50% by weight of required cement content with 1.0 lb slag per lb of cement replaced
Microsilica	4%-8% by weight of required cement content with 1.0 lb microsilica per lb of cement replaced

Type IP or IS blended cement is allowed for the cement-and-fly-ash or cement-and-slag portion of the mix. Type IT may be allowed for the cement-and-pozzolan portion of the mix with the permission of the Engineer. Do not substitute fly ash or slag for a portion of Type IP, IS or IT cement or for Portland cement in high early strength concrete.

Use white cement that meets ASTM C150, except that the ferric oxide content is limited to 0.5%.

Use Type IP blended cement that meets AASHTO M 240, except that the pozzolanic content is limited to between 17 and 23% by weight and the constituents shall be interground.

Use Type IS blended cement that meets AASHTO M 240 except that the slag content is limited to between 35% and 50% by weight and the constituents are interground.

Use Type IT blended cement that meets AASHTO M 240. The Engineer will evaluate the blend of constituents for acceptance in Department work.

Use Type IL blended cement that meets AASHTO M 240, except that the limestone content is limited to between 5 and 12% by weight and the constituents shall be interground. Class F fly ash can replace a portion of Type IL blended cement and shall be replaced as outlined in Subarticle 1000-4(I) for Portland cement. For mixes that contain cement with alkali content between 0.6% and 1.0% and for mixes that contain a reactive aggregate documented by the Department, use a pozzolan in the amount shown in Table 1024-1.

Do not use air-entraining Portland cement. Do not mix different types of cement, different brands of cement, or the same brand from different mills nor use them alternately except when authorized in writing by the Engineer.

Protect cement from contamination or damage during handling and storage. Do not use cement that is damaged, partially set, lumpy or caked.

All cement is sampled and tested by the Department as it arrives on the project or at the precasting plant at such frequency as established by the Department.

1024-2 FLY ASH

Provide fly ash from an approved source that meets ASTM C618 for Class F or Class C, except ensure that the loss on ignition does not exceed 4%. Table 1A of ASTM C618 applies to Class F fly ash. Use fly ash that meets the optional physical requirements for uniformity shown in Table 2A of ASTM C618.

Do not use Class C fly ash in Portland cement concrete if the alkali content of the cement exceeds 0.4%.

All fly ash is sampled and tested by the Department as it arrives on the project at such frequency as established by the Department.

As required by the above statute, the State Construction Office (SCO) consulted with the NC Department of Transportation (NCDOT) regarding the use of coal combustion products (CCP) in construction projects. SCO representatives attended joint meetings with NCDOT and industry groups that produce products that utilize CCP. The SCO researched the state-of-the-art of use of CCP in construction and attended the inaugural Coal Ash Forum held in Charlotte in early December.

Unlike NCDOT, the SCO does not publish standard specifications. As reviewed and administered by SCO, state capital improvement projects utilize project-specific specifications prepared by the projects' contracted design firms. Such specifications are typically based upon several nationally recognized formats, such as "Masterspec". In response to bidding results and field construction experience, the SCO guides project specifications by means of published policies and guidelines. As required by the above statute revision and as a result of our subsequent inquiries & meetings, the SCO developed the attached "State Construction Office Policy Related to Beneficial Coal Combustion Products".

The policy focuses on two beneficial reuses of CCP; the use of fly ash in concrete and the use of fly ash & bottom ash in structural fill. These reuse categories historically account for the largest tonnages of beneficially reused CCP and offer the most promising areas for increased reuse.

The SCO concurs with the NCDOT's determination that seasonal fluctuations of CCP production and related spot shortages of concrete-grade fly ash currently prevent the mandatory use of fly ash in all concrete mixes. NCDOT's proposed concrete specification, which increases the maximum percentage of fly ash in a concrete mix and which permits more economical replacement-of-concrete-with-fly-ash ratios, is likely to prompt utilities and concrete producers to invest in storage facilities for newly produced fly ash and prompt utilities to increase reclamation of fly ash from existing storage ponds. Such industry changes may allow the mandatory use of fly ash in concrete in the future.

The SCO policy requires the consideration of CCP structural fills for projects that entail the significant importation of structural fill to the project site. For cases where the overall cost of CCP structural fill is competitive with traditional soil fill, the installation of the CCP structural fill must be in accordance with NCDENR requirements and the requirements of the general statutes as modified by Senate Bill 729.

Please let us know if you have any questions or comments related to the new SCO policy.

cc:

Secretary Daughtridge, DOA
Deputy Secretary Fleggas, PE, DOA
Rhonda Todd, Legislative Liaison, DOA
Mark Bondo, Fiscal Research, NC General Assembly
Michael L. Holder, PE, Chief Engineer, NC DOT

Attachments: Beneficial Reuse of Coal Combustion Products
Division 10 Fly Ash Modification