UNITED KINGDOM QUALITY ASH ASSOCIATION

Technical Datasheet

1.5

The Durability of Fly Ash Concrete in Contaminated Land Applications

Introduction

Work on the performance of construction materials in contaminated land applications has been carried out by BRE Scotland since the 1990's. As part of this work, they buried a series of insitu and precast concrete samples and concrete block masonry piers on a contaminated site in 1997. The mixes were designed to be resistant to the known sulfate levels, barring a single low grade cast in-situ concrete, but the effect of the other contaminants on the strength and durability of the concrete was unknown. Samples of the various concretes were removed from the site at 1 year and this was repeated at 10 years.

Excavating the Samples

The samples cast in-situ and precast piles, concrete block masonry piers and steel piles were all removed during the summer and autumn of 2007. The samples were all assessed visually, noting any cracking, damage from removal, photos, etc. Then cores were taken for further analysis for strength. Simultaneously samples of the ground water and soil were taken and tested. Significant levels of Polycyclic Aromatic Hydrocarbons (PAH) and Petroleum Hydrocarbons (PH) are in the soil with Total PAHs amounting to 9.7% and Total PHs of 11.9% by mass of the soil. The soil was classified for sulfates as DS-2 (See BRE Special Digest 1).

Results

Visually the performance of all the materials used in these trials has been excellent in resisting degradation, even though they are in contact with some heavily contaminated soils.

The concrete masonry block piers remain in good condition with no signs of any deterioration having occurred. The masonry piers compressive strengths ranged between 105% and 140% of the initial compressive strengths, even though these are relatively low strength materials being nominally 7MPa blocks. This shows that hydration continues for many years improving the resulting strengths. Samples of the same blocks were sealed in plastic bags for use as references and interestingly the blocks in contact with the contaminated soils achieved higher strengths than the control samples.

Both the insitu cast and precast concrete piles have also performed well, with little deterioration having occurred in the ground over the 10 year period. The main issue was damage caused during the installations and removal of the precast samples.

The insitu compressive strength of the various insitu cast concrete mixes used from the core results is shown in Table 1.

Cement Type	PC 100%	PC 100%	SRPC 100%	70% PC + 30% PFA	30% PC + 70% GGBS	94% PC + 6% Micro Silica
Insitu Strength expressed as percentage of 28 day cube strength	87% W/C 0.45	94% W/C 0.61	64% W/C 0.45	133% W/C 0.45	113% W/C 0.45	109% W/C 0.45

Table 1 – Core strengths of insitu concrete piles after 10 years

It is common to find the insitu strength of Portland cements, e.g. PC and SRPC, to be lower than the 28 day cube strengths, with 77% being the often quoted figure for PC. Pozzolanic cements, such as PFA, continue to gain strength for many years when in contact with water. These results show this pozzolanic reaction and the resulting excellent performance of the PFA based concrete insitu, gaining considerably higher strengths in comparison with the 28 day cube strength, more than any other cementitious type.

Acknowledgements

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In general usage the term 'fly ash' is used for pulverized coal ash but it can also cover ash from burning other materials. Such 'fly ash' may have significantly differing properties and might not offer the same advantages as ash from burning pulverized coal. UKQAA datasheets only refer to PFA / fly ash produced from the burning of predominantly coal in power stations.

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