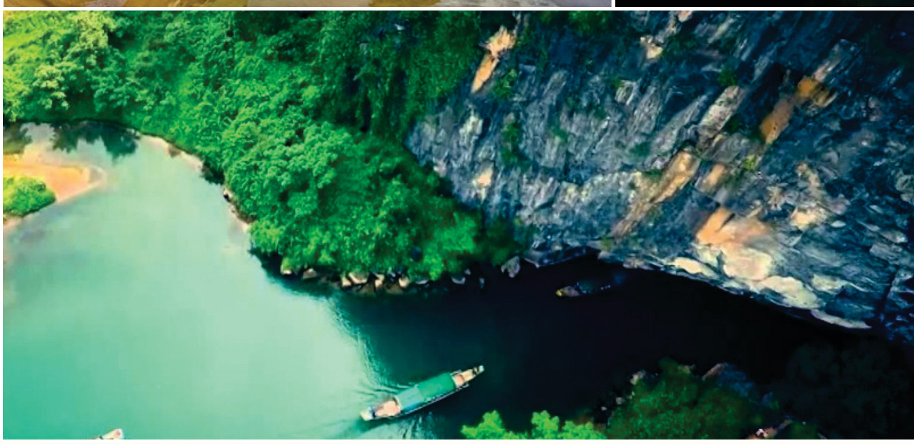
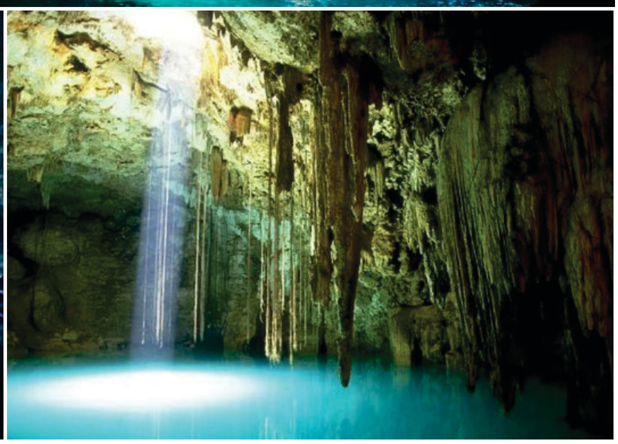
PROCEEDINGS OF THE 4th INTERNATIONAL CONFERENCE
VIETGEO 2018, QUANG BINH, 21-22 SEPTEMBER, 2018

GEOLOGICAL AND GEOTECHNICAL ENGINEERING IN RESPONSE TO CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT OF INFRASTRUCTURE



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Quang Binh, 21&22 September 2018

INTERNATIONAL CONFERENCE
VIETGEO 2018

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21&22 September 2018

QUANG BINH, VIETNAM

Organized by

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TABLE OF CONTENT

SESSION 2
GEOTECHNICS FOR SUSTAINABLE DEVELOPMENT OF INFRASTRUCTURE

SeSS$_I$O N 3
GEOTECHNICAL MONITORING AND MATERIALS

SeSS$_I$O N *1*
GEOHAZARDS AND SLOPE STABILITY

SeSS$_I$O N *2*
TECHNICAL NOTES

PREFACE

ɪnfrastructure development towards the sustainability in vietnam as well as in the world is facing with many challenges, especially in the context of global climate changeV Smart responses to climate change for harmonious and sustainable development are a legitimate desireV This is also the responsibility in the hands of scientists in general and geological - geotechnical engineers in particularV

following the development and the success of the first conference in hue 2đ12 (huegeo 2đ12), the second in hanoi in 2đ12 (hanoi geo 2đ12), the third in halong in 2đ13 (vietgeo 2đ13), the fourth international conference will be officially named vietgeo 2đ1²V vietgeo 2đ1² is co-organized by the vietnam association of engineering geology and the environment (vaege) c hanoi τniversity of mining and geology (hτmg)c Quang binh Department of Science and Technologyc ιa maguchi τniversity, JapancSuranaree τniversity of Technology, ThailandcTongji τniversity, Chinac ho Chi minh τniversity of Technology (hCm τT)c vNτ τniversity of Science, vietnam National τniversity hanoi (vNτ -hτS) c hue τniversity of Sciences - hue τnivers ity (hτSC)c hydraulic Construction ɪnstitute (hCɪ) and Technical ωorld CoV ltd (Tω) on 21st and 22nd September 2đ1² in Donghoi city, Quang binh province, vietnamV

vietgeo 2đ1² will focus on the following themesd

- Slope stability and prediction,
- Coastal geotechnical engineering in response to climate change,
- Deep foundation and underground construction,
- ground improvement method for infrastructure construction,
- geotechnical instrumentation and materialsV

vietgeo 2đ1² has received many kind supports from Quang binh Department of Science and Technology, Technical ωorld CoV ltd (Tω), feCO N Corporation, gmC ɪnvestment and Development CoV ltdV (gmC), Research Center for Technology and ɪndustrial equipment (ReCTɪe) , τnion of Survey and Construction JVSVC (τSCO), geotechnical Research Cenre - hτmg, Nam mien Trung CoV ltd, hanoi Construction Design ɪnvestigation Consultants JVSVC, Power engineering Consulting JVSVCɪ (PeCCɪ), hydraulic Construction ɪnstitute (hyCɪ)V

The organizing committee would like to express our sincere thanks and appreciations to all of participants and supporting institutionsV Special thanks to members of the advisory board, local volunteers and especially those of the secretariats who handle the daily hard work to make the conference successfulV

ωe hope you will find this conference not only a chance to discuss, to share experience but also to explore cooperative opportunitiesV

Organizing Committee of VIETGEO 2018

PROCEEDINGS OF THE 4th INTERNATIONAL CONFERENCE VIETGEO 2018

QUANG BINH, VIETNAM
21&22 September 2018

SeS S_ION 1

GEOLOGICAL AND GEOTECHNICAL ENGINEERING IN RESPONSE TO CLIMATE CHANGE

EFFECT OF PARTICLE SIZE DISTRIBUTION OF LIEM SON, KIM BANG, HA NAM LIMESTONE GRADING AS INERT ADDITIVE ON BUT SON CEMENT MOTAR

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Abstract: T*he purpose of this work is to describe the effect of nanoparticle size of limestone as an inert additive on cement on important physic and mechanical properties of cement paste*V The *present examinations indicate that* lie *m* Son, K*im* b*ang*, h *a* Nam *limestone with potential reserve and good quality can use as an inert additive on cement*V Rese*arch effect of particle size distribution of this limestone as inert additive on mechanical properties of cement mortar indicates that increasing nano and micro particle size content of need limestone in original cement can increase early strength but it does not influence late strength*V

Keywordsd*limestone*c*cemen*c*additive*c*particle size*c*properties*V

1.Introduction

l*im estone is known as a main raw material naturally occurring calcareous deposits, limestone provides calcium carbonate* (C*a*CO_3) *for cement to combine with very small amounts of* "*corrective*" *materials such as iron ore, bauxite, shale, clay or sand may be needed to provide extra iron oxide* (fe $_2O_3$), *alumina* (a l_2O_3) *and silica* (S*i*O_2) *to adapt the chemical composition of the raw mix to the process and product requirements*V

T*oday*, O*rdinary* P*ortland* C*ement manufactured by modern technology exceeds the quality requirements of* PC2*đ cement specified in* TCv N $_{23}{}^2$ $_2$d$_2$đđ^{3}V I*t is also in conformity with* a STm C$_{12}$*đ* T*ype*$_{1V}$ f*oll owing outstanding properties*d

S*table physicochemical properties*c

S*uitable for high-quality construction projects*c

R*apid strength development cement with consistent high strength performance*c

e*xcel lent durability that resists aggressive environmental attacks due to very low permeability coefficient*c

R*apid setting cement with superior workability for easier handling*, *placing and finishing*c

R*elatively low water demand thus reduced concrete surface cracking*c

e*nhanc ed concrete cohesion, sustained uniform concrete performance*V

S*o*, PCb *cement is a* P*ortland* b *lended* C*ement which is very common in market of* v *ietnam*, *suitable for civil construction from application for foundations-columns-floor-roof of house to building-other finishing works*V

D*epending on the type and amounts of added additives*, *the hydration process varies from the hydration of the original cement*, *but they all affect the hydration of the clinker mineral which contributes to the development of the contributing substances*V *and finish the cement stone structure*V C*r*$_2O_3$, S*i*O_2, a l_2O_3, C*a*CO_3, T*i*O_2 *for cement in fine grinding with appropriate content also increase the strength of the concrete and reduce the water void*V

l*im estone is used as an additive*, *according to current scientific research*, *limestone nanoparticles* *and microcells are nearly inert δ1γ in cement hydration but it has the effect of enhancing the early age of cement stone*, R*educe the* ω*a ter* /C*ement ratio*, *increase the* ω*a ter* /C*ement ratio*V T*his is explained by the fact that limestone nanoparticles act as crystalline gums that speed up the cement hydration process to increase the early age of cement stone*, *furthermore the combination of nano and limestone micro- covers and filling the porous holes between the hydration products is the main effect that enhances the cement stone*V

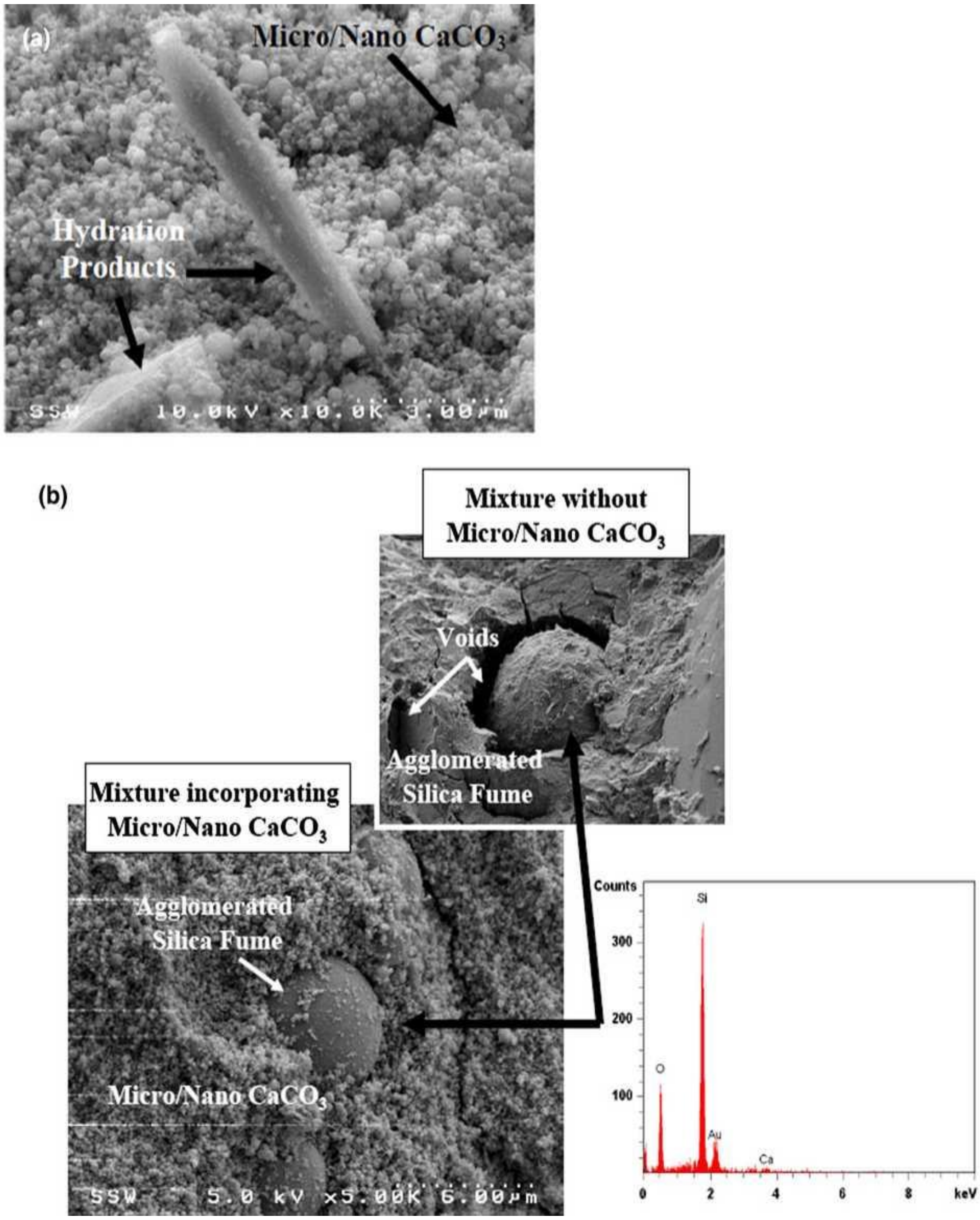


fig V1V m*icro*/*nano* C*a*CO$_3$

*a*V C*over and fill the porous hole between the hydrated products and b*V fi*lls the space around the silica fume* δ1γ

2.Material

2.1. Limestone

l*im estone originates from chemical-type deposition of over saturated saline solutions and accumulation of (carbonate) minerals from dead marine organisms*V *This sedimentary phase is followed by digenesis during which the original content fragments disappear and are replaced by recrystallized calcite*V *Calcareous deposits often include impurities (clay, sand) that sediment together with the chemical precipitation and the organnogenic accumulation*V

l*im estone sample is collected from* l*ie m* Son, K*im* b*ang*, h*a* Nam*V* m*ineralogical, chemical and mechanical characterization of limestone are showed in table* 1, 2 *and* 3 V

T*ab*V1V m*ineralogical characterization of limestone* (m*ineralogical analysis by* χ RD) (m*ain phases*)

m*ineral*	Calcite CaCO3 δμ γ	Dolomite Ca(mg,fe) (CO3)2 δμ γ	Quartz SiO2 δμ γ
Quality	1đ -2đ	12 -22	l*it tle*

T*ab*V2V *Chemical characterization of limestone*

Ox*ide*	CaOδμγ	mgOδμ γ	lO 1δμ γ
Quality	23Vđ1	1V32	đV23

T*ab*V3V m*echanical characterization of limestone*

me*chanical*	h*ardness* δm*ohs*γ	m*ass volume* δgЌcm3γ	*Compressive strength* δkg Ќcm2γ
Quality	1 -1V2	2V31 - 2V1đ	1,3đđ and - 1,112

a *ccording to mineralogical, chemical and mechanical characterization of limestone, it can be used as a main raw material for clinker cement and as an inert additive for cement according to* TCv N 3đ12d 2đ13

2.2. Portland cement Clinker

Cement Clinker are collected from b*ut* Son, v*icem*, h*a* Nam*V* 1*ts composition have been indicated in* T*ab*1V

T*ab*V1V *Chemical composition of* b*ut* Son *clinker*

Ox*ide*	CaO	SiO2	al2O3	fe2O3	mgO	K2O + Na2O	SO3	l O1
Quality δμγ	31V3	21V1	2V22	3V12	2V22	đ3V1	đV23	đV33

m*ineral are calculated from chemical base on* b*ogue* δ2γ *and showed in table* 2V

μ C3S k 1V đ1 C – 1V3 S – 3V12 a – 1V12 f
μ C2S k 2V3 S + 2V đ1 a + 1 V đ1 f – 3V đ1 C
μ C3a k 2V32 (a – đV31 f)
μ C1a f k 3V đ1 f

T*ab*V2V m*ineral composition of* b*ut* Son Clinker

m*ineralogical of* ClK μ			
C3S	C2S	C3a	C1af
32V12	13V31	2V23	3V32

2.3. Gypsum

τ *sed gypsum is* l*ao gypsum with formula* CaSO1V2h 2O *included impurities* 1 – 2μ V *The chemical properties have been indicated in table* 3V

T*ab*V3V *Chemical composition of* l*a o gypsum*

1*ndication*	l*ao g ypsum*
SO3 (μ)	33V32
h*umidity* (μ)	2
R*esidue insolate* (μ)	3V2

3. Research Methods

3.1. Composition of researching sample

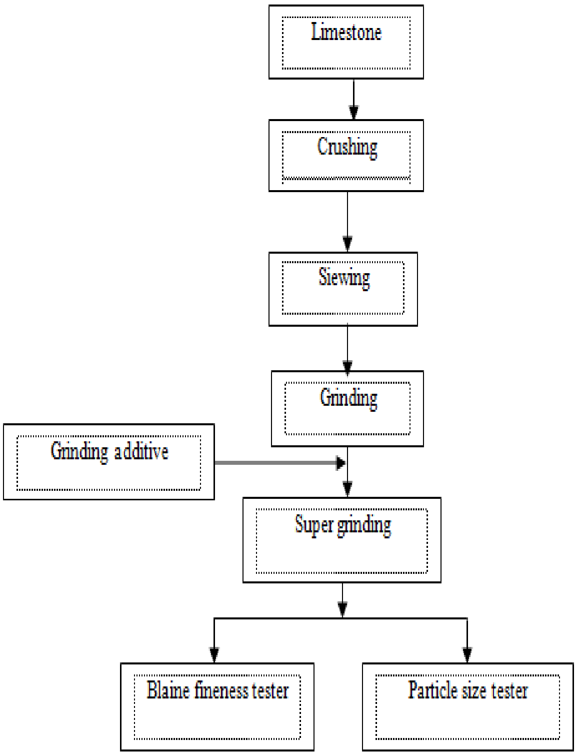
l*im estone sample have been collected in* l*i em* Son, K*im* b*ang*, h*a* Nam*V They have been tested by different production process as* Diagram1V

T*ab*V1V *Sample sign*

S*ample*	a *dditive*	g *rinding time duration*	a *dditive*Ќ (*cement clinke*+3μ *gypsum*) (m*ass*)
m1	l*im estone*	2h	
m2	l*im estone*	1h	2đЌ2đ
m3	l*im estone*	3h	

3.2. Sieving method

Sieving is a simple method for the classification of powders$_{V1}$t can be performed either in a dry or a wet way, with manual or mechanical vibration, and for fixed duration or until a sufficiently low powder flow rate is observed through the sieves$_{V1}$t is however limited by physical dimensions of the sieve, i$_V$e$_V$ usually $_{12}$µm $_V$ according to TCv N $_1$đ$_3$d$_2$đđ$_3$



Diag$_{V1V}$ Process of testing

3.3. Blaine Permeability

fine ness tester is used for the measurement of the specific surface area of particles on the base of air permeability methodd the time t necessary for a volume of air to flow through a packed bed of particles is recorded TCv N $_1$đ$_3$đ -$_2$đđ$_3$ gives the evaluation of specific surface area$_V$

3.4. Dimension distribution

lase r diffraction is based on a complex theory of interaction between monochromatic light and individual particles$_{V1}$t has been tested in industry ceramic and glass instituted the water for standard consistence test and Determination of Setting Time

This test method is a modification of the method set out in v ietnamese Standard $_1$đ$_3$đd$_2$đđ$_3$ and $_1$SO $^3{}_2{}^{31}$ – $_1{}^{323}{}_V$

3.4. Compressive strength test

This test bases on TCv N $_3$đ$_{13}$d$_2$đ$_{11}$ and $_1$SO $_3{}^{13}$ – $_1{}^{323}$ $_V$

3.5. SEM method

The Sem samples were measured at the $_1$nstitute of Technical Physics - h anoi τ niversity of Science and Technology$_V$

4. Results and Analysis

4.1. Limestone Blaine

Result of limestone b laine of Thanh l iem, Kim b ang, h a Nam has been showed in table $^2{}_V$

Tab$_V{}^2{}_V$ b laine of Thanh l iem, Kim b ang, h a Nam limestone with difference grinding time

Sample	b laine, (cm²/g)
m$_1$	$_{22}$đ$_{3V1}{}^{11}$
m$_2$	3123V313
m$_3$	3331V^3 11

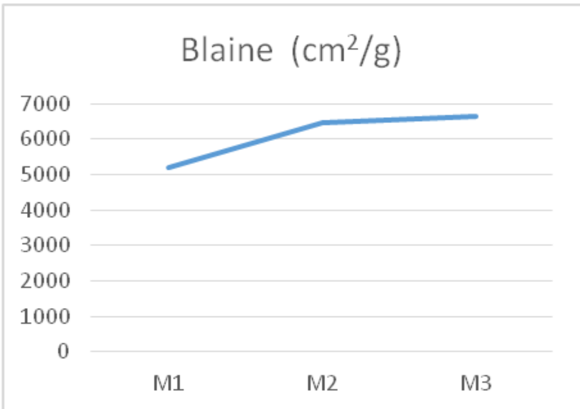


fig $_{V2V}$ b laine fineness of Thanh li em, Kim b ang, h a Nam limestone with different grinding time$_V$

fine ness of limestone corresponds to its b laine fineness$_V$

The fineness and b laine specific surface area of limestone increased with an increase in grinding time, but there is limited, it means when grinding time increase, the b laine fineness is not increased$_V$

4.2. Dimension distribution

Dimension of limestone with different grinding time have been described by figure $_{3V}$

4.3. Effect of inert limestone fineness on mechanical of cement concrete

ωa ter for standard consistence and initial and final setting time of cement concrete have been indicated in table ^{3}, $_1$đ $_V$

Tab$_V^{3}_V$ ω *ater for standard consistence*

Sample	g *rinding time* (*min*)	ω*a ter for standard consistence*, (*ml*)	Temperature (^{d}C)
m_1		12đ	33
m_2	2đ	11 1	2 3
m_3		11 1	31

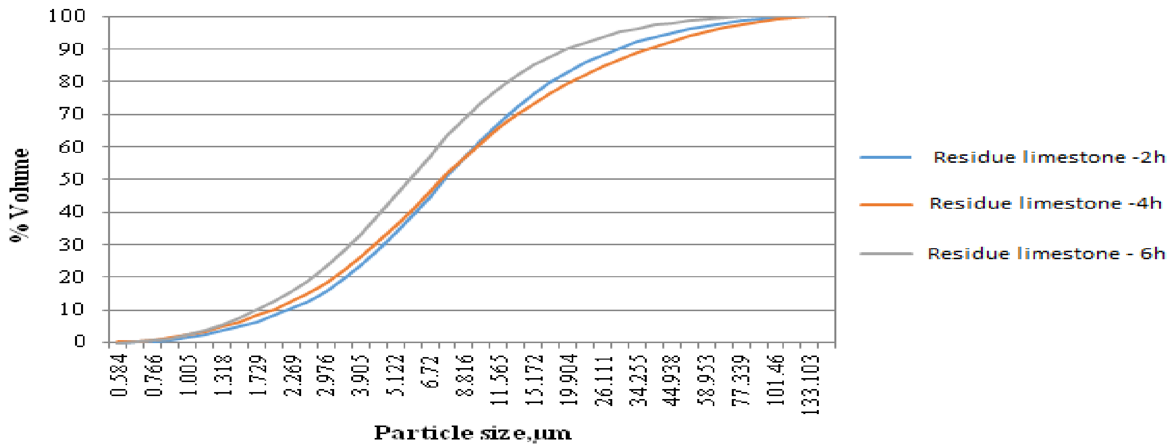


fig $_{V3V}$ Residue *of* Thanh li *em*, Kim b *ang*, h *a* N*am limestone with different grinding time*

This is explained by the fact that limestone samples have a larger percentage of fine particles and the shape of particle becoming sphere so the limestone particles are very flexible,

Tab$_{V1}$đ$_V$ $_I$*nitial and final setting time of cement concrete*

Sample	g *rinding time* (*min*)	$_I$*nitial setting time* (*min*)	*fina l setting time* (*min*)	Temperature (^{d}C)
m_1		1đ2	123	33
m_2	2đ	31	13 2	2 3
m_3		11đ	113	31

$_I$*f the fineness increases*, $_I$*nitial and final setting time trends to increase*$_V$ *This can be explained by the fact that limestone nanoparticles create a crystalline nucleus that accelerates the hydrolysis of cement to help cement cure rapidly*$_V$

4.4. Effect of inert limestone fineness on compressive strength of cement concrete

Result of compressive strength has been indicated in figure $_{1V}$

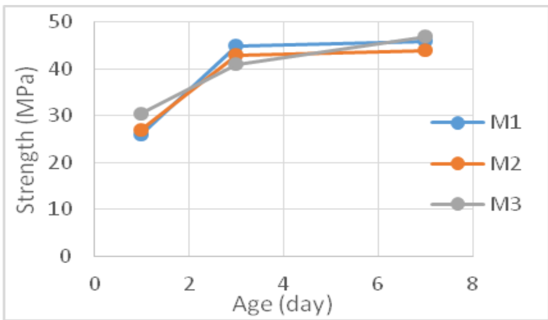
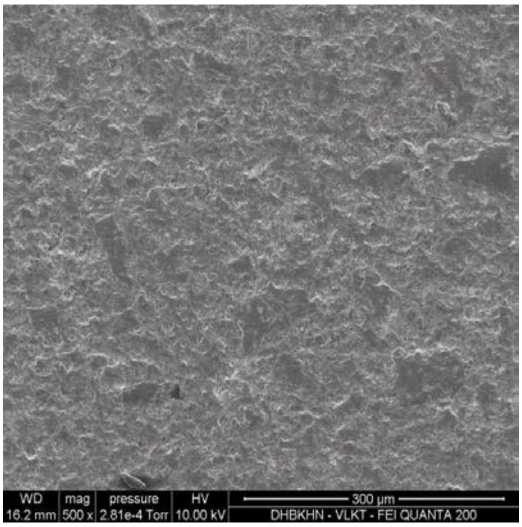


fig $_{V1V}$ *Compressive strength of sample* a *t the first day*, *when the dimension decreases*, *impressive strength increases*$_V$ b *ut at the third day and the seventh day strength does not increase when fineness increases*$_V$

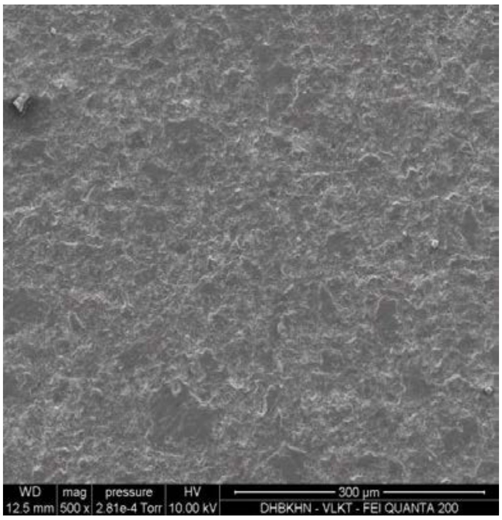
$_I$*t means the fineness of limestone affects the intensity of early age of the cement stone*$_V$ b *ecause nanoparticles of limestone create a crystalline nucleus that accelerates the hydration of cement to increase the early age of the cement stone*$_V$

$_I$*n addition*, *the combination of nano and microparticle limestone that cover and fill the porous holes among the hydration products is a major contributor to cement strength*$_V$

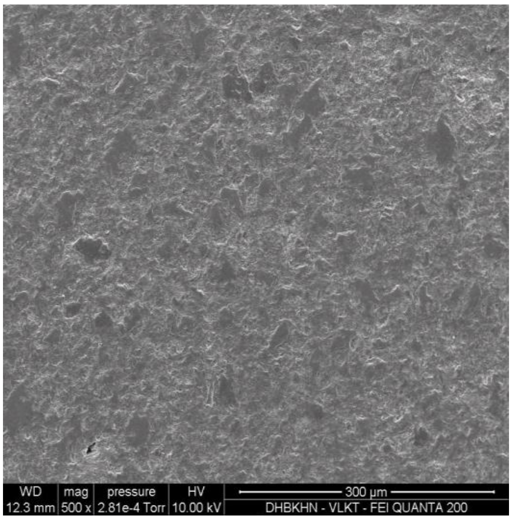
h *owever*, *the amount of nano and microsize limestone should be sufficient because of the increase in cement content*, *due to insufficient cement to bond these particles*, *thus it reduces the strength of the cement stone*$_V$



a, Sem m*đ* +$_2$*dđ*



b, Sem m$_1$ +$_2$*dd*



c, Sem m$_2$ +$_2$*dd*

fig $_{V2\ V}$ Sem *picture*

4.5. Impact on the porosity of the cement stone

The *image* $_1$ *showed that porosity of* m$_1$ *less than* m$_2$ *and* m$_3$ $_V$ *This is probably explained by the combination of* Nano *and micro limestone*$_V$ They *cover and fill the porous holes among the hydrated products*$_V$ a *nd it also explains that the main effect enhances the strength of the cement stone*$_V$

5. Conclusion

$_I$*nvestigations confirmed that nanoparticle limestone can be used as an inert additive to* *increase early compressive strength of cement motar*V

h*owever, flexible* b*laine fineness is about* 3*đđđ cm*²/gV T*o increase nanoparticle limestone not only consumes grinding energy but also improves properties of cement paste*V

References

δ1γ D*e* S*chutter*, g V e*ffect of limestone filler as mineral addition in self-compacting concrete*V *in* 33*t h* C*onference on* O*ur* ω*or ld in* C*oncrete* n S*tructures*d ‘R*ecent* a*dvances in the* T*echnology of* f*esh* C*oncrete*(Oω1 C$ 2đ11) V 2đ11V g*hent* τ *niversity*, D*epartment of* S*tructural engineering*V

δ2γ b*ui* v *an* C*hen*, C*ement* T*echnology*, h*anoi* τ *niversity of* S*cience and technology*, 1 33 3V