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Quality of Type I Portland Cement from Ghana and UK

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Abstract
Type I Portland cement is general purpose cement found in many countries and it is manufactured by different companies. This study sought to compare the properties of Type I Portland cements from Ghana (less economically developed country) and United Kingdom (more economically developed country) to ascertain whether the quality of Ghana cement is a contributing factor for recent spate of building collapse in the country. The study adopted a laboratory-based experimental approach to determine the properties of three cement samples: one from Ghana and two from the United Kingdom (UK). It was identified that UK cements particles were the fineness, contained more Calcium oxide (CaO), recorded earlier setting times and achieved early strength. Ghana cement on the other hand, had more Alkali (Na_2O + K_2O) content, higher density, good resistance to water and achieved better late strength development than UK grey cement. The study has revealed that although there are some differences in the properties of Ghana and UK Type I Portland cements, they all meet international standard requirements and therefore, the quality of Ghana cement may not be one of the contributing factors of recent building collapse in the country.
Keywords: Portland cement, Particle size distribution, Chemical composition, Compressive strength, Water absorption, Building collapse, SEM

1. Introduction

Portland cement is a closely controlled chemical combination of calcium, silicon, aluminum, iron and small amounts of other compounds, to which gypsum is added in the final grinding process to regulate the setting time. Some of the raw materials used for the manufacturing of cement are limestone, shells, and chalk or marl, combined with shale, clay, slate or blast furnace slag, silica sand and iron ore (Info Series, 2010). The term "Portland" in Portland cement originated in 1824 when an English mason obtained a patent for his product, which he named Portland cement. This was because his cement blend produced concrete that resembled the color of the natural limestone quarried on the Isle of Portland in the English Channel. Different types of Portland cement are manufactured to meet different physical and chemical requirements for specific purposes. The American Society for Testing and Materials (ASTM) Designation C150 provides eight types (I, II, III, IA, IIA, IIIA, IV and V) of Portland cement (AST C150, 2007).

Type I Portland cement is general purpose cement suitable for all uses where the special properties of other types of cements are not required (AST C150, 2007). It is used where cement or concrete is not subject to specific exposures, such as sulfate attack from soil or water, or to an objectionable temperature rise due to heat generated by hydration. Its uses include pavements and sidewalks, reinforced concrete buildings, bridges, railway structures, tanks, reservoirs, culverts, sewers, water pipes and masonry units (Info Series, 2010).

Cement is one of the key components of most buildings, it is the common base material used for casting concrete, bricklaying, rendering, screeding, and so plays a major part in nearly all construction projects. To produce high quality long lasting concrete structures, cements of a high and consistent quality must be employed (Haecker *et al.*, 2003). Worldwide, cement industry spends countless hours to ensure the quality of its products, mainly based on laboratory tests. In the USA, most physical testing of cements is performed according to ASTM Standards (1999). In Germany, testing is generally governed by the European Norm (1995). In Britain, Portland cement test is performed in accordance with British/European Standard BS EN 197-1 (2011). The fineness of a Portland cement and its chemical composition are the key factors in determining cement strength characteristics (Zhang & Napier-Munn, 1995) as well as other properties.

Incidents of building collapse have been reported from most countries and the records keep rising. The Royal Plaza Hotel in the city of Nakhon Ratchasima, Thailand collapsed on 13 August 1993, killing 137 people and injuring 227 (Worsak, 1994). According to a report from Siraj and Maha (2006), a hostel housing Muslim pilgrims performing Hajj collapsed in Mecca, Saudi Arabia on 5 January 2006, killing 76 people and injuring 62. Beaumont (2008) reported of the Pétionville school collapse, which occurred on November 7, 2008, in Petionville, a suburb of Port-au-Prince, Haiti, where the church-operated College 'The Evangelical Promise School' collapsed and killed at least 93 people, mostly children, and injured over 150. In January 2012, the collapse of a Rio de Janeiro building triggered the collapse of two neighboring buildings of which 21 people were killed.

Ghana is no exception of building collapses. The past five years have seen increased cases of building collapse in both urban and rural areas, which resulted in fatalities, injuries and loss of life and properties. Table 1 presents some of the recent cases of building collapse between 2009 and 2013 in Ghana. The quality of cement used for the construction of a building or a concrete structure could contribute to the stability of the structure. Holding all other factors constant, poor quality cement could cause the collapse of a structure and vice versa.

The quality of cement has strong linkage between particle size distribution (PSD), chemical composition and compressive strength (Bentz, 2010; Osbaeck & Johansen, 1989; Wakasugi *et al.,* 1998). According to Bentz (2010) one source of untapped potential for varying engineering properties of hardened concrete is the variation of the cement particle size distribution. Type I Portland cement is common and found in many countries with different manufacturing companies producing it. However, limited studies have been conducted to compare the properties of cement from different countries. This study sought to compare the properties of Type I Portland cements from Ghana and UK. Ghana cement was chosen for this study because of many building collapses it has experience in recent times (Danso & Boateng, 2013). Cement from UK was selected for this study because it is one of the developed countries with less incidence of building collapse. The quality assessment was done using the particle size distribution, chemical composition, strength properties and scanned electron microscope (SEM) of Type I Portland cements manufactured in Ghana and UK.

Table 1**:** Recent Cases of Building Collapse in Ghana (Danso & Boateng, 2013)

S/N	Location of Building	Type of Building	Date	Suspected Causes	Deaths/Injuries
1	Kumasi	Uncompleted storey building	2009	Faulty design	-
2	Accra	Two-storey court complex	2009	Faulty construction	-
3	Zenu, Ashaiman	Two-storey	2009	Structural failure	4 Died
4	Wa, U/W	Residential	2010	Rain storm	5 Died, 4 Injured
5	Baatsona, Accra	Uncompleted storey building	2010	Faulty construction	2 Died, 6 Injured
6	Dompoase-Aprabo	Residential	2010	Rain storm	2 Died, 2 Injured
7	Sawla	Residential	2011	Structural failure	4 Died
8	Kato near Berekum	Residential	2011	Rain storm	2 Died, 3 Injured
9	Ayomso, B/A	Residential	2012	Rain storm	2 Died, 2 Injured
10	Apatrapa, Kumasi	Uncompleted storey building	2012	Structural failure	-
11	Kasoa, C/R	Public toilet	2012	Structural failure	1 Died, 2 Injured
12	Achimota, Accra	Five-storey shopping mall building	2012	Structural failure	14 Died, 67 Injured
13	Krofrom, Kumasi	Three-storey residential building	2013	Rain storm	3 Died, 5 Injured

2. Materials and Methods

2.1 Materials

The materials that were used for the laboratory experiment are cement, sand and water. Three Type I Portland cements (Figure 1) were used for this study. Ghacem Portland cement from Ghana (Ghana grey), and Portland cement (UK grey) and Snowcrete white Portland cement (UK white) were obtained. The Ghana grey and UK grey are of the same class of 32.5R and therefore are placed at the same level for comparison. The UK white has a higher class of 52.5R, but was included to find out if it will make any difference. The sand used was clay-free and obtained from Portsmouth, UK. **X-Ray Diffraction** (XRD) analysis of the sand confirmed to be pure quartz sand with no significant impurities. The water used was from the Civil Engineering laboratory tap of University of Portsmouth, UK.

Ghana Grey UK White UK Grey

Figure 1: UK and Ghana Type I Portland cements

2.2 *Methods*

The tests performed include particle size distribution, chemical composition, setting time, density, water absorption and compressive strength. In addition, scanned electron microscope (SEM) analysis was also conducted. These tests were selected because they provide a wide range of determinants of quality of cement, which includes physical, chemical and mechanical properties of cement. Particle size analysis was performed using Laser Diffraction (Malvern Mastersizer 2000). This was done by measuring 10g of each of the three cement samples into a beaker and 50ml of deionised water and 50ml of Sodium Hexametaphosphate were added in accordance with BS 1377 (BS1377, 1990).The specimens were left for 24 hours, and then Malvern software was used to run the method till the measurement was completed.

Chemical composition of the samples was determined through XRF Analysis Method. Samples were prepared by grinding in a Tungsten Carbide TEMA mill for which pellets were made. The samples were then analysed using a Rigaku ZSX Primus II x-ray fluorescent spectrometer. Paired-sample t-test was conducted to determine the differences in the chemical composition of Ghana and UK cements.

Two cylindrical specimens (75 mm length and 40 mm diameter) were made: (1) mortar with cement-sand ratio of 1:2 and (2) only cement (cement paste) with single water cement (w/c) ratio of 0.35 by mass. Setting time of the mortar and the cement paste were determined by the use of Vicat needle in accordance with ASTM C 191–99 (1999). Single laboratory precision for mortar and paste were prepared and tested at normal consistency as12 mins for initial setting time and 20 mins for final setting time. After 28 days of curing, the cylinders were tested for dry density and water absorption. Compressive strength test was conducted on 7th, 14th and 28th days. The test was performed to determine the strength of cement paste specimen under the influence of compression stress over age. The compressive strength of cement paste specimen was carried out by using ELE ADR-Auto compression 2000 test machine with a maximum capacity of 2000 KN. The compressive strengths were calculated as:

$$\sigma_c = \frac{F}{A} \quad (1)$$

Where: σ_c is compressive strength; F is the maximum force (N) applied at which the specimen failed; and A is the cross-sectional area (mm^2) of specimen on which the force was applied.

Density test was performed in order to determine how compact the specimens were. The dry density of the specimen was determined by drying the specimens at constant temperature of approximately 110 ^{O}C in an oven for 48 hours. After which, the dimensions of each specimen were measured in centimeters to the nearest millimeter and the overall volume computed in cubic meters. The specimens were then weighed in kilograms to the nearest 10 gm. The density of each specimen was calculated as:

$$\rho = \frac{m}{V} \quad (2)$$

Where: ρ is the density; m is the mass (kg); and V is the volume (m^3).

Water absorption test was conducted to measure the ability of the specimen to resist the absorption and retention of water. The weights of the specimen were measured with electronic scale after drying, and then immersed in water for 14 hours. The saturated weights of the specimen were measured, after which the water absorption percentage of the specimen was determined mathematically as:

$$WA = \frac{M1-M}{M} \times 100 \quad (3)$$

Where: WA is water absorption; M_1 is the mass of saturated specimen (kg); and M is the mass of dry specimen (kg).

SEM analysis was carried out for the mortar specimen at the middle (25mm from exposed surface) and surface regions (0–15mm from exposed surface) of the experimental specimens which produced micrographic images at 2,500 magnifications.

3. Results and Discussion

3.1 Particle Size Distribution

The result of the particle size distribution for the three cement samples as obtained from the experimental work is presented in Table 2. From the results it can be seen clearly that between clay and medium silt (0.1 – 31.25 µm) content, UK white cement had the highest values, followed by UK grey cement, with lowest being the Ghana grey cement. In addition, between coarse silt and fine sand (31.225 – 250.00 µm) content, Ghana grey recorded the highest values, followed by UK grey and the least being UK white cement.

Figure 2 shows a graphical state of the three cement samples. The UK Portland cements (white and grey) particles were the fineness, with the white being finer than the grey. In the view of Zhang and Napier-Munn **(1995)** the fineness of a Portland cement is one of the key factors in determining cement strength characteristics. They further explained that the fineness of the cement is more effective in strength at the early days (1-3 days) than at longer period (28 days). The reason is that the rate of hydration is controlled by fineness of cement. Rapid rate of hydration occurs when the cement has finest particles. This is because the amount of hydration of cement formed at the beginning of hardening depends primarily on the magnitude of the solids surface area upon which the mix water can act. This implies that the UK white and

Table 2: Particle size distribution of UK and Ghana cements

Specimen	Clay (0.1 - 3.90 µm)	V. Fine Silt (3.90 - 7.81 µm)	Fine Silt (7.81 - 15.63 µm)	Med Silt (15.63 - 31.25 µm)	Coarse Silt (31.25 - 62.50 µm)	V. Fine Sand (62.50 - 125.00 µm)	Fine Sand (125.00 - 250.00 µm)
UK White	24.95868	13.67897	26.23622	25.06434	9.492318	0.569465	0.000000
Ghana Grey	23.07867	8.935699	14.55672	21.88743	22.27487	8.742211	0.524395
UK Grey	23.87164	10.05915	19.49081	27.48481	17.07419	1.847737	0.171675

grey cements may have better hydration and early strength than Ghana grey cement. Celik (2009) further expressed that particle size distribution among others are important physical parameters affecting cement service properties. These parameters define the proportion of fine and coarse particles in the cement. The proportion controls water demand, setting and hydration reactions (Sprung *et al.,* 1985). However, Mehta (1997) pointed out that for durability consideration, finer cement may not always be preferable to coarse ones. This means the quality of cement cannot be tied only to the fineness but also some amount of coarseness due to the fact that coarse particles have link to the durability of the cement products.

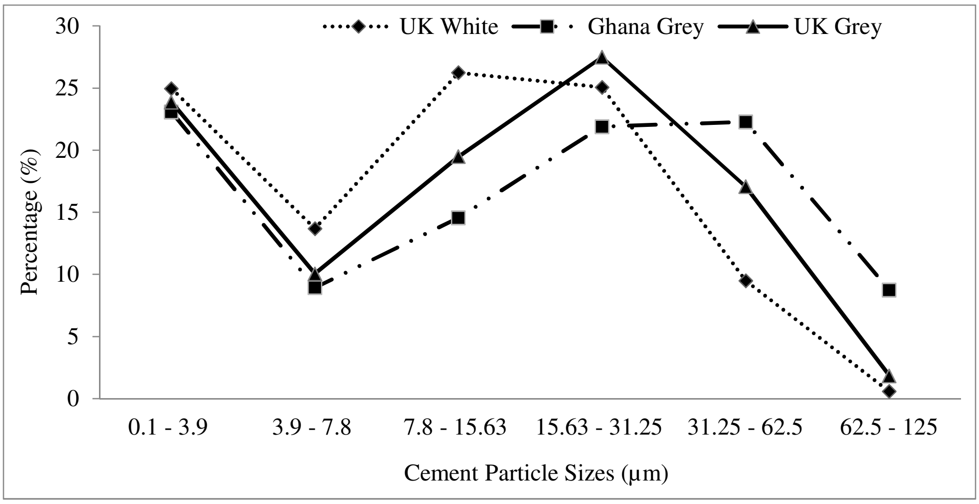


Figure 2: Particle size distribution graph of UK and Ghana cements

3.2 Chemical Composition

The results shown in Table 3 reveal variation of chemical oxides composition in the three cement samples. The UK white has the highest sum of Calcium oxide (CaO) and Silicon dioxide (SiO_2) concentration (94%). This was followed by UK grey (85%) and then Ghana grey (83%). According to the European standard (EN 196-2, 1995), the sum of the proportions of CaO and SiO2 in cement should not be less than 50% by mass (Sam *et al.,* 2013). This implies that all the three samples met international standard as the CaO and SiO2 content of all the samples were above 50%. The content of Aluminum oxide (Al_2O_3) was higher in Ghana grey (4.77%) than both UK grey (3.84%) and UK white (1.89%). The content of Magnesium oxide (MgO) followed a similar trend (Table 3). However, the Sulphuric anhydride (SO_3) content was higher in UK grey (4.50%) than Ghana grey (3.76%) and UK white (2.49%). The content of Ferric oxide (Fe_2O_3) followed the same order, UK grey (3.56%), Ghana grey (3.53%) and UK white (0.41%). The Alkali ($Na_2O + K_2O$) content of Ghana grey (1.74%) was higher that UK grey (1.21%) and UK white (0.23%).

Table 3: Chemical compositions of UK and Ghana cements

Chemicals	UK White (%)	UK Grey (%)	Ghana Grey (%)
SiO_2	20.30	16.30	19.50
CaO	73.70	68.70	63.20
Al_2O_3	1.89	3.84	4.77
Fe_2O_3	0.41	3.56	3.53
MgO	0.45	0.89	2.72
SO_3	2.49	4.50	3.76
Na_2O+K_2O	0.23	1.21	1.74

The results of chemical composition (Figure 3) suggest that the UK white and grey cements may be slightly stronger than Ghana grey since the silicates C_3S and C_2S are slightly higher in the UK white and grey cements than the Ghana grey. Aluminum oxide (Al_2O_3) which is a component of the C_4AF characteristically has fast reaction with water and may lead to a rapid stiffening of the paste with a large amount of the heat generation (quick-set). In order to prevent this rapid reaction, Sulphuric anhydride (SO_3) gypsum is added to the clinker for the purpose of regulating setting time. Gypsum predominantly affects concrete set times by delaying the hydration of C_3A, which typically "flash sets" on contact with water. However, too much gypsum can cause expansion of the concrete at a later stage, which might lead to cracking. Magnesium Oxide (MgO) causes delayed expansion when present in large amounts. This explains why the high Al_2O_3 in Ghana grey (4.77%) and UK grey (3.84%) corresponded with relatively high SO3 content in both samples and a similar trend of MgO content in Ghana grey (2.72%) and UK grey (0.89%) (Table 3).

Furthermore, the alkali content of cement (mostly chloride) is reflected in the amounts of potassium oxide (K_2O) and sodium oxide (Na_2O). Large amounts can cause certain difficulties in regulating set times of cement. Low alkali cements, when used with calcium chloride in concrete can cause discoloration in trowelled flatwork surfaces. The differences in alkalinity and other chemical compositions among the three samples were not very wide. However, there was the need for statistical assessment of the differences to ascertain their significance.

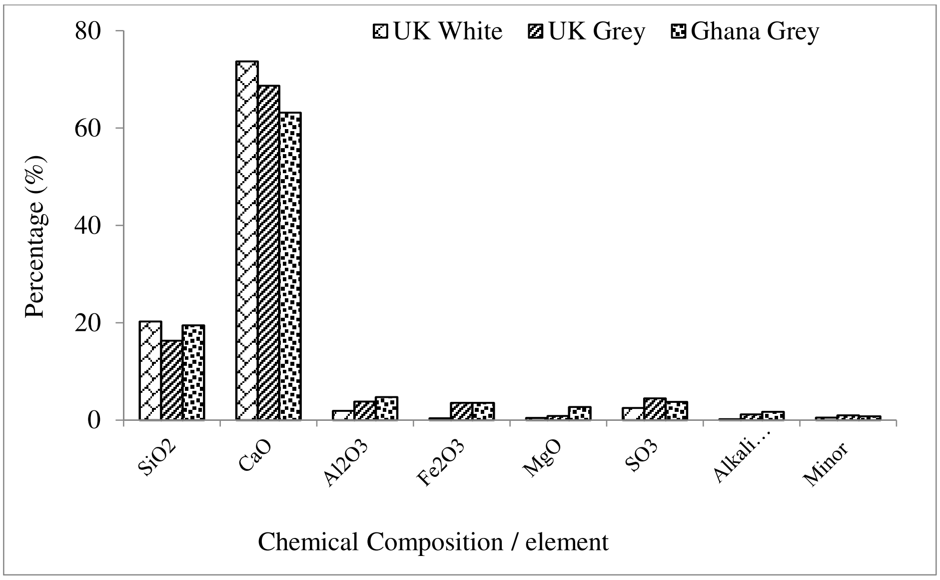


Figure 3: Chemical composition of UK and Ghana cements

Paired-sample t-test provided the results of 0.968 (Sig) value at 95% confident interval between Ghana Grey and UK Grey cements, and 0.895 (Sig) value between Ghana Grey and UK White cements (looking for significance value of 0.05 or less to claim significance). The result revealed that there was no statistically significant difference between each pair of the cements. It can therefore be stated that there is no statistically significant difference between the chemical composition of UK and Ghana cements.

3.3 Setting Time

Details of setting time results for the three Type I cements are provided in Table 4 for five replicates of each cement sample, while summary of the results can be found in Figure 4. The UK white cement recorded earlier initial and final setting times for both cement paste and mortar, followed by UK grey cement and then Ghana grey cement. This setting order would generally be expected with finer cements achieving both initial and final set at earlier times, owing to their enhanced hydration rates (Bentz, 2010). This provides a clear indication that there is a strong relationship between the PSD and setting time of cements. The reason for hydration of cement being rapid in finer cement could be attributed to particle-to-particle connections (Bentz *et al.,* 2008) and thus causing earlier setting in cement with finer particles. In addition, there is a relationship between the setting time and the chemical composition. Higher alkali content prolongs cement setting time (Liu *et al.,* 2013). The alkali content in Ghana grey cement was higher than UK grey and white and thus explains the delay in the setting time of Ghana grey cement.

Table 4: Setting time of UK and Ghana cements

Specimen	Initial Setting Time (hr) 1	2	3	4	5	Ave	Diff	Final Setting Time (hr) 1	2	3	4	5	Ave	Diff
Paste														
Gh G	3.11	3.21	3.17	3.29	3.22	3.20	0.18	4.37	4.46	4.35	4.52	4.58	4.46	0.23
UK W	2.31	2.18	2.34	2.29	2.35	2.29	0.17	3.50	3.49	3.68	3.42	3.65	3.55	0.26
UK G	2.56	3.04	2.48	3.01	2.54	3.13	0.16	4.08	3.5	4.04	3.56	4.11	4.26	0.21
Mortar														
Gh G	3.32	3.39	3.47	3.21	3.49	3.38	0.28	4.45	4.57	4.52	4.33	4.59	4.49	0.26
UK W	2.50	2.46	2.49	2.36	2.57	2.48	0.21	3.34	3.4	3.31	3.52	3.58	3.43	0.27
UK G	3.08	3.27	3.13	3.04	3.19	3.14	0.23	4.11	4.29	4.31	4.07	4.24	4.20	0.24

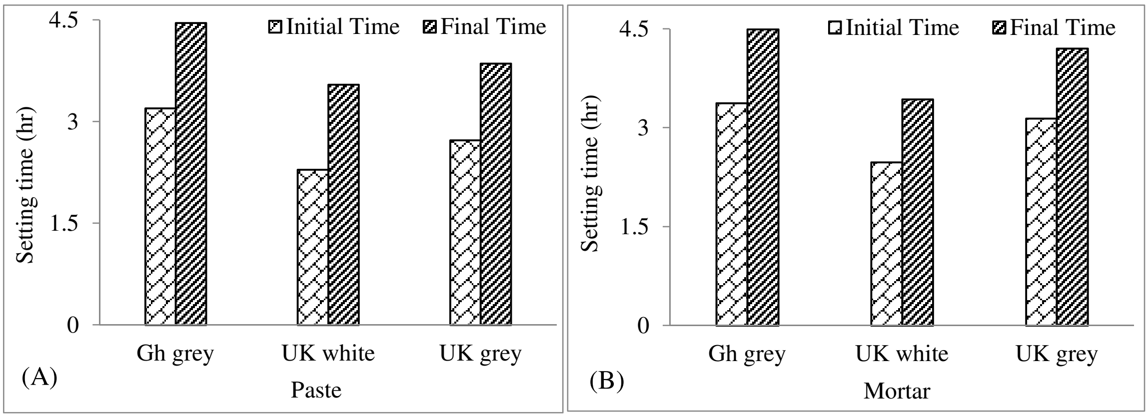


Figure 4: Setting time of UK and Ghana cements, (A) Paste and (B) Mortar

3.4 Dry Density and Water Absorption

The average values of the dry density test results are provided in Table 5 while the summary of results is presented in Figure 5. The results show that the Ghana grey specimen recorded increased average density of 3% and 5% respectively for mortar and cement paste than UK grey. In addition, the density of Ghana grey cement (1795kg/m^3 and 1832kg/m^3 respectively for paste and mortar) was higher than UK white cement (1682kg/m^3 and 1824kg/m^3 respectively for paste and mortar) specimens. However, the density of the UK grey (1707kg/m^3 and 1779kg/m^3 respectively for paste and mortar) was higher than UK white for cement paste specimen, while it was the opposite for the mortar specimen.

Table 5: Average dry density and water absorption of UK and Ghana cements

Specimen	Dry Density (kg/m^3) Mortar	Dry Density (kg/m^3) Paste	Water Absorption (%) Mortar	Water Absorption (%) Paste
UK White	1824	1682	8.7	5.1
Ghana Grey	1832	1795	9.3	8.6
UK Grey	1779	1707	9.2	10.1

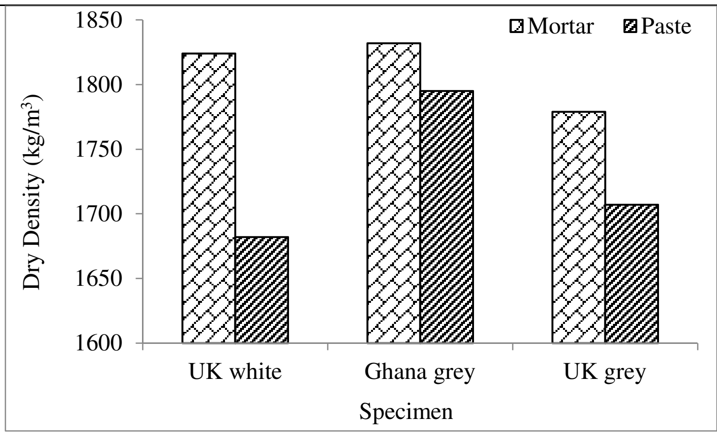


Figure 5: Dry density of UK and Ghana cements

It was identified that the density of Ghana grey cement was higher than both the UK grey and white cements. This might be due to greater coarse particles obtained in the PSD test result for Ghana grey cement. This establishes a relationship between the density and PSD of cement, indicating that the coarser the particles the higher the density. The densities of the entire three specimens were found to be higher than the 1500kg/m^3 recommended by ASTM C270-73 (ASTM C270-73, 1973) for Portland cement mortar. This implies that the Type I Portland cements from Ghana and UK are of high quality.

For water absorption, Figure 6 and Table 5 present the summary of the test results. The UK grey recorded about 17% increase in water absorption more than Ghana grey for cement paste specimen, while Ghana grey had an increase of 1% more than UK grey for mortar specimen. In addition, the UK white had the lowest water absorption as compared to Ghana grey and UK grey specimens. This result indicates that the UK grey cement has higher water absorption (10.1% and 9.2% for paste and mortar respectively) properties than Ghana grey cement (9.3% and 8.6% for paste and mortar respectively). This shows that Ghana grey cement performed better in resistance against water absorption than UK grey cement. This might be attributed to slow setting of the Ghana grey cement, since gradual hydration effect on cement is likely to reduce the creation of pores, thereby reducing the absorption rate of the cement (Zhan *et al.,* 20113).

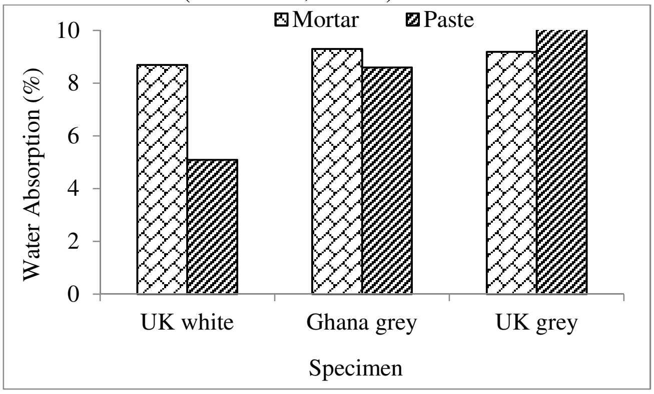


Figure 6: Water absorption of UK and Ghana cements

In addition, the higher density of Ghana grey cement might be the cause of increased resistance to water absorption, which indicates less pores development in Ghana cement. The relationship between density and water absorption are very important in determining the quality of a material (Rodrigues *et al.,* 2013). On the other hand, the UK white cement performed better in absorption resistance (8.3% and 5.1% for paste and mortar respectively) than both Ghana grey and UK grey cements. However, the resistance to water absorption for all the three specimens were better than the acceptable recommended range of 11% and 16% by ASTM C642 (1990). This implies that the Type I Portland cements from Ghana and UK have good resistance to water absorption and are within the standard requirement.

3.5 Compressive Strength

The compressive strength test results for cement paste specimens have been summarized indicating the averages for five replicates for each curing age in Table 6. The trend of strength development of the specimens by age is shown in Figure 7. The test results show increased strength development by increase in age of all the cements. There was about 54%, 76% and 53% increases in strength for UK white, Ghana grey and UK grey specimens respectively between 7-day and 28-day curing ages. A similar trend was recorded in previous study (Haecker *et al.,* 2003), which implies that the strength of cement develops by age. Notable among the results are the strength development of UK grey and Ghana grey cements. The UK grey had a higher strength by the 7-day curing; however, the Ghana grey developed a higher strength than UK grey at 28-day curing age. This might be due to the fine particles sizes and early setting time of the UK grey cement, which facilitated the early strength development similar to the results of the study conducted by Gao and Song (2013). The late higher strength development of the Ghana grey cement over the UK grey cement could be attributed to the higher density of the Ghana grey cement. This clearly shows a relationship between the compressive strength and density, PSD and setting time of the cements. Furthermore, the higher 28-day compressive strength of the Ghana grey cement over the UK grey cement can be linked to the lower water absorption of the Ghana grey cement, implying that the better water resistance of cement, the higher the strength. The compressive strength values achieved for all the three specimens were better than the recommended compressive strength values by CIP 35 (CIP 35, 2003).This standard states that concrete compression strength requirements can vary from 17MPa from residential concrete to 28MPa and higher in commercial structures. The Engineering ToolBox (2010) also recommends 20-40MPa. The results of this study implies that Type I Portland cement produce in Ghana and UK have good resistance under the influence of a compressive stress and meet the standard requirement for general purpose construction work.

Table 6: Average compressive strength of UK and Ghana cements

Specimen	Compressive strength (MPa)		
	7 days	14 days	28 days
UK White	41.3	54.7	63.6
Ghana Grey	25.2	36.2	44.3
UK Grey	27.4	35.8	41.6

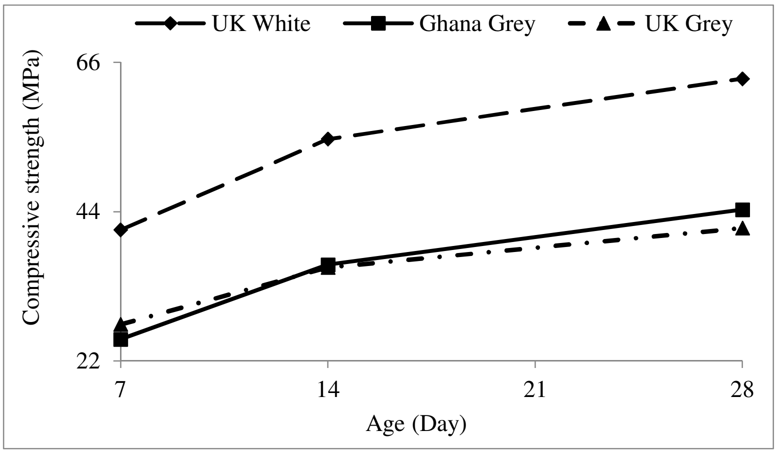
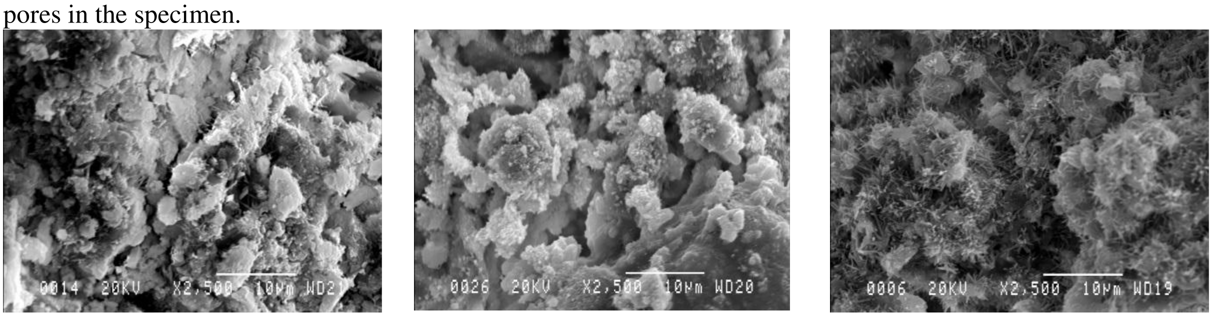


Figure 7: Compressive strength of UK and Ghana cements

3.6 SEM Analysis

In Figure 8, a scanning electron micrograph of the three specimen of sand-cement mortar after 28 days of hydration at 2,500 magnifications is shown. It can be observed in all the three images that a fine network of cement has surrounded the sand particles and stretching in the form of fibers linking the sand particles. The fine network of pozzolanic product (calcium silicate hydrate "CSH") has been created in the middle of a capillary pore, acting as a trap for chlorides (Papadakis, 2000). It can be observed that both the UK grey and white images have more fibrous like elements, which confirm their fineness. This means that the finer the cement PSD, the more fibrous like elements is developed in the specimen which might have been caused by early setting time and strength development. Ghana grey image on the other hand, has less fibrous like elements. This may be due to smaller pores, and therefore recorded the lowest water absorption. In addition, this development might have a link with the chemical composition and the setting time of the cement, as the alkali content in Ghana grey cement was higher and caused delay in the setting time which might have contributed to the smaller and increase pores in the specimen.



UK White Ghana Grey UK Grey

Figure 8: SEM (2,500×) of sand-cement mortar after 28 days of curing

4. Conclusion

The study compared the properties of Type I Portland cements from Ghana and United Kingdom to ascertain whether the quality of Ghana cement is a contributing factor for recent spate of building collapse in the country. For PSD, it was found that UK Portland cements (white and grey) particles were the fineness, with the white being finer than the grey. In terms of chemical composition, the Alkali ($Na_2O + K_2O$) content in Ghana cement was more than UK cements while the Calcium oxide (CaO) content in UK cements exceeded that of Ghana cement. Paired-samples t-test showed that there was no statistically significant difference between the chemical composition of UK and Ghana cements. The UK white cement recorded earlier initial and final setting times for both cement paste and mortar, followed by UK grey cement and then Ghana grey cement. It was identified that the dry density of Ghana grey cement was higher than both the UK grey and UK white cements. Furthermore, the Ghana grey cement performed better in resistance to water absorption than UK grey cement, while the UK white was better than both Ghana grey and UK grey cements. In addition, while UK white cement performed better in compression than Ghana grey and UK grey cements, the Ghana grey was better than the UK grey cement. It can therefore be concluded that though there are some differences in the properties of Ghana and UK Type I Portland cements, they all meet international standard requirements and recommendations, and therefore the quality of Ghana cement might not be the cause of recent spate of building collapse in Ghana. It is therefore recommended that further studies may be conducted on other factors such as quality of aggregates, reinforcement bars, timber, water and mix ratios use in the construction industry in Ghana in order to establish the contributing factors of the collapse of buildings.

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