SJST

Widad Ragab/ SILPHIUM Journal of Science and Technology. 8(1), 2025, 1-3.

Research Article

SILPHIUM JOURNAL OF SCIENCE AND TECHNOLOGY
(SJST)

Effect of Coarse Aggregate Type and Quality on Mechanical Properties of High-Strength Concrete

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Received 12/02/2025   Revised 0 7/04/2025   Published online 21/06/2025

ABSTRACT

This study aimed to analyze the impact of different types of coarse aggregates on the properties of high-strength concrete. Five main types of aggregates were tested: (1) Anorthosite (AS), (2) Gray Granite (GG), (3) Limestone (LS), (4) Charnockite (CK), and (5) Gneiss (GS).

Three different concrete grades were prepared for each aggregate type (B40, B60, B90) while maintaining constant other factors such as water-cement ratio and admixture proportions. a comprehensive series of tests was conducted to evaluate:

- Compassion strength
- Part tensile strength
- Flexural strength
- Modulus of flexibility
- Break vitality

Key Findings:

1. The steel slag aggregate (LS) achieved the highest compressive strength values among all samples.
2. Gray Granite (GG) demonstrated exceptional performance in high-strength concrete mixtures (B90).
3. A clear relationship was observed between the mineral composition of aggregates and concrete performance:
    - Quartz-rich aggregates (e.g., granite) recorded the highest compressive strength and fracture energy values
    - Smooth-surfaced aggregates (e.g., limestone) showed relatively lower performance
4. Aggregate surface topography had a noticeable effect on the bond strength between aggregates and cement paste

Keywords:. *Coarse aggregates, high-strength concrete, compressive strength, modulus*

تأثير نوع الركام الخشن وجودته على الخصائص الميكانيكية للخرسانة عالية القوة

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الملخص

هدفت هذه الدراسة إلى تحليل تأثير أنواع مختلفة من الركام الخشن على خصائص الخرسانة عالية القوة حيث تم اختبار خمسة أنواع رئيسية من الركام وهي: (1) الأنورثوسايت(AS) ، (2)الجرانيت الرمادي(GG) ، (3)الحجر الجيري(LS) ، (4) الشارنوكايت(CK) ، و(5) النيس.(GS)

تم إعداد ثلاث درجات مختلفة من الخرسانة لكل نوع ركام (B40، B60، B90) مع الحفاظ على ثبات العوامل الأخرى مثل نسبة الماء إلى الأسمنت ونسبة المواد المضافة.و تم إجراء سلسلة من الاختبارات الشاملة لتقييم:

1. مقاومة الضغط
2. مقاومة الشد
3. مقاومة الانحناء
4. معامل المرونة
5. مقاومة الكسر

النتائج الرئيسية:

1. حقق الركام من خبث الفولاذ (LS) أعلى قيم لمقاومة الضغط بين جميع العينات.
2. أظهر الجرانيت الرمادي (GG) أداءً استثنائيًا في خلطات الخرسانة عالية المقاومة.(B90)
3. لوحظت علاقة واضحة بين التركيب المعدني للركام وأداء الخرسانة:
   - الركام الغني بالكوارتز (مثل الجرانيت) سجل أعلى قيم لمقاومة الضغط وطاقة الكسر
   - الركام ذو الأسطح الملساء (مثل الحجر الجيري) أظهر أداءً أقل نسبيًا
4. كان لتضاريس سطح الركام تأثير ملحوظ على قوة التماسك بين الركام والعجينة الإسمنتية.

الكلمات المفتاحية: ركام خشن، خرسانة عالية المقاومة، مقاومة ضغط، معامل مرونة، متانة، تحليل ميكانيكي.

INTRODUCTION

The terming "High strength concrete" have been adopted to proscribe concretes with 45MPa compressive strength which is in line with the proscription by the ACL comity (Beshr, et al., 2003) however, there has been other definitions that has been ascribed to the context of high strength concrete Gholampour and Ozbakkaloglu (2018), defined high strength concrete as a context that has a uniaxial strength higher than that obtainable in a locality. This definition is acceptable as well as the strength of concrete tends to change with respect to region. The erection of tall buildings and strong bridges by engineers incorporates the use of high strength concrete. This is simply due to the reduced dead load of high strength concrete (HSC) structure, which results in small cross sections.

In recent times, the expanded utilization of cement has brought about unnecessary utilization of characteristic admixtures Hamad and Dawi, (2017) which constitute around 70% of the aggregate volume in a solid blend (Zhou and Chen, 2017). In line with this, Thomas et al. (2021) investigated the influence of recycled coarse aggregate (RCA) quality on the performance of high-strength concrete and found that RCA with less than 5% adhered mortar content could achieve up to 90% of the compressive strength of natural aggregate concrete. However, RCA significantly increased water absorption by up to 40%, which required the use of super plasticizers to maintain workability. Their study emphasized the importance of RCA pretreatment, such as acid washing, particularly for high-strength applications.

Previous study (Asteray, Oyawa, and Shitote, 2018) has noted that in cases of high strength concrete, the cement paste zone transition strength is not limiting, however, the strength and the mineral composition of the coarse aggregate that invariably control the concrete entire strength Ahmad et al. (2022) supported this finding by demonstrating that the geological origin of coarse aggregates significantly influences the compressive strength of HSC. Their study showed that basalt aggregates increased the 28-day compressive strength by 12–15% compared to limestone due to higher density and lower porosity. Yet, larger aggregate sizes (>20 mm) reduced cohesion in the interfacial transition zone (ITZ), resulting in micro cracks under load.

Study by Feylessoufi, (2018) analyzed the impact of four different aggregates on concrete mixtures with same proportion of materials and properties. Li et al. (2023) conducted a comparative study of basalt and granite aggregates in HSC and found that granite aggregates produced higher tensile splitting strength (5.8 MPa) compared to basalt (4.9 MPa) due to the interlocking nature of their angular particles. However, basalt-based HSC had superior abrasion resistance, while granite's higher thermal expansion coefficient may reduce durability in fluctuating temperatures The utilization of demolished concrete (DC), which are customarily discarded in landfills at a noteworthy cost, in concrete has as of late gotten noteworthy consideration, as this innovation empowers protection of non-inexhaustible regular assets while likewise essentially decreasing the natural effect of both cement and DC Utilization. (Vishalakshi, Revathi, and Sivamurthy Reddy, 2018). Inside this unique situation, resuse of aggregate mixtures which is acquired from crushed solid structures, has been considered as an option material in the regulation and creation of auxiliary cements. Despite the fact that Reused Concrete Admixtures (RCA), which is delivered from halfway or full substitution of normal Concrete admixtures by reused solid Concrete admixtures, has huge monetary and natural advantages (Saxena and Tembhurkar, 2018), its utilization has so far been constrained in development industry on account of the worries with respect to the substandard nature of reused concrete mixture contrasted with that of regular Admixtures (Zhou and Chen, 2017).

In the course of recent decades, a substantial number of studies have been directed to comprehend the execution of RCA containing coarse reused solid Concrete admixtures (Beshr, Almusallam, and Maslehuddin, 2003). The audit of the current writing on RCAs demonstrates that a large portion of the current investigations were worried about the fleeting conduct and just a set number of studies have been answered to date on the long haul conduct of RCAs (Ismail, Kwan, and Ramli, 2017). It has been demonstrated that the quality of the parent concrete (the solid from which reused Concrete admixtures are determined) influences the long haul conduct of RCAs (Khaliq and Taimur, 2018). Along these lines, understanding the instruments behind the impact of the parent solid quality on the long haul conduct of RCAs is of critical intrigue. In addition, in spite of the fact that the ubiquity of high-quality cements in the development business has been on a relentless grade (Nepomuceno, Isidoro, and Catarino, 2018). Just a single report (Ali and Nadjai, 2018) has been accounted for to date on the time-needy and long haul mechanical properties of high-quality

RCAs with various parent solid qualities, which concentrated on RCA blends containing fly fiery remains. In this manner, there are as of now no examinations on the long haul conduct of traditional high-quality RCAs arranged with reused Concrete admixtures having distinctive parent solid qualities.

Additionally, the crawl conduct, an exceedingly vital time-subordinate property, of high-quality RCAs and microstructure of RCA blends with distinctive parent solid qualities have not yet been researched. Along these lines, unmistakably extra examinations are required to better get it the impact of the parent solid quality on the time-subordinate furthermore, long haul mechanical properties of high-quality RCAs and systems behind the watched test comes about. This paper introduces a test contemplate directed to address the look into holes delineated above by exploring the variety of physical, mechanical, and time-subordinate properties of typical and high strength RCAs with the parent solid quality of coarse reused Concrete admixtures. The paper at first gives an outline of the trial program, including material properties, example properties, and testing methods, which is trailed by the consequences of the test program. A nitty gritty exchange together with microstructural investigation of various blends utilizing filtering electron micrographs (SEM) and vitality dispersive X-beam spectroscopy (EDX) at 28 days curing is in this manner introduced to clarify the instruments behind the test outcomes.

For normal concretes, compressive strength less than 40MPa, there is a limiting strength property of the coarse aggregate as a result of the ratio of cement-water (C/W) mostly within the range of (2-3) in-line with studies by Arcaro and Almeida, (2017). It is established that the aforementioned cement-water ratio, the component with the weaker strength attribute comprises of the transition zone between the coarse aggregate and cement as compared to only the aggregate as well as the cement past. On the other hand, when normal concrete mixtures are to be designed, the chemical composition of the aggregates are rarely put into consideration apart from cases where the aggregate in question comprises of several mineral composition ranging from opal which happen to be a very reactive mineral silicon that can pose a degradative effect on the concrete thereby affecting its durability. The useful benefits characterizing the mineral composition of coarse aggregate in line with ascertaining concrete quality were noted by (Ayad and Said, 2018). Also, elastic property effect of various coarse aggregates on high strength concrete were also outline by Bloetscher, Wander, Smith, and Dogon, (2017). these researches put into consideration the various importance of mineral properties of aggregates in the hysteresis and elastic modulus of high strength concrete with the same ratio of concrete to water (Carísio, Martins, de Melo, and Dias, 2017; Duran, 2017).

They discovered that for 85% calcite aggregates, quartzite-gravel and aggregates of dolomitic limestone (80%) has a compressive strength of 90, 109and 85 after 81days compressive strength. Hence, the generalization that the cement-aggregate bond is much stronger in the aggregate of limestone as a result of reaction interfacial effect. Study by Nikpour, Senouci, and Eldin, (2017) also studied the impact of four different aggregates. At the end of their study, they discovered that there was differences in the modulus of elasticity of the studied aggregates. Ntimugura, Sore, Bello, and Messan, (2017), in their study also came up with the formula for quantifying the compressive strength of different concrete aggregates mixtures to be adopted in high strength concrete.

Study by Koris, Kozma, and Bódi, (2018) also discovered a linear correlation relationship that exist between aggregate mixtures and high strength concrete (HSC). With high strength concrete gaining increasing popularity in our today world, there is need to look more into its mechanical and chemical properties in other to compile the strength behavior other than certain condition with certain admixture.

Studies by Min, (2018) has shown that thee exist a relationship between concrete compressive strength and various properties ranging from modulus of elasticity, flexural strength and tensile strength. High strength concretes cracking mostly adopts a homogenous behavioral material approach as compared to the conventional concrete. There also exist a behavioral linear elasticity in high strength concrete compared to the conventional concretes. Hence, it is vital to come up with a database on the strength properties of concretes in relation to aggregate properties.

With the above notion in mind, the study aims at analyzing the impact of 5 different aggregates on the compressive strength of high strength concrete.

II. MATERIALS AND METHODS

A. *Materials*

The type of materials adopted for this study are notably: Corse aggregates, silica fume, cement, sugar plasticizer and fine aggregates

Type of cement: the cement adopted for this study has a specific gravity off 3.0 which is line with the specification of international standards (IS12250, 1997).

Silica fume type: the specifications for silica fume used for the study experimental analysis is 80% silicon dioxide (Amorphous).

Types of aggregates: the aggregates were sourced from local rivers within Tripoli municipality. The aggregates has a specific gravity property of 2.98 with a modulus fines percentage of cement and water absorption property of 0.10 and 3.0 respectively.

Plasticizer type: Plasticizer of melanin base type was adopted for the study

Coarse aggregates: different aggregates about five of its notably Anorthosite (AS) gray granite (GG) lime stone, (LS) chnockite (CK) and Gneiss (GS) are adopted as aggregates to be used for the experimental study. The mineral constituents in these aggregates were identified with megascopic instrument in-line with the aggregate's physical characteristics. The aggregates were down sized to a particle size 12mm to 20mm.

Fig. 1. The different aggregate samples adopted from the study.

TABLE I. THE PHYSICAL MAKE-UP OF CHOSEN AGGREGATES

S/N	Quality	CK	GS	CK	AS	GG
1	Texture					
2	Abrasion Value	11	8	20	13	18
3	Value of impact	13	6	15	19	6
4	Index of elongation (%)	10	4	21	-	5
5	Value of crushing (%)	7	9	23	-	7
6	Absorption of water (%)	12	8	19	-	23
7	Gravity	1	7	7	-	8
8	Index of Flakiness	17	11	13	21	13

B. *Admixture proportion*

For this study, the concrete mixture was aligned to meet B40, B60 and B90 concrete specification. Different aggregate in 5 mixes. However, the concentration of fine aggregates of cement were same for all concrete mixes.

C. *Test for concrete admixture strength*

140×140×140 mm dimension cubes numbering about three were constructed for each mixture of concrete to ascertain the concrete compressive strength at the 28th day in-line with IS: 515-2011 specification.

TABLE II. QUANTITIES OF MIXTURE

Mix. No.	*Aggregate type*	*FA (g/m^3)*	*Water (g/m^3)*	*Silica fume (g/m^3)*	*Plasticizer (g/m^3)*
B 40	As	700	130	64	0.5
	CS	710	139	65	0.6
	GC	786	186	68	0.6
	GG	615	197	73	0.6
	GS	703	145	75	0.6
B 60	As	516	156	78	0.7
	CS	517	160	80	4.8
	GC	705	168	81	4.8
	GG	710	169	82	4.8
	GS	725	170	83	4.9
	As	723	171	85	5.0
	CS	720	172	88	5.1

B 90	**GC**	**610**	**174**	**90**	**5.1**
	GG	**605**	**176**	**92**	**6.8**
	GS	**602**	**180**	**93**	**6.6**

III. RESULTS AND DISCUSSION

The modulus elasticity and strength of the tested concrete of different proportions and aggregates types are represented in Table 3.

Table 3 strength test for the concretes with different aggregate mixtures.

TABLE III. COMPREHENSION/COMPASSION STRENGTH

Type of Mix	Compaction strength	Flexural strength	Tensile split strength	Elasticity modulus (GPA)
GS 40	42.90	7.20	7.29	33.49
CK 40	39.60	6.02	5.89	33.65
GG40	41.81	6.01	4.23	31.01
LS 40	36.72	5.86	4.03	30.96
As 40	31.65	7.82	4.01	30.56
GS 60	29.96	9.86	4.02	30.21
CK 60	32.96	9.89	3.95	30.03
GG 60	33.49	10.02	3.64	29.82
LS 60	42.98	10.36	3.45	29.63
As 60	53.91	10.45	3.39	29.48
GS 90	51.73	11.54	3.28	29.49
CK 90	48.71	11.89	3.23	29.43
GG90	48.33	1.56	2.94	28.89
LS 90	47.96	12.01	2.93	28.26
As 90	47.29	1.06	2.86	28.65

A. *Comprehensive/Compassion strength*

For the many versions of prepared M40 concrete aggregates mix, there is variation among the concrete types mostly in the range of 3.5-6.90 which shows a considerable low compressive strength impact on the aggregate type. This is as a result of the notion that aggregate type has not been known to be a determinant factor in concrete comprehensive strength as it is mostly stronger than cement transition zone and matrix.

All aggregates in general have much greater strength than the mixtures of cement. On this note, concrete failures are mostly within the transition zone during ultimate load of the conventional concrete. Also, previous studies have reported that mixes with LS have shown considerably greater strength in comparison to other aggregates mixes. This is attributed to its reactivity. However, concrete mixes with LS have shown some considerable high load bearing strength just like other concrete mixed. Hence showcasing an inert compact high strength.

For the M to different range of concrete Mix, GG had a considerable result of 1.8%, 41.81, 63.92, 48.71% compared to the mix range respectively.

The M60 concrete mix had a much higher yield with corresponding percentage compressive strength of 6.3%. Hence indicating that aggregate type has a corresponding effect on comprehensive load bearing strength of concrete. For the M90 series, the GG mix was considerably 6.8%. 6.4% and 9.2% respectively of higher compressive strength prior to comparison with the LS, SC, and CK concrete mixtures respectively. It goes a long way in indicating that aggregate type is vital in determining the compressive strength of concrete which is in line with previous studies. Making of concrete has also adopted both mineral chemical and mineral admixtures hence, the microstructure of concretes are mostly composed of impervious micro structure. Hence, aggregated admixtures are considered a strength limiting factor when putting into consideration possible failures. Hence, there is need for appropriate choice of aggregate for a particular type of high strength concrete.

For concretes with high level of strength, that were mixed with a corresponding low ratio of w/b as well as low fraction of coarse aggregate. Notwithstanding, both chemical and mineral admixtures have been adopted for the production of high strength concrete. Therefore, there tend to be microstructure and impervious strength properties in concrete. Gaining the solid system and interfacial ground zone as strong as coarse aggregate. Thusly, sums may must be considered as quality confining variable as it winds up powerless for dissatisfaction. Subsequently, it is essential to pick aggregates to make high caliber strong (Obeng, Tuffour, Obeng, and Koranteng-Yorke, 2017).

In high quality cement, GG blend has shown significantly higher compressive quality than different blends. The Graniteis and phaneritic shake bestowing crystalline surface to total. The unpleasant surface of the total (crystalline surface) contributes mechanical quality to the solid (Obeng, Tuffour, Obeng, and Koranteng-Yorke, 2017). Also, the mechanical properties of Concrete admixtures demonstrate that it is moderately harder than the other Concrete admixtures showing that it contributes even physical quality to concrete. The better mechanical properties of Concrete admixtures must be expected to their mineralogical synthesis. The Granite is relied upon to have quartz mineral at higher extent than alternate Concrete admixtures. Generally, the total with higher quartz content shows moderately preferred mechanical properties over different total Sakai, Yokoyama, and Kishi, (2017). The crystalline surface also, prevalent mechanical properties of Granite total made the GG blend to display higher quality than different Concrete admixtures. It must be because of progress in mineralogical organization and structure partner with these Concrete admixtures. The LS blend has shown moderately less compressive quality than different blends with the exception of GS blend. It is because of smooth surface and latent nature of total. All things considered, Saleem, (2017) detailed that Limestone total cement accomplished higher compressive quality than Granite total cement.

B. *Part tensile strength*

The split elasticity of M40, M60 and M90 review concrete with various Concrete admixtures are displayed in Table 3. Among all M40 review blends, AS blend showed 5.2%, 4.9%, 6.9% and 10.8% higher split malleable quality contrasted with LS, AS, GS and CK, blend separately. Be that as it may, the impact of total on split tractable quality is more articulated in high strength concrete than conventional Concrete. If there should be an occurrence of the M60 review, the split quality of GG blend was 2.0%, 5.8%, 9.0% and 14.4% higher than GS, AS, LS and CK blend separately. Indeed, even in the M90 review, AS blend was 6.0%, 8.0%, 11.4% and 14.8% higher split quality contrasted with blend GS, AS, LS, CK. The varieties in split rigidity of high strength concrete are comparable to that of compressive quality. In any case, the proportion between the split ductile and compressive quality is diminished with increment in compressive quality. Further, the proportion in high quality cement change in the scope of 0.05 to 0.068 and it is nearly in congruity with the accessible writing (Wang, 2018).

C. *Flexural strength*

The flexural quality of M40, M60 and M90 review concrete made with various Concrete admixtures are outfitted in Table 3. The varieties in flexural quality of cement made with various Concrete admixtures are same as the varieties saw in compressive and split elasticity of cement. It creates the impression that the flexural quality is higher than the ordinary norms. This is on the grounds that the exact relationship proposed in the writing is excessively assessed the flexural quality as the impact of profundity of the pillars has not been mulled over in setting up a relationship (Yahia, Alsharie, Suliman, and Masoud, 2017). Be that as it may, flexural quality is nearly keeping pace with ordinary benchmarks.

D. *Modulus of flexibility*

The modulus of flexibility of M40, M60 and M90 review concrete with various Concrete admixtures are displayed in Table 3. The modulus of flexibility of Concrete admixtures and their volumetric extent impacts the modulus of flexibility of solid substantially more than compressive strength (Yahia, Alsharie, Suliman, and Masoud, 2017). It is apparent from the outcomes that the Normal Quality Concrete blends made with various sorts has indicated noteworthy variety in modulus of versatility than high strength concrete. It is because of higher volumetric extent of aggregate admixtures in Normal Strength Concrete. Higher break vitality than Limestone total with smooth surface (Yahia, Alsharie, Suliman, and Masoud, 2017). Also, the high strength concrete with higher compressive quality shows fragile break conduct. Additionally, the crack vitality of cement tends to increment with compressive quality (Yahia, Alsharie, Suliman, and Masoud, 2017). It is a direct result of low w/b proportion and expansion of mineral admixture causing generous change in the security quality amongst total and hydrated bond glue. In impact, the break in examples shifts from going around the coarse total and prompts fragile disappointment (Zhang and Ong, 2017). By the by, Yan et al (Zhang and Ong, 2017) announced that there is no unmistakable connection between compressive quality furthermore, crack vitality for high quality cement.

E. *Part tensile strength*

The split elasticity of M30, M50 and M80 review concrete with various Concrete admixtures are displayed in Table 3. Among all M30 review blends, GG blend showed 4.4%, 5%, 7% and 11.2% higher split malleable quality contrasted with GS, AS, LS and CK blend separately. Be that as it may, the impact of total on split tractable quality is more articulated in high strength concrete than Normal Strength Concrete. If there should be an occurrence of the M60 review, the split quality of GG blend was 1.4%, 6.2%, 8.7% and 14.4% higher than GS, AS, LS and CK blend separately. Indeed, even in the M90 review, AA blend was 4.9%, 6.6%, 9.2% and 14.4% higher split quality contrasted with blend GS, AS, LS and CK separately. Further, the proportion in high quality cement change in the scope of 0.05 to 0.072 and it is nearly in congruity with the accessible writing (Zhang and Ong, 2017). M40 review concrete, AS blend has displayed 5.24%, 19%, 33.2 and 41.1% higher modulus of versatility contrasted with GS, AS, LS and CK blend separately. In any case, modulus of versatility of M50 review GG blend was 4.9%, 6.6%, 9.2% and 14.4% higher than GS, AS, LS and CK blend separately. Correspondingly, M80 review, GG blend accomplished 5%, 10%, 15.1% and 21% higher modulus of flexibility than GS, AS, LS and CK blend separately.

F. *Break vitality*

The break vitality of M40, M60 and M90 review concrete made with various Concrete admixtures are given measurable investigation in Table3. The crack vitality of the solid relies upon the properties of total, for example, its mineralogy, molecule frame and surface (Zhang and Ong, 2017). Further, the solid made with Granite total having harsh surface showed higher crack vitality than Limestone total with smooth surface (Fládr and Bílý, 2018). Also, the high strength concrete with higher compressive quality displays weak break conduct. Likewise, the crack vitality of cement tends to increment with compressive quality (Fládr and Bílý, 2018). It is a direct result of low w/b proportion and expansion of mineral admixture causing considerable change in the security quality amongst total and hydrated concrete glue. In impact, the crack in examples shifts from going around the coarse total and prompts fragile disappointment (Fládr and Bílý, 2018). By and by, Yan et al (Fládr and Bílý, 2018) detailed that there is no unequivocal connection between compressive qualities furthermore, crack vitality for high quality cement.

In the present examination, comes about demonstrate that crack vitality is straightforwardly relative to compressive quality. In addition, relapse investigation was completed to relate the compressive quality and crack vitality of cement speaking to various evaluations of cement made with different kinds of Concrete admixtures and communicated utilizing conditions 1 to 3 .The above exact conditions can be viably used to foresee the break vitality of cement of different evaluations utilizing compressive quality. It demonstrates that the total with predominant mechanical properties created concrete with higher break vitality. Clearly the total properties rely upon their mineralogical qualities, extent of minerals, and level of adjustment and so forth (Fládr and Bílý, 2018). In M40 review, AS blend has displayed 3.4%, 5.3%, 5.4 furthermore, 7.7% higher break vitality than GS, AS, LS and CK blend separately. If there should arise an occurrence of M60 review, the break vitality of AS blend was 10.2%, 7.2%, 9.4% and 10.6% higher than GS, AS, LS and CK blend separately. Also, in M90 review, AS blend exhibited 7%, 8.8%, 10.2% and 11.9% higher crack vitality than GS, AS, LS and CK blend individually. The trademark length of crack in concrete demonstrates the weakness of cement. The outcomes demonstrate trademark length diminished with increment in compressive quality of cement.

IV. CONCLUSION

Efforts were made in this work to explore the effect of raw material type on the performance of high-strength concrete. High-strength concrete mixes made using various concrete additives showed significant variations in compressive strength and crack resistance, indicating that raw material type affects the performance of cement, especially high-strength concrete The petrographic properties of concrete admixtures, such as mineral composition, mineral ratio, composition, degree of modification, auxiliary properties, and others, also affect cement performance. However, a petrographic study of concrete admixtures is essential to understand the role of these factors in cement performance.

***Conclusions and Recommendations*:**

1. The type of aggregate plays a crucial role in determining the properties of high-strength concrete.
2. The following factors should be considered when selecting aggregates:
   - Mineral composition
   - Surface characteristics
   - Hardness
   - Particle shape
3. Concrete performance can be enhanced by:
   - Choosing quartz-rich aggregates for applications requiring high durability
   - Using aggregates with rough surfaces to improve bonding strength this study provides a scientific framework for selecting the optimal aggregates in major construction projects.

ACKNOWLEDGMENT

I use this medium to say thanks to my family, as well as the course facilitator of research methods and all the staffs of Civil engineering department of Cyprus International University, Allah bless you all.

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