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IJTIMOIY-GUMANITAR FANLARNING DOLZARB MUAMMOLARI

№ 1 (6) – 2026

АКТУАЛЬНЫЕ ПРОБЛЕМЫ СОЦИАЛЬНО-ГУМАНИТАРНЫХ НАУК

ACTUAL PROBLEMS OF HUMANITIES AND SOCIAL SCIENCES

TOSHKENT-2026

12.00.00- YURIDIK FANLAR:

Axmedshayeva Mavlyuda Axatovna – yuridik fanlar doktori, professor;

Muxitdinova Firyuza Abdurashidovna – yuridik fanlar doktori, professor;

Esanova Zamira Normurotovna – yuridik fanlar doktori, professor, Oʻzbekiston Respublikasida xizmat koʻrsatgan yurist;

Hamroqulov Bahodir Mamasharifovich – yuridik fanlar doktori, professor v.b.,;

Zulfiqorov Sherzod Xurramovich – yuridik fanlar doktori, professor;

Xayitov Xushvaqt Saparbayevich – yuridik fanlar doktori, professor;

Asadov Shavkat Gʻaybullayevich – yuridik fanlar doktori, dotsent;

Ergashev Ikrom Abdurasulovich – yuridik fanlari doktori, professor;

Utemuratov Maxmut Ajimuratovich – yuridik fanlar nomzodi, professor;

Saydullayev Shaxzod Alixanovich – yuridik fanlar nomzodi, professor;

Hakimov Komil Baxtiyarovich – yuridik fanlar doktori, dotsent;

Yusupov Sardorbek Baxodirovich – yuridik fanlar doktori, professor;

Amirov Zafar Aktamovich – yuridik fanlar doktori (PhD);

Joʻrayev Sherzod Yuldashevich – yuridik fanlar nomzodi, dotsent;

Babadjanov Atabek Davronbekovich – yuridik fanlar nomzodi, professor;

Normatov Bekzod Akrom oʻgʻli — yuridik fanlar boʻyicha falsafa doktori;

Rahmatov Elyor Jumaboyevich — yuridik fanlar nomzodi;

13.00.00- PEDAGOGIKA FANLARI:

Xashimova Dildarxon Urinboyevna – pedagogika fanlari doktori, professor;

Ibragimova Gulnora Xavazmatovna – pedagogika fanlari doktori, professor;

Zakirova Feruza Maxmudovna – pedagogika fanlari doktori;

Kayumova Nasiba Ashurovna – pedagogika fanlari doktori, professor;

Taylanova Shoxida Zayniyevna – pedagogika fanlari doktori, dotsent;

Jumaniyozova Muhayyo Tojiyevna – pedagogika fanlari doktori, dotsent;

Ibraximov Sanjar Urunbayevich – pedagogika fanlari doktori;

Javliyeva Shaxnoza Baxodirovna – pedagogika fanlari boʻyicha falsafa doktori (PhD);

Bobomurotova Latofat Elmurodovna — pedagogika fanlari boʻyicha falsafa doktori (PhD).

19.00.00- PSIXOLOGIYA FANLARI:

Karimova Vasila Mamanosirovna – psixologiya fanlari doktori, professor, Nizomiy nomidagi Toshkent davlat pedagogika universiteti;

Hayitov Oybek Eshboyevich – Jismoniy tarbiya va sport boʻyicha mutaxassislarni qayta tayyorlash va malakasini oshirish instituti, psixologiya fanlari doktori, professor

Umarova Navbahor Shokirovna– psixologiya fanlari doktori, dotsent, Nizomiy nomidagi Toshkent davlat pedagogika universiteti, Amaliy psixologiyasi kafedrasi mudiri;

Atabayeva Nargis Batirovna – psixologiya fanlari doktori, dotsent;

Shamshetova Anjim Karamaddinovna – psixologiya fanlari doktori, dotsent;

Qodirov Obid Safarovich – psixologiya fanlari doktori (PhD).

22.00.00- SOTSIOLOGIYA FANLARI:

Latipova Nodira Muxtarjanovna – sotsiologiya fanlari doktori, professor, Oʻzbekiston milliy universiteti kafedra mudiri;

Seitov Azamat Poʻlatovich – sotsiologiya fanlari doktori, professor, Oʻzbekiston milliy universiteti;

Sodiqova Shohida Marxaboyevna – sotsiologiya fanlari doktori, professor, Oʻzbekiston xalqaro islom akademiyasi.

23.00.00- SIYOSIY FANLAR

Nazarov Nasriddin Ataqulovich –siyosiy fanlar doktori, falsafa fanlari doktori, professor, Toshkent arxitektura qurilish instituti;

Boʻtayev Usmonjon Xayrullayevich –siyosiy fanlar doktori, dotsent, Oʻzbekiston milliy universiteti kafedra mudiri.

OAK Ro‘yxati

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Tahririyat manzili:

100070. Toshkent shahri, Yakkasaroy tumani, Kichik Beshyog‘och ko‘chasi, 70/10-uy. Elektron manzil: scienceproblems.uz@gmail.com

Bog‘lanish uchun telefon:

(99) 602-09-84 (telegram).

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MUNDARIJA

12.00.00 – YURIDIK FANLAR

13.00.00 – PEDAGOGIKA FANLARI

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REVIEW ON FILLER EFFECT OF VARIOUS NONREACTIVE MATERIALS IN CONCRETE

Temple Chimuanya Odimegwu[1,2]
[1] Department of General Professional Sciences, Alfraganus University Tashkent, Uzbekistan
[2] Department of Civil Engineering, Turin Polytechnic University in Tashkent
E-mail: odimtemplec@yahoo.com, odimegwutemple@afu.uz.

Abstract. Fillers are particles added to the material or mixed in order to reduce the excessive utilisation of binder and at the same time improve some properties of the mixture, from past study several materials have been used as fillers in the replacement of either cement or fine. This paper presents a review of past studies on the filler effect of various nonreactive materials as fillers. Materials like ground river sand, limestone dust, ground quartz, carbon black, quarry dust and marble dust are reviewed. Based on analysis, it has been proven that filler plays a significant role in concrete, not only contributing to strength improvement and other properties in concrete, but also when used as a replacement for cement or fine aggregate, whereby minimizing the excessive consumption of conventional materials. However, it can be concluded from past studies that in replacement level of the various materials as filler in concrete, the replacement should be in the range of 2 to 15% for a sustainable concrete structure. Furthermore, as the particle size of the filler affects the performance of the concrete, it is thus concluded that a finer particle size range of the filler should be in the range of 0.025 to 6μm for better results and filling ability or particle packing.

Keywords: Filler effect, nonreactive material, Limestone dust, Ground river sand, Ground quartz, Carbon black, Marble dust.

BETONDAGI TURFA XIL REAKTIV BO'LMAGAN MATERIALLARDAN TO'LDIRUVCHILARNING TA'SIRINI SHARH

Temple Chimuanya Odimegwu[1,2]
[1] Umumkasbiy fanlar kafedrasi, Alfraganus universiteti, Toshkent, O'zbekiston
[2] Toshkentdagi Turin politexnika universiteti, Qurilish muhandisligi kafedrasi

Annotatsiya. Plomba moddalari - bu bog'lovchi moddaning ortiqcha ishlatilishini kamaytirish va aralashmaning ayrim xususiyatlarini bir vaqtning o'zida yaxshilash uchun materialga qo'shilgan yoki aralashtirilgan zarrachalar. Avvalgi tadqiqotlarda tsement yoki mayda agregat o'rnini bosuvchi turli materiallar plomba sifatida ishlatilgan. Ushbu maqola turli xil reaktiv bo'lmagan plomba materiallarining ta'siri bo'yicha oldingi tadqiqotlarning sharhini taqdim etadi. Ko'rib chiqilgan materiallarga maydalangan daryo qumi, ohaktosh changi, maydalangan kvarts, uglerod qora, karer changi va marmar chang kiradi. Tahlil asosida plomba moddalari betonda muhim rol o'ynashi, nafaqat betonning mustahkamligi va boshqa xususiyatlarini oshirishga hissa qo'shishi, balki tsement yoki mayda agregat o'rnini bosuvchi sifatida ishlatilganda an'anaviy materiallarning ortiqcha ishlatilishini minimallashtirishi ko'rsatildi. Biroq, avvalgi tadqiqotlar shuni ko'rsatadiki, betonda turli plomba materiallarining almashtirish darajasi barqaror beton tuzilishiga erishish uchun 2% dan 15% gacha bo'lishi kerak. Bundan tashqari, plomba zarrachalari hajmi betonning ishlashiga ta'sir qilganligi sababli, yaxshiroq natijalarga erishish va plomba sig'imini yoki zarrachalar zichligini oshirish uchun plomba moddasi 0,025 dan 6 μm gacha bo'lgan mayda zarrachalar hajmiga ega bo'lishi kerak degan xulosaga kelish mumkin.

Kalit so'zlar: to'ldiruvchi effekt, reaktiv bo'lmagan material, ohaktosh changi, maydalangan daryo qumi, maydalangan kvarts, uglerod qorasi, marmar changi.

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Introduction. As the demand for construction increases, so does the demand and cost of materials to consummate the construction work. Concrete is one of the oldest construction materials that is still a reliable material used in the construction industry. Due to the cost of most materials that are used in concrete work, researchers are now focusing on replacing most of the constituent materials that make up concrete, which will reduce cost and not threaten the integrity of the said concrete and not limited to environmental benefit when they are replaced with by-products. Due to this fact, attention has been drawn to utilising almost all industrial and agricultural by-products as filling material in concrete, which in most cases are used to replace cement (as filler or substitute for cement) because of the high cost of cement and high energy consumption involved in the production. Fillers are material which its function in any concrete is attributed on the shapes and sizes particles to fill the gaps between aggregates and lowers the consumption of binders and improve the properties of the mixed material without reducing the strength, when they are mixed with cement they help improve the particle packing and above all create other properties in fresh concrete (Moosberg-Bustnes et al, 2004). Cordeiro et al (2008) described filler effect as the packing characteristics of a chemically inactive material of a mixture that depends on the shape, texture and particle size distribution of the said material. Because of the filler effect in concrete or cement paste, the little pores present within cement particles can be filled by a finer particle, which depends on the filler and cement particle distribution. This effect will significantly affect the properties of the cement pastes and the concrete, giving rise to a more improved concrete system (De Schutter, 2011). having known the importance of filler and cement replacement in concrete numerous studies have been done both past and ongoing using different by-products (Rice Husk Ash, Palm Oil Fuel Ash, Olive Oil Ash Sugarcane and Bagasse Ash, Fly Ash, Silica Fume, Limestone, Ground river sand, Quartz, Metakaolin and Mable Dust) as filler and to replace cement (Karim et al, 2013; Zain et al, 2011; Shukla et al, 2011; Cheerarot et al, 2004; Rashad et al, 2014; Khan et al, 2016; De Schutter, 2011, Tandre et al, 2013) at different effect in both filler effect and pozzolanic effect to know the specific effect of this material when reacts with cement. This paper will review the possible literature of different filler material (ground river sand, limestone dust, ground quartz, carbon black and marble dust) and their effect on concrete to better understand their contribution, it is thus important to note that most filler materials possess both filler effect and pozzolanic effect in the concrete structure while other have little or no reaction with cement hydration.

Inert Materials used as filler

Several materials have been used in the past as fillers in concrete, used to clearly differentiate the contribution of this material as filler and investigate the filler effect of most pozzolanic materials. These materials have added knowledge on the filler effect in some cementation materials. This study is focused on highlighting these materials and identifying their contribution to the filling effect of the internal matrix of mortar and concrete.

Ground River Sand is used as Filler

In order to really understand the filler effect is thus ideal to use a chemically inactive material; most studies have utilised ground sand (Grand-River sand) as an alternative demonstration of pozzolans, with the chemically inactive material having similar-sized particles to the pozzolanic material. This has shown a significant behaviour in terms of understanding the mechanism of filler effects on any material, which will, at the same time, give a clearer understanding of the "chemical effect of pozzolans in a cementitious system".

Table 1: Chemical composition of Ground River Sand (Khan et al, 2014a)

Compound	Composition (%)
SiO_2	85.72
Al_2O_3	3.75
Fe_2O_3	1.08
CaO	0.32
MgO	0.09
Na_2O	0.09
K_2O	0.85
SO_3	0.04
P_2O_5	0.04
MnO	0.01

Khan et al (2014) utilised ground river sand in a lower percentage up to 2.5, 5, 7.5, to 20% respectively and different particle sizes as supplementary of cement in mortar production, to determine the filler effect of pozzolan on compressive strength. They found out that the compressive strength of ground river sand mortar was lower than that of the mortar without the ground river sand, which was because the ground river sand was chemically inactive, having no chemical reaction with cement, and there was no pozzolanic effect on the concrete microstructure.

Table 2: Ground River Sand Compressive strength (Khan et al, 2014a)

Sample Symbol	7days Compressive Strength (MPa)
Control	36.40
SGS2.5	34.28
SGS5	33.36
SGS7.5	32.90
SGS10	31.00
SGS15	30.14
SGS17.5	29.30
SGS20	29.14

Khan et al, (2016b) carried out an experiment with Ground River sand replacing cement in small percentages of 2.5, 5, 7 respectively with particle size 7.6 µm in mortar and the result indicate that filler effect was more significant at a lesser amount of cement replacement of about 0 to 10% using nonreactive filler material, they also discovered that 7.5 cement replacement gave the maximum strength in terms of replacing cement with ground river sand and with the image of the Scanning Electron Microscope confirming the filler effect of "microstructure development of mortar". Another experiment was done by Jaturapitakkul et al, (2010a) replacing type 1 cement with ground river sand of weight of binder 10 to 40% and their findings prove that the strength of mortar increases as the finer particle of the ground river sand is increased also the difference in compressive strength of mortar with ground river sand due to filler effect likely to be higher as the difference in fineness of ground river sand increases. Cheerarot et al, (2004) using ground river sand and a pozzolan to replace cement in different percentages of 10, 20, 30 to 40 and particle size ranging from 6.4, 11.7 to 20.6 to cast mortar, their result showed a bit increase in strength of grand river sand with particle size of 6.4 μm than the mortar sample with particle size 20 μm. This result has also proved that the particle size of replacement material plays a major role in the determination of filler effect (physical effect) and also in the strength development of the cementitious system. Whereas, Jaturapitakkul et al (2011b) later used a higher percentage of Grand River sand and ground palm oil fuel ash grounded to different particle sizes to replace cement up to 10 to 40% with the idea to establish the filler effect and pozzolanic reaction of the pozzolan at 7 and 90 days of curing. Their findings brought to a conclusion that the strength of mortar was almost constant at 7 to 90 days for a given cement replacement. This behaviour was due to the filler effect of the ground river sand.

Ground Quartz is used as Filler.

Quarts have been used in past research in establishing filler effect with different filler material most especially pozzolanic materials, because quartz is seen as a low-reactive material when interacting with the cementitious material, having a very high content of Silicon Dioxide (SiO_2), see table 3.

Table 3: Chemical Composition of Quartz (Berodier & Scrivener, 2014)

Compounds	Composition (%)
SiO_2	97.91
Al_2O_3	1

Several attempts in the past have been made to incorporate this material with other pozzolanic material to better understand the filler effect when those pozzolans are used to replace cement. Moosberg-Bustnes et al (2004) studied the effect of quartz as filler and the possibility of replacing cement with quartz in different particle sizes and amounts of replacement. The authors reported that quartz as filler in cement replacement shows a positive effect by improving particle packing, thus filling the voids, and the fineness of the particles also had an effect in improving the hydration of the concrete.

Table 4: Compressive Strength of Quartz (Moosberg-Bustnes et al, 2004)

Filler (kg)	216 kg cement	w/c=0.96	260 kg cement	w/c=0.81	260 kg cement	w/c=0.96
	7 days MPa	28 Days MPa	7 days MPa	28 Days MPa	7 days MPa	28 Days MPa
216	-		24.4	32.6	16.5	17.3
260	12.0	17.7	24.6	33.0	19.5	20.9
300	15.5	21.9	24.3	32.3	19.8	21.2
343	16.8	23.1	27.0	36.4	21.2	22.2
386	17.5	24.2	28.9	38.0	20.5	22.1
433	18.9	26.6	-	-	-	-

These findings are similar to a past investigation done by Kronlof, (1994) who used 4 quartz powder with intention of improving “particle parking” in workability of concrete and the result shows that the finest particle of the filler improved the parking effect (filler effect) therefore reduce the water content, improve workability and also increased the strength of the concrete due to the interaction between the cement paste and the quartz powder.

Cordeiro et al, (2008) utilized quartz in their experiment to study the filler effect in mortar with the particle size of crushed quartz 29.1 μm which they conclusion that the crushed quartz gained an early strength which was due to the filler effect which means that the effect of filler is substantial in early stage strength development and this prove was clear when compared to the control sample. Berodier and Scrivener (2014) to study the effect of filler and kinetic hydration when quartz in different percentage cement replacement 10, 20, 40, 50 and 70%, reported that although quartz is inert as proved but that it enhanced the rate of reaction of the clinker, they also observed that in every replacement level there was relationship of increasing acceleration slope which is attributed to the particle size and replacement level of the quartz.

Carbon Black is used as a filler.

The carbon black a by-product generated from rubber industry, is conceded as an inert material (nonreactive) which is also a good material to help understand the filler effect of some pozzolanic material, it can be seen in spherical shapes and a very small size particles (powder) that are same as silica fume, attempt has been made in several past studies to clear the confusion in differentiating pozzolanic effect and filler effect when using materials that will improve the behaviour of concrete both physically and chemically. Carbon black has been used in different studies in the past as filler material and substitute to cement in concrete, Goodman & Bentur, (1992) used different particle size of carbon black (0.025, 0.073 and 0.33 μm) to replace silica fume with carbon black in effort to clarify the influence of micro-filler of concrete in strength enhancement and at what possible rate an inert filler can contribute to the mechanical properties. A cube of size 70×70×70 mm and beam size 70×70×280 mm was used to prepare concrete while pastes matrix was prepared with a 25×25×25 mm mould, they found out that the addition of carbon black in silica fume replacement influenced the strength of the concrete practically similar to the silica fume of the same water cement ratio 0.46, thus this influence of strength increase was due to decrease in particle fineness (particle size smaller than 0.073 μm) and due to "densification of the transition zone" which they prove that a finer particle improves the micro-filler effect in the concrete which comes up by mechanism that makes the concrete dense whereby the aggregate enhances the strength by filling the voids of the concrete.

Padma & Pandeeswari (2016) utilized carbon black as filler to replace cement in the different percentages 10, 20 and 30% with the idea to study the effect of carbon black in concrete when partially replaced cement, the authors found out that the strength of the concrete increased with increase in carbon black content at 30% and this mix had the best strength among the other mix in their study including the reference concrete cube. This increase is attributed to the filler effect of the carbon black in the concrete mix, which leads them to the conclusion that replacement of cement with carbon black up to 30% is ideal and will give a significant result in concrete. Chitra et al, (2014) who added carbon black powder in different percentages (0, 2, 5, 8, 12 and 15) as filler in conventional concrete, the authors concluded that 2%, 5% gave better behaviour when compared to the control concrete, but in terms of the morphology picture 8% carbon black had a better closed parking of the particles in the concrete whereby closing the voids between the particles present in the concrete but went ahead to advise that 5% of carbon black as filler will be an ideal percentage addition of carbon black in concrete to enhance the performance of the concrete having percentage increase of strength at about 27.73% when compared with the reference sample.

Table 5: Compressive strength of Carbon black (Chitra et al, 2014)

Replacement Content with Carbon Black (%)	Compressive Strength (N/mm^2)	Increase in Compressive Strength (%)
0 %	24.30	-
2 %	28.44	+17.03
5 %	29.33	+20.7
8 %	17.56	-27.73
12 %	13.33	-45.14
15 %	11.56	-52.42

A similar percentage addition of carbon black was later investigated by Jeyashree & Chitra (2017), who explored the effect on a concrete element with carbon black powder as filler material having a particle size of 0.05 μm with different percentage replacement of 0, 2, 5, 8, 10 and 12%. The result from this study ascertained that 2 %, 5% and 8% carbon black to optimum cement replacement had the best result when compared to the control sample in terms of compressive strength, Rebound hammer test and ultrasonic pulse velocity test, which indicates that carbon black is a good ingredient as filler material in concrete to improve the properties of concrete structure and also effective for RCC elements. This was due to the particle size of the carbon black, which reduced the void present in the concrete.

Marble Dust used as Filler

Marble dust is a by-product generated during the process of cutting marble. It consists of a high CaO up to 50% Southararajan & Sivakumar, (2013) and other minor chemical content of SiO_2, Na_2O, MgO, Fe_2O, Al_2O_3 and the chemical composition differ from sample to sample due to the formation of the parent marble rock from origin.

Table 6: Chemical composition of Marble dust

Chemical	Composition (%)	
	Aruntas et al, (2010)	**Bekir (2009)**
SiO_2	0.67	4.67
Na_2O	0.14	-
MgO	0.59	0.4
Fe_2O,	0.08	0.03
Al_2O_3	0.12	-
CaO	54.43	51.8
LOI	43.4	41.16

This byproduct has been judiciously used in several past studies, and it has performed wonderfully in past in terms of its filler ability in concrete when incorporated with fine aggregate or replacing cement in a specific percentage as filler material. Bekir et al, (2009) reported on self-compacting concrete using marble dust as filler and replacing cement with marble dust in different content 50, 100, 150, 200, 250 and 300 kg/m^3 to study the effect of marble dust as filler in self-compacting concrete, they highlighted from their result that 200 kg/m^3 is the best dosage for marble dust as filler in self-compacting concrete and that marble dust had a positive effect on the concrete, giving rise to increase of strength on early and later age of the concrete sample which was due to filler effect of the marble dust which filled up the gaps between the particles of the mix. They specified that the addition of marble dust above 200 kg/m^3 will bring about a decrease in the mechanical properties of hardened self-compacting concrete. Meanwhile Hameed et al, (2016) later investigated the effect of marble dust in self-compacting concrete as a filler, this was done by using marble dust to replace cement in different content 5, 10, 15 and 20 by weight, in view to that they concluded that the use of marble dust (marble powder) to replace cement gave the self-compacting concrete contributed to strength gain by acting as effective filler with a size particle finer than 150μm which help in particle packing that result to the strength improve. The authors went ahead to discuss that of all the replacement content, 15% of marble dust content replacing cement gave a more suitable result without jeopardising the strength and other properties of the self-compacting concrete.

Another author Bahar, Bahar (2010), studied the effect of marble dust as a replacement of fine aggregate in concrete strength with different percentages 25, 50 and 100 replacement and curing ages (3, 7, 28 and 90 days). They came up with an encouraging result which shows that addition of marble dust as replacement of fine aggregate of particle size passing through 0.25mm sieve size increase the strength of the concrete and the unit weight because of the fineness of the marble dust and the higher specific gravity which gave a filler effect in the concrete structure since marble dust particle size is finer than that of the fine aggregate in their study.

Table 7: Compressive strength of Marble dust in different replacement of fine aggregate (Bahar, 2010)

Percentage replacement	Compressive Strength (MPa)			
	3 days	7 days	28 days	90 days
0 %	14.32	35.5	48.68	60.51
25%	15.8	35.54	50.25	61.44
50%	17.66	36.43	50.69	61.50
100%	21.46	38.97	53.39	63.30

Several studies have proved that marble powder has no chemical reaction when blended with cement, Corinaldesi et al, (2010) highlighted in their report that marble dust by all indication shows filler effect at early age because of filler potentials of the marble dust and does not contribute chemically to the hydration process of the cement, the author also reported an increase in compressive strength at 28 days of age when marble dust replaced fine sand up to 10% more than the control concrete, giving an improved and promising concrete and mortar behaviour A study done on bituminous concrete by Satish et al, (2002) using marble dust as filler in different replacement content 3, 5, 7 and 9% and other fillers, the authors concluded that 5 % marble dust filler content had the best strength among other filler in the study, it was also well informed in the study that the addition of marble dust in the experiment improved the bituminous concrete bulk density. Proving that the utilisation of this by-product as filler in bituminous concrete will yield a successful and sustainable material for road construction.

Limestone is used as filler.

Limestone is a sedimentary rock with major composition of calcium carbonate or dolomite, and is used as an ingredient in cement with a higher percentage content of calcium oxide (See Table 8)

Table 8: Physical and Chemical Composition of Limestone (Isaia et al, 2003)

Chemical	Composition
SiO_2	9.6
Al_2O_3	2.0
FeO_3	0.7
CaO	43.9
MgO	4.7
SO_3	0.3
Na_2O	0.1
K_2O	0.2
LOI	38.6
Physical Test	
Specific gravity $Kg=dm^3$	2.33
BET fineness $m^2=kg$	5300
/average of grains lm	4
Grains /< 3 lm%	46

Limestone has been used in the past study as a mineral filler must especially in self compacted concrete, Guemmadi et al, (2009) incorporated fine limestone in concrete with different cement replacement in percentage 6, 12, 18, 24, 30, 36%, and an optimum percentage up to 42% with different particle size of limestone and compared with the conventional concrete sample for compressive strength and economic feasibility. They found out that limestone fine has an advantage in the concrete, more homogenous mix and improved particle packing, giving a similar compressive strength at same age (28 days) and more economical than the conventional concrete reducing the rate of cement consumption up to 23% while 18% "finely ground limestone" filler had a higher strength for the same cement content with reduced cost of the concrete. The strength increase was attributed to the quickening effect of the filler in connection with the "calcium carboaluminate hydrates" that might have furnished the increase in hydration. Vuk et al, (2001) evaluated the effect in addition of 5 percent limestone on different properties of cement and they disclosed that there was increase in early age strength development which is due to the addition of limestone and that this could only be explained by improved hydration, in view of the fact that one must consider the physical action of limestone and its changes in hydration. This result agreed with the review by Detwiler &Tennis (1996). They added that 5% limestone added to cement does not affect the performance of Portland cement negatively, and grinding the limestone to an appropriate particle size would demonstrate improvement in performance of the cement paste and workability when compared to the same cement without limestone.

Isaia et al, (2003) reported that limestone filler can be utilized in production of high strength concrete with particle size at about 4μm (which has to do with the fineness of the limestone particles) and percentages replacement of 12.5, 25 and 50% having different water cement ratios (0.35, 0.50 and 0.65%), they established that the filler effect had a positive influence in the high strength concrete mix at higher curing age 91 days and it was noticed that the effect of filler in the concrete increased more than its counterparts.

Table 9: Compressive Strength of Concrete with Limestone Filler (Isaia et al, 2003)

Replacement (%)		28days	91days
Control Sample		64.0	68.8
12.5	Water Binder Ratio 0.35	51.9	68.9
25		48.7	56.7
50		32.9	39.3
Control Sample		47.8	52.2
12.5	Water Binder Ratio 0.50	37.8	48.9
25		31.8	35.3
50		20.7	24.8
Control Sample		33.4	34.8
12.5	Water Binder Ratio 0.65	23.5	29.5
25		19.3	20.1
50		11.5	12.7

Bonavetti et al (1999) in their study to evaluate the filler effect of limestone with limestone replacing cement by 0, 9.3 and 18.1 by mass of clinker and tested for 1, 3, 7, 28 to 150 days. They found out that limestone filler have a significant improvement in the cement efficiency in the concrete sample having a lower water cement ratio due to more hydration of active cementitious material, they also concluded that there was early age strength increase by limestone filler which was due to the enhancing the clinker grains hydration and at later age after 1 day there was reduction in strength of about 7% to 12% at 28 days for limestone replacement level of 9.3 and 18.1. Tandre et al (2013) reported that limestone when used as a filler or accelerator in concrete it give two different effect, as mineral additive and filler material (filler effect or physical effect) which makes it more beneficial to some other fillers because of its ability and behaviour with cement to form a more cementitious system or to contribute in ion exchange with cement, due to this facts majority will actually perceive limestone to be additive than is been used as filler. They went ahead comparing the performance of limestone with another filler and found out that limestone with different cement replacement increased the rate of reaction with different cement replacement with limestone having a better acceleration in hydration reaction than other filler material in the study, although De Schutter, 2011; Mohammed et al, 2013 stated that there has not been a concrete proof to claim the contribution of chemical improvement of this material to hydration in cement paste. Voglis et al. (2005); Guemmadi et al. (2008) disclosed that limestone interacts with alumina paste in cement to produce a "calcium mono Cabo aluminate" hydrate and a noticeable change in strength in the concrete, having a higher early strength development with a lower demand for water in the mix than other pozzolans. This early strength development was also reported by Matschei, et al., (2007) and Lothenbach et al, (2008), who explained that the addition of limestone as filler rapidly accelerates the early strength development of the mix to produce calcium Cabo-aluminate. Later, Mohammed et al, (2013) investigated the "microstructure and hydration of sustainable self-compacting concrete with different filler types" in view to establish how limestone filler and other fillers with higher replacement of cement will affect the early stage hydration, composition and microstructure. They finalised in their statement that a self-compacting concrete can be manufactured with limestone powder of size lower than 65µm, which they attained the compressive strength of 50 MPa with 33% cement replacement, which will give an economical and sustainable concrete system.

Heikala et al, (2000) studied the effect in replacement of limestone (5, 10, 15, 20%) for Homra in Pozzolanic-cement and the result indicated that addition of limestone reduced the initial and final setting time of the paste and reduces the porosity, they concluded that limestone fills gaps between the particles of the cement because of the carbon aluminate that might speed-up the setting of the cement paste. Bonavetti et al., (2003) investigated the effect of limestone filler on degree of hydration, and the optimum replacement of limestone filler in cement paste up to 20% in different water-cement ratio (0.25 and 0.50) by the use of "quadratic statistical model", and the result indicate an increase in the degree of hydration for a low water-cement ratio with increase in limestone filler content. Ghorab et al. (2014) explored the behaviour of 10 - 30% of cement paste and mortars replaced by limestone, and they concluded that the compressive strength of limestone mortars up to 15% content was almost the same strength as the control sample, but the strength decreased with higher limestone content. Similar trend was observed in a report by Schmidt, (1992) when cement was replaced with limestone by 10% limestone content, after testing the permeability of air entrained sample that was made with Portland limestone cement and Portland cement they found out that in all parameters that the permeability coefficients for the Portland lime cement concrete was somewhat lower than its counterparts (control) made with only Portland cement. It was not clear if this behaviour was because of the finer particles of the limestone or a more efficient particle in the mix. Meanwhile, above the idea of replacement, some other studies projected the fact and significant effect of fineness of limestone when utilised in the replacement of cement in pastes,

Some researcher like Hawkins et al, (2003) recommended that in application of limestone to cement for a better result is imperative that limestone should be finer than cement so that the result will be more competitive even at replacement up to 8%, Kumar et al, (2014) in their research proved that limestone with an average particle size of 3 µ with 10% replacement tend to give strength that is almost same strength with the sample without limestone. Lollini et al (2014) advised that when considering replacing cement with limestone in percentages up to 15 to 30% in any concrete mix with limestone having a coarser particle size than cement, the behaviour will yield a reduced strength and a poor durability at all curing ages. This result agrees with a field study done in Canada by Tennis et al, (2011) which reveals that up to 12% limestone can be used to produce concrete that will be likely equal to the performance of Portland cement making sure that the limestone is properly crushed to its highest fineness and another data from the United States that was studied also pointed out that cement and limestone are ideal ingredients which have significant effect on the strength and improved the concrete properties more than the concrete with only Portland cement. Tsivilis et al. (2003) studied the effect of adding limestone, using water and air permeability tests, porosity tests, and sorptivity, with limestone replacing cement from 10 to 35% by weight. it was found that the concrete sample with the addition of limestone showed properties that are similar to those of samples with Portland cement. They reported that limestone had a positive effect on the water permeability and sorptivity with 15%, which didn't change the porosity of the sample. Samples with a higher gas permeability than samples with ordinary Portland cement. This fact proves that further increase of limestone content in the concrete will pose a negative effect on the concrete porosity.

Other materials like Querry dust have also been studied. Kaish et al (2024) incorporated quarry dust and limestone dust as fillers to improve the internal structure of the produced concrete. different parameters were studied, including shrinkage performance, absorption behaviour and high temperature performance, as shown in Table 10.

Table 10. Comparative behaviour of Conventional and Quarry-Based Concretes as filler

Property	Conventional Concrete	Quarry Dust Concrete	Quarry + Lime Concrete
Shrinkage	Higher	Lower	Lowest
Water Absorption	Moderate	Lower	Lowest (balanced lime)
High-Temperature Strength	Rapid loss >600 °C	Better retention	Best retention

Source: Kaish et al (2024)

The findings indicate a reduced shrinkage due to the particle shape (angular) of the quarry dust that filled the voids in the internal concrete structure and increased density (see Table 10). Mixtures of limestone and quarry dust showed reduced pore connectivity, and enhances compactness and block capillary pores, and reduced permeability. Then better and improved performance of quarry dust its ability to fill the internal void and making the sample dense when compared to the reference sample.

Conclusion. The findings from the examination of existing literature on the filler effect of various materials indicate the significant role these inert substances play in enhancing the mechanical properties of concrete, either by partially or wholly substituting fine aggregates or cement. A key point from this paper is the critical importance of the particle size of the filler material. This factor greatly influences not only the workability but also the strength of the concrete mix by effectively filling the gaps between the larger particles present. For optimal results when using filler materials in place of fine aggregates, it is beneficial that these fillers possess a finer particle size, ideally within the range of 0.025 to 6 micrometres. This fineness allows the filler to occupy spaces in the concrete matrix, leading to a denser and stronger composite. Conversely, when considering the replacement of cement with filler materials, the objective is to reduce the overall consumption of cement without compromising the integrity of the concrete.

Based on the observed effects, it is recommended that the percentage of filler replacement be kept relatively within a range of 2% to 15%. This approach is crucial to ensure that the mechanical properties of the concrete are not negatively impacted, maintaining its desired strength characteristics. Furthermore, it is beneficial to utilise a non-reactive material to distinguish between the filler effect and the pozzolanic effect. This methodology could yield deeper insights into the performance of pozzolanic materials when employed as fillers. The current research has not sufficiently explored the interaction of non-reactive by-products with pozzolanic materials, particularly regarding their dual functionality when replacing either cement or fine aggregates. By conducting studies in this area, we could better understand the specific circumstances under which pozzolans exhibit less reactivity in their role as pozzolanic agents and more as fillers, thereby maximising their effectiveness in concrete.

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Bogʻlanish uchun telefon:

(99) 602-09-84 (telegram).