FECON
Listen to the Earth, Conquer the Height

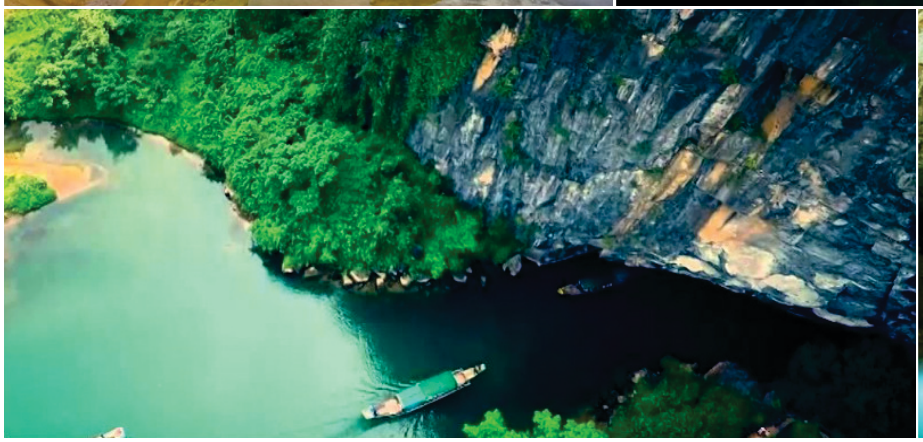
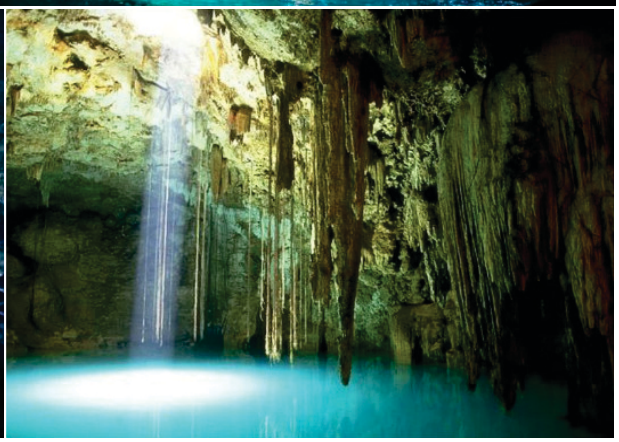
VIỆN THỦY CÔNG

YAMAGUCHI UNIVERSITY

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



SCIENCE AND TECHNICS PUBLISHING HOUSE

PROCEEDINGS OF THE 4th INTERNATIONAL CONFERENCE VIETGEO 2018

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

Quang Binh, 21&22 September 2018

INTERNATIONAL CONFERENCE
VIETGEO 2018

ORGANIZING COMMITTEE:

assoc. Prof. Ta Duc Thinh	Vice President, Vietnam
assoc. Prof. Le Hai An	Director, Vietnam
Dr. Nguyen Duc Ly	Quang Binh Department of Science and Technology
Prof. Motoyuki Suzuki	Yamaguchi University, Japan
assoc. Prof. Nguyen Huu Phuong	Vice President, Vietnam
assoc. Prof. Do Minh Duc	Vice President, Vietnam
Prof. Nguyen Quoc Dung	Hydraulic Construction Institute, Vietnam
Prof. Suksun Horpibulsuk	Suranaree University of Technology, Thailand
mr. Le Cao Minh	Technical World Co. Ltd, Vietnam
assoc. Prof. Nguyen Van Vuong	VNU Vice President University of Science, Vietnam
Prof. Dingwu Qi	Tongji University, China
assoc. Prof. Dau Van Ngo	Ho Chi Minh University of Technology, Vietnam
assoc. Prof. Do Quang Thien	Hue University of Science, Vietnam
assoc. Prof. Nguyen Quang Minh	Hanoi Vice President, Vietnam

SCIENTIFIC COMMITTEE:

Prof. Tran Thanh Hai	Hanoi Vice President, Vietnam
Prof. Motoyuki Suzuki	Yamaguchi University, Japan
Prof. emeritus. Hiroshi Matsuda	Yamaguchi University, Japan
Prof. Suksun Horpibulsuk	Suranaree University of Technology, Thailand
Prof. Pham Van Ty	Vice President, Vietnam
Prof. Nguyen Quoc Dung	Hydraulic Construction Institute, Vietnam
Prof. Faquan Wu	General Secretary of IAEG
Prof. Dingwu Qi	Tongji University, China
Dr. Kochi Toshifumi	Kyoei Tab - Geotechnical Consultant, Japan
assoc. Prof. Tran Manh Tuan	VNU Vice President University of Science, Vietnam

CONFERENCE SECRETARIAT:

Dr. Bui Truong Son	Hanoi Vice President, Vietnam
Dr. Bui Trong Vinh	HCMUT, Vietnam
Dr. Nguyen Chau Lan	UTC, Vietnam
Dr. Vu Ba Thao	Hydraulic Institute, Vietnam
Dr. Tran Thanh Nhan	Hanoi SC, Vietnam
Dr. Nguyen Van Phong	Hanoi Vice President, Vietnam
Dr. Nguyen Thi Nu	Hanoi Vice President, Vietnam
Dr. Nhu Viet Ha	Hanoi Vice President, Vietnam
msc. Nguyen Thanh Duong	Hanoi Vice President, Vietnam
msc. Duong Van Binh	Hanoi Vice President, Vietnam
msc. Nguyen Van Hung	Hanoi Vice President, Vietnam
msc. Vu Thai Linh	Hanoi Vice President, Vietnam
msc. Pham Thi Ngoc Ha	Hanoi Vice President, Vietnam
msc. Phung Huu Hai	Hanoi Vice President, Vietnam

PROCEEDINGS OF THE 4th INTERNATIONAL CONFERENCE VIETGEO 2018

QUANG BINH, VIETNAM
21&22 September 2018

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

Editors:

TA DUC THINH
PHAM VAN TY
NGUYEN HUY PHUONG
DO MINH DUC
BUI TRUONG SON
TRAN MANH LIEU
VU BA THAO

SCIENCE AND TECHNICS PUBLISHING HOUSE

INTERNATIONAL CONFERENCE

VIETGEO 2018

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

21&22 September 2018

QUANG BINH, VIETNAM

Organized by

v *ietnam* a *ssociation of* e *ngineering* g *eology and the* e *nvironment* (v a e g e)
h *anoi* τ *niversity of* mi *ning and* g *eology* (h τ mg)
Q*uang* b *inh* D*epartment of* S*cience and* T*echnology*
T*echnical* ω *orld* Co V l *td* (Tω)
fe CON C*orporation*
ι *amaguchi* τ *niversity*, J*apan*
Sura*naree* τ *niversity of* T*echnology*, T*hailand*
T*ongji* τ *niversity*, *China*
h *o Chi* mi *nh* τ *niversity of* T*echnology* (h Cmτ T)
h *ue* τ *niversity of* S*ciences* - h *ue* τ *niversity* (h τ SC)
v Nτ τ *niversity of* S*cience*, v *ietnam* N*ational* τ *niversity*, h *anoi* (v Nτ -h τ S)
h *ydraulic* C*onstruction* I *nstitute* (h *y*C I)

With the supports of

Q*uang* b *inh* D*epartment of* S*cience and* T*echnical* ω *orld* Co V l *td* (Tω)
fe CON C*orporation*
g mC I *nve stment and* D*evelopment* Co V l *td* V
R*esearch* C*enter for* T*echnology and* I *ndustrial* e *quipment*, h Cmτ T
τ *nion of* S*urvey and* C*onstruction* J V SC (τ SCO)
g *eotechnical* R*esearch* C*enre*, h τ mg
N*am* mi*en* T*rung* Co V l *td* V
h *anoi* C*onstruction* D*esign* I *nvestigation* C*onsultants* J V S V C
P*ower* e *ngineering* C*onsulting* J V SC I (Pe CC I)
h *ydraulic* C*onstruction* I *nstitute* (h *y*C I)

TABLE OF CONTENT

SeSSIO N 2
GEOTECHNICS FOR SUSTAINABLE DEVELOPMENT OF INFRASTRUCTURE

SESSION 3
GEOTECHNICAL MONITORING AND MATERIALS

SESSION 1
GEOHAZARDS AND SLOPE STABILITY

SeSS$_I$O N *2*
TECHNICAL NOTES

PREFACE

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

following the development and the success of the first conference in hue 2012 (huegeo 2012), *the second in* hanoi *in* 2013 (hanoigeo 2013), *the third in* halong *in* 2015 (vietgeo 2015), *the fourth international conference will be officially named* vietgeo 2017. *vietgeo 2017 is co-organized by the* vietnam association *of* engineering geology *and the* environment (vaege) c hanoi university *of* mining *and* geology (hτmg)c Quang binh Department *of* Science *and* Technologyc ιa maguchi τnive rsity, Japanc Suranaree τni versity *of* Technology, Thailandc Tongji τn iversity, Chinac ho Chi minh τni versity *of* Technology (hCm τT)c vNτ τn iversity *of* Science, vietnam National τniversit y hanoi (vNτ -hτS) c hue τniversi ty *of* Sciences - hue τnivers ity (hτSC)c hydraulic Construction Institute (hCI) *and* Technical ωorld Colτd (Tω) *on* 21st *and* 22nd September 2017 *in* Dong hoi city, Quang binh province, vietnam.

vietgeo 2017 *will focus on the following themes*d

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

vietgeo 2017 *has received many kind supports from* Quang binh Department *of* Science *and* Technology, Technical ωorld Colτd (Tω), feCO N Corporation, gmC Investment *and* Development Colτd (gmC), Research Center for Technology *and* Industrial equipment (ReCTIe) , τn ion *of* Survey *and* Construction JSC (τSC O), geotechnical Research Cenre - hτm g, Nam mien Trung Colτd, hanoi Construction Design Inves tigation Consultants JSC,Power engineering Consulting JSC1 (PeCC1), hydraulic Construction Institute (hyCI).

T*he organizing committee would like to express our sincere thanks and appreciations to all of participants and supporting institutions. 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 successful.*

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

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

REUSABILITY THE BOTTOM ASH FROM THERMAL POWER PLANT (CTPP) FOR GRADED MATERIALS AND CONCRETE AGGREGATE BASED ON PARTICLE SIZE DISTRIBUTION

Nguyen Thi Nu[1], Nguyen Ngoc Dung[1], Nhu Viet Ha[1], Duong Van Binh[1], Phan Tu Huong[2], Ta Thi Toan[1]

[1] h *anoi* τ *niversity of* m*ining and* geol*ogy*, v *ietnam*

[2] h *anoi* τ *niversity of* a *rchitectural*, v *ietnam*

Corresponding author' Email: nguyenthinu@humg.edu.vn

Abstractd T*his paper presents the results in particle size analysis of the ash* (*fly and bottom ashes*) *from coal thermal power plant and suggests direction of use them to form natural gradated material for pavement, cement concrete aggregate and building mortar*V T*he objects of this study are the ashes from* a *n* K*hanh and* C*ao* N*gan* CTPP, T*hai* N*guyen province*V T*he particle size of the ashes are analysised then compared to national standards* (TCv N*s*)V T*he results indicated that the ash from* a *n* K*hanh* CTPP *belongs to* C *or* D *grade, which can be used directly to form natural materials*V *In contrast, the particle size of the ash from* C*ao* N*gan* CTPP *needs to be improved for the standard grade*V f*or forming cement concrete aggregate and construction mortar, both ashes from two* CTPP*s need to be improved particle size for standard grade*V

Keywords: *ash*c*particle size*ec *coal thermal power plant*c *aggregate*V

1. Introduction

T*he ash from* CTPP*s has been studied to use in various fields by researchers around the world*V T*he results that applying in transport field such as* a *merican* C*oal* a *sh* a *ssociation* (2đđ3), b *ehera* (2đ1đ), R*evathi* (2đđ3)VI*n* 2đ1đ, C*etin*, a *ydilek et al also studied* Cb R *parameters and elastic modulus of mix of ash with recycled materials to form pavement as well as recommended fly ash content*V I*n soil treatment field,* I*smaiel* (2đđ3), e*dil*, a *costa et al*V(2đđ3) *studied the usage fly ash from* CTPP*s for fine grained soils*V T*hose results showed a prospect using the waste ash from coal thermal power plants on the world*V

I*n* v *ietnam*, CTPP *is now evaluated as an useful solution with low cost, short constructive time, low investment, and high capacity as a timely adapt in rising electricity for economic development*Vm*any* CTPP*s have been built such as* N*a* D*uong*, a *n* K*hanh*, C*ao* N*gan*, T*hai* b *inh*, v *inh* T*an*, D*uyen* h *ai*, *etc*V*in the last decades*V h *owever, the biggest problem of* CTPP*s is the ash* (*fly and bottom ash*), *which is light in weight, easily dispersible with metal components*V T*hey will be sources of environmental and ecological pollution when accumulated*V C*urrently, there were some studies about ash to use for roads by* b *ui* a *nh* T*uan* (2đ13), C*hu* T*hi* h *ong* N*han*, T*ran* N*goc* h *uy et al*V (2đ11), D*o* v *an* N*u* (2đ1 đ), N*guyen* m*anh* T*huy and* D*o* D*uc* T*uan* (2đđ2)V h*owever, the ashes have different characteristics that wasting from different* CTPP *thus studies to apply for different fields are very important and still a topical question*V

2. Materials and procedure

T*he object of the study is the ashes from* CTPP*s of* a *n* K*hanh and* C*ao* N*gan*, T*hai* N*guyen province*V T*he samples of ashes were taken in waste disposal sites of these* CTPP*s*V T*he principle of sampling according to two steps*d(1) *preliminary dividing areas that have uniform particle size on the basis of the survey all of the dumping sites*c *and* (2) *taking representative samples for areas that have the difference of identical particle size in the step* 1V

T*o determine the particle size of ash to evaluate the reuse them as natural materials for pavement structure according to* TCv N 22 2 1 d 2đ 11 (2đ11) , *we conducted particle size test according to* TCv N

using sieve size *to determine the particle size of ash to evaluate the reuse them as concrete aggregate and construction mortar according to* *with raw coarse aggregate on* *mm sieve, using screen sieve of* *with fine aggregate using sieve size* *and*

The ash samples were processed by () *drying in windy condition,* () *divided into* *parts, then extracting the standard weight and using the sieve method to analyze the particle size.* *The samples were sieved through the sieves and weighed the residue on the sieve, calculating the percentage content of the granules.* *for the purpose of evaluating the reuse them as a natural material for pavement structure, the screening* (μ) *is calculated and compared with the particle size of the natural materials within the standard grade boundary* () *for the purpose of evaluating the reuse of them as concrete aggregate and construction mortar, we need to determine the individual residue, cumulative residue, modulus,* D*max and* D*min of aggregates to compare with the allowable limits of particle size in the standard* ()

Testing were conducted at g*eotechnical* l*abor atory* la S -χ D *, eng ineering* g *eology* D*epartment,* h *anoi* τ *niversity of* mi *ning and* g *eology.*

3. Results and discussion

3.1. Evaluation of reusing ash as natural materials for pavement structure

The results of particle size analysis from samples taken at a *n* K*hanh and* C*ao* N*gan plants are shown in* T*able* - *and* f *igure* - *The results showed that the coal ash from* a *n* K*hanh plant* (T*able* , f*ig*) *has coarse particle size and non-uniform are much more than coal ash from* C*ao* N*gan plant* (T*able* , f *igure*)

T*ab* P*article size of ash samples from* a *n* K*hanh plant*

P*article size,*	S*creening* (*square sieve*), μ *mass*					
mm	a K	a K	a K	a K	a K	a K

T*ab* P*article size of ash samples from* C*ao* N*gan plant*

P*article size,*	S*creening* (*square sieve*), μ *mass*					
mm	CN	CN	CN	CN	CN	CN

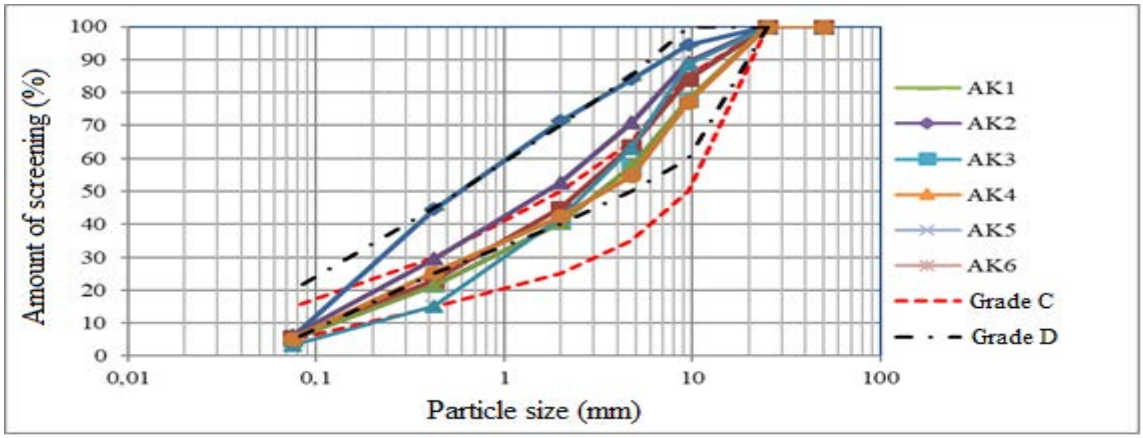


fig $_{V1V}$ P*article size of ash samples from* a *n* K*hanh plant and standard grade range*

T*ab*$_{V3V}$ P*article size of natural grade according to* TCv N $^{22}{}_{2}{}^{1}$d $_{2}đ_{11}$ ($_{2}đ_{11}$)

g *rade*	Screening (*square sieve*), µ *mass*						
	$_{2}đ$ *m m*	$_{22}$ *m m*	$^{3}{}_{,2}$ *m m*	$_{1}{}_{,}{}^{1}{}_{2}$ *m m*	$_{2}$,*đ m m*	*đ*,$_{122}$*m m*	*đ*,*đ*$^{1}{}_{2}$*m m*
a	$_{1}đđ$	-	$_{3}đ$ - $_{32}$	$_{22}$ - $_{22}$	$_{12}$ - $_{1}đ$	^{2} - $_{2}đ$	$_{2}$ - ^{2}
b	$_{1}đđ$	$^{1}{}_{2}$ - $^{3}{}_{2}$	$_{1}đ$ - $^{1}{}_{2}$	$_{3}đ$ - $_{3}đ$	$_{2}đ$ - $_{12}$	$_{1\,2}$ - $_{3}đ$	$_{2}$ - $_{2}đ$
C	-	$_{1}đđ$	$_{2}đ$ - $^{2}{}_{2}$	$_{32}$ - $_{32}$	$_{22}$ - $_{2}đ$	$_{12}$ - $_{3}đ$	$_{2}$ - $_{12}$
D	-	$_{1}đđ$	$_{3}đ$ - $_{1}đđ$	$_{2}đ$ - $^{2}{}_{2}$	$_{1}đ$ - $^{1}đ$	$_{22}$ - $_{12}$	$_{2}$ - $_{2}đ$

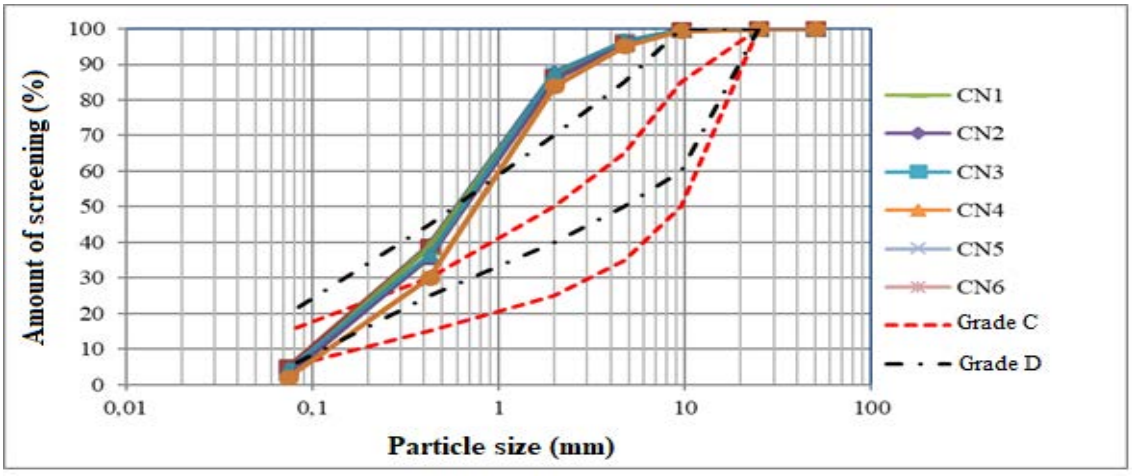


fig $_{V2V}$ P*article size of ash samples from* C*ao* N*gan plant and standard grade range*

a *ccording to* T*able* $_{3}$, *the coal ash from* C*ao* N*gan plant* (f *igure* $_{2}$) *is not classified as standard grade, while the coal ash from* a *n* K*hanh plant* (f*ig ure* $_{1}$) *is classified as type* C (*$_{1}$P$_{3}$ samples*) *and as type* D (*$_{2}$P$_{3}$ samples*)$_{V}$

a *ccording to the standard of particle size, the coal ash from* a *n* K*hanh plant is capable of direct reuse as a natural materials for the road pavement structure*$_{V}$ C*ao* N*gan coal ash can not be re-used directly*$_{V\,I}$*t is also necessary to add coarse grains and reduce fine grains according to the method of grade change*$_{V}$ T*he particle size of ash was calculated for* CN$_{1}$ *in accordance with natural grade of types* C *and* D *as shown in* T*ables* $_{1}$ *a nd* $_{2V}$ O*ther samples may use the same method to adjust the grade in accordance with standards*$_{V}$

T*ab*$_{V1V}$ *Calculation sheet for ash particle size in accordance with grade* C (TCv N $^{22}{}_{2}{}^{1}$d $_{2}$đ$_{11}$) *for* CN$_1$ - C*ao* N*gan plant*

P*article size, mm*	g *rade* S*tandard , type* C	CN$_1$				
		S*creening,* µ	C*ontent,* µ	a *ddP reduce* µ	N*ew content* µ	a *djusted screening,* µ
$_{2}$đ	-	$_{1}$đđ	đ,đ		đ,đ	$_{1}$đđ
$_{22}$	$_{1}$đđ,đ	$_{1}$đđ,đ	đ,đ	+đ	đ,đ	$_{1}$đđ
$^{3}{}_{,2}$	$_{2}$đ - $^{2}{}_{2}$	$^{33}{}_{,3}$	đ,$_{1}$	+$_{12}$	$_{12,1}$	$^{2}{}_{1}{}_{,3}$
$_{1}{}_{,}{}^{1}{}_{2}$	$_{32}$ - $_{32}$	$^{3}{}_{3}$,đ	$_{3,2}$	+$_{2}$đ	$_{23,2}$	$_{31}$,đ
$_{2}$	$_{22}$ - $_{2}$đ	$^{21}{}_{,}{}^{2}$	$^{2}{}_{,2}$	+$_{3}$	$_{11,2}$	$_{1}{}^{3}{}_{,}{}^{2}$
đ,$_{122}$	$_{12}$ - $_{3}$đ	$^{3}{}_{3}{}^{3}{}_{,2}$	$_{1}{}^{2}{}_{,3}$	-$_{2}{}^{2}$,đ	$_{2}$đ,$_{3}$	$_{2}{}^{3}{}_{,2}$
đ,đ$^{1}{}_{2}$	$_{2}$ - $_{12}$	$_{3,2}$	$_{32,3}$	-$_{2}$đ,đ	$_{12,3}$	$_{13,2}$

T*ab*$_{V2V}$ *Calculation sheet for ash particle size in accordance with grade* D (TCv N $^{22}{}_{2}{}^{1}$d $_{2}$đ$_{11}$) *for* CN$_1$ - C*ao* N*gan plant*

P*article size, mm*	g *rade standard type* C	CN$_1$				
		S*creening* µ	C*ontent* µ	a *ddP reduce* µ	N*ew content,* µ	a *djusted screening,* µ
$_{2}$đ	-	$_{1}$đđ	đ		đ,đ	$_{1}$đđ
$_{22}$	$_{1}$đđ	$_{1}$đđ,đ	đ,đ	+đ	đ,đ	$_{1}$đđ
$^{3}{}_{,2}$	$_{3}$đ - $_{1}$đđ	$^{33}{}_{,3}$	đ,$_{1}$	+đ	đ,$_{1}$	$^{33}{}_{,3}$
$_{1}{}_{,}{}^{1}{}_{2}$	$_{2}$đ - $^{2}{}_{2}$	$^{3}{}_{3}$,đ	$_{3,2}$	+đ	$_{3,2}$	$^{3}{}_{3}$,đ
$_{2}$	$_{1}$đ - ^{1}đ	$^{21}{}_{,}{}^{2}$	$^{2}{}_{,2}$	+đ	$^{2}{}_{,2}$	$^{21}{}_{,}{}^{2}$
đ,$_{122}$	$_{22}$ - $_{12}$	$^{3}{}_{3}{}^{3}{}_{,2}$	$_{1}{}^{2}{}_{,3}$	đ,đ	$_{1}{}^{2}{}_{,3}$	$^{3}{}_{3}{}^{3}{}_{,2}$
đ,đ$^{1}{}_{2}$	$_{2}$ - $_{2}$đ	$_{3,2}$	$_{32,3}$	-$_{13}$,đ	$_{1}{}^{3}{}_{,3}$	$_{1}{}^{3}{}_{,2}$
ζ đ,đ$^{1}{}_{2}$		đ,$_{2}$	$_{3,1}$			

f*rom the calculation tables, it is necessary to change the particle size* (T*able* $_{1}$) *to conform to the grade* C$_V$T*o be consistent with the grade* D (T*able* $_{2}$), *we need to reduce the particle size* đ$_V$đ$_2$ - đ$_{V122V}$

3.2. Evaluation of reusing ash as concrete aggregate and construction mortar

R*esults of particle analysis to evaluate the reuse of ash for concrete aggregate and construction mortar from samples taken at* a *n* K*hanh and* C*ao* N*gan plants are shown in* T*able* $_{3}$-$_{11V}$ T*he cumulative residues of the* a *n* K*hanh ash samples are shown in* T*able* $_{3}$ *and the* C*ao* N*gan plant in* T*able* $^{1}{}_{V}$ a *ccording to the data, ash content of both plants has both coarse aggregate* (*rubble*) *and fine aggregate* (*sand*)$_V$

T*ab*$_{V2\ V}$ T*he cumulative residues of the* an K*hanh ash samples*

P*article size*, *mm*	T*he cumulative residues* a $_i$, μ					
	a K_1	a K_2	a K_3	a K_1	a K_2	a K_3
- $_1$đ	đ,đ	đ,đ	đ,đ	đ,đ	đ,đ	đ,đ
$_2$đ	đ,$_2$	đ,^{2}	$_1$,^{3}	$_1$,^{1}	đ,đ	$_1$,^{3}
$_1$đ	$_2$,^{2}	$_{12}$,$_1$	$_1$^{3},^{3}	^{3},^{2}	$_1$,^{2}	$_{22}$,$_3$
$_2$	$_{13}$,^{2}	$^2_3$,$_2$	$_{13}$, $_2$	$_{31}$,^{1}	$^2_2$,^{2}	$_2$đ,^{1}
$_2$,$_2$	$_3$đ,$_1$	$^1_2$,$_3$	$_{31}$,đ	$_{21}$,^{2}	$_{23}$,$_3$	$_{33}$,$_1$
$_1$,$_{22}$	$_{33}$,$_1$	$_{31}$,đ	$_{33}$,^{1}	$^2_2$,$_3$	$_{32}$,đ	$^1_3$,đ
đ,$_{33}$	$_{12}$,$_1$	^{1}đ,^{3}	$^1_3$,$_3$	$_{33}$,$_1$	$^1_2$,$_2$	$^1_2$,$_3$
đ,$_{31}$	$_{33}$,^{3}	$^2_1$,$_3$	$^2_3$,$_3$	$_{12}$,$_1$	$^2_3$,$_3$	$^2_2$,$_1$
đ,$_{11}$	$^1_1$,$_2$	$^2_3$,^{1}	$_{22}$,$_2$	$^2_1$,$_2$	$^3_1$,$_1$	$_{21}$,$_1$
	C*ontent* μ					
ζ đ,$_{11}$	$_{22}$V$_2$^{1}	$_{13}$V$_{11}$	$_{11}$V$_2$^{3}	$_{11}$V$^3_2$	$^2_V$$_1$đ	$_{12}$V^{13}

T*ab*$_{V3\ V}$ T*he cumulative residues of the* C*ao* N*gan ash samples*

P*article size*, *mm*	T*he cumulative residues* a $_i$, μ					
	CN_1	CN_2	CN_3	CN_1	CN_2	CN_3
- $_1$đ	đ,đ	đ,đ	đ,đ	đ,đ	đ,đ	đ,đ
$_2$đ	đ,$_1$	đ,$_2$	đ,$_1$	đ,$_2$	đ,$_1$	đ,$_1$
$_1$đ	$_1$,^{2}	$_1$,2	3,3	$_1$,2	3,đ	$_2$,$_2$
$_2$	$_{11}$,$_3$	$_{11}$,3	$_{13}$,đ	$_1$ $_1$,$_2$	$_{11}$,$_2$	$_{13}$,$_2$
$_2$,$_2$	$_{22}$,^{1}	$_{23}$,đ	$_{21}$,$_1$	$_{22}$,^{2}	$^3_1$,đ	$_{22}$,đ
$_1$,$_{22}$	$_{33}$,$_2$	$^1_3$,$_2$	$_{33}$,$_2$	$^1_3$,^{2}	$_{33}$,^{1}	$_1$đ,$_1$
đ,$_{33}$	$^1_3$,$_1$	$^1_2$,$_2$	$^1_2$,đ	$^1_3$,$_3$	^{1}đ,$_1$	$^1_1$,$_1$
đ,$_{31}$	$^2_2$,^{3}	$^2_3$,$_3$	$^2_2$,^{3}	$^2_1$,$_1$	$^2_2$,$_3$	$^2_2$,$_2$
đ,$_{11}$	^{33},$_2$	^{33},^{3}	$^3_3$,^{3}	^{33},$_3$	^{33},$_1$	^{33},^{2}
	C*ontent*, μ					
ζ đ,$_{11}$	$_{13}$V$_2$^{2}	$_{13}$V$_3$đ	$_{13}$V^{32}	$_{12}$V$_1$^{2}	$^1_1$V$_2$đ	$_{11}$V$_{21}$

T*he results of the coarse grained* (*rubble*) *analysis show that the ash from* a *n* K*hanh plant* (T*able* ^{2}) *has a coarse grained content of* $_{13}$V^2 *to* $_2$đ$_{V3}$μ , *and* C*ao* N*gan ash* (T*able* ^{3}) *has a coarse grained content of* $_{2V}$^{32} *to* $_1$ V$^2_2$μ $_V$a *ccordingly*, *ash from* a *n* K*hanh plant has* $_3$ *samples that meet the standards of grading*, $_3$ *samples do not reach grade*$_V$ *for the use of coarse aggregate*, *we only need to add individual residue ai* (a K_1d a_1đ k + $_2$μ , a K_1 d a_1đ k + ^{3}μ , a K_2 da_1đ k + $_{23}$μ) *after remove fine grain to achieve cumulative residue at* $_1$đ -$_2$đm m *particle size*$_V$ a *s for* C*ao* N*gan ash*, *the grading is not within the permitted range*$_{V\ 1}$*n order to use them*, *we need to adjust the particle size to conform to the standard of grading method as shown in* T*able* $_1$ -$_{2V}$

T*ab*$_{V1\ V}$ C*ontent of coarse grained grade* (*rubble*) *according to standards and ash samples from* a *n* K*hanh plant*

P*roperties*			a K$_1$	a K$_2$	a K$_3$	a K$_1$	a K$_2$	a K$_3$	vN S*tandard*
C*umulative percent retained*, a *i*,μ	P*article size*, *mm*	^{1}đ	đ	đ	đ	đ	đ	đ	
		$_{1}$đ	đ	đ	đ	đ	đ	đ	đ
		$_{2}$đ	3	2	1	2	đ	1	đ-$_{1}$đ
		$_{1}$đ	32	$_{1}$đ	13	31	$_{1}^{1}$	12	$_{1}$đ -^{1}đ
		2	$_{1}$đđ	$_{1}$đđ	$_{1}$đđ	$_{1}$đđ	$_{1}$đđ	$_{1}$đđ	^{3}đ -$_{1}$đđ
	D*max*		$_{2}$đ	$_{2}$đ	$_{2}$đ	$_{2}$đ	$_{2}$đ	$_{2}$đ	$_{2}$đ
	D*min*		2	2	2	2	2	2	2
	R*emark*		f*ail*	P*ass*	P*ass*	f*ail*	f*ail*	P*ass*	P*ass*

T*ab*$_{V2\ V}$ C*ontent of coarse grained grade* (*rubble*) *according to standards and ash samples from* C*ao* N*gan plant*

P*roperties*			CN$_1$	CN$_2$	CN$_3$	CN$_1$	CN$_2$	CN$_3$	vN S*tandard*
C*umulativ e percent retained*, a *i*,μ	P*article size*, *mm*	^{1}đ	đ	$_{1}$	2	3	1	2	
		$_{1}$đ	đ	đ	đ	đ	đ	đ	đ
		$_{2}$đ	1	1	2	1	3	2	đ-$_{1}$đ
		$_{1}$đ	22	23	23	22	23	23	$_{1}$đ -^{1}đ
		2	$_{1}$đđ	$_{1}$đđ	$_{1}$đđ	$_{1}$đđ	$_{1}$đđ	$_{1}$đđ	^{3}đ -$_{1}$đđ
	D$_{max}$		$_{2}$đ	$_{2}$đ	$_{2}$đ	$_{2}$đ	$_{2}$đ	$_{2}$đ	$_{2}$đ
	D$_{min}$		2	2	2	2	2	2	2
	R*emark*		f*ail*	f*ail*	f*ail*	f*ail*	f*ail*	f*ail*	P*ass*

T*he results of the fine grained grade* (*sand*) *analysis showed that the* a *n* K*hanh ash* (T*able* $_{1}$đ) *had a fine grained content of* $_{11V}^{3}$ *to* $_{3}$đ$_{V2}$μ $_{V}$C*ao* N*gan ash had the fine grained content of* $_{1\ 2V1}$ *to* $_{1}^{1}$V^{1}μ $_{V}$a *ccordingly*, *the ashes from both plant did not meet the particle size requirements for construction concrete*$_{V}$ω *hen used for construction concrete*, *it is possible to adjust the particle size to conform to the standard according to the grading method*, *as shown in* T*able* $_{1}$ -$_{2V}$

T*ab*$_{V3\ V}$ C*ontent of fine grained grade* (*sand*) *according to standards and ash samples from* a *n* K*hanh plant*

P*roperties*			a K$_1$	a K$_2$	a K$_3$	a K$_1$	a K$_2$	a K$_3$	vN S*tandard*
C*umulativ e percent retained*, a *i*,μ	P*article size*, *mm*	2 ,2	1 3 ,đ	3 1 ,2	3 1 ,đ	2 ^{3} ,3	3 1 ,^{1}	2 2 V2	đ-$_{2}$đ
		1 ,2 2	2 3 ,3	1 1 ,2	1 1 ,1	3 ^{3} ,2	1 ^{1} ,đ	3 3 V2	12 -12
		đ,3 3	3 1 ,1	2 2 ,^{3}	2 2 ,^{3}	2 đ,^{2}	3 1 ,2	1 1 V^{1}	32 -^{1}đ
		đ,3 1 1	2 3 ,^{2}	^{1} đ,3	^{1} 1 ,2	3 ^{2} ,3	^{2} 1 ,3	3 3 V^{2}	32 -^{3}đ
		đ,1 1	3 ^{3} ,2	1 2 ,3	^{2} đ,đ	1 1 ^{3}	2 2 ,1	^{1} 1 ,đ	^{3}đ -$_{1}$đđ
C*ontent*, μ		ζ đ,1 1	3 đ,2	2 1 ,1	2 đ,đ	2 2 ,1	1 1 ,^{3}	2 3 ,đ	ζ $_{1}$đ
f*in eness* m*o dulus*, m$_k$			2 ,đ	2 ,^{1}	2 ,^{2}	2 ,^{1}	3 ,1	2 ,1	2 ,đ-3 ,3
S*and classification*			C*oarse sand*						
R*emark*			f*ail*						P*ass*

T*ab*$_{V}^{1}$ $_{V}$ C*ontent of fine grained grade* (*sand*) *according to standards and ash samples from* C*ao* N*gan plant*

P*roperties*			CN$_1$	CN$_2$	CN$_3$	CN$_1$	CN$_2$	CN$_3$	v *ietnam* S*tandard*
C*umulative*		2,2	1đ,3	1đ,^{1}	1đ,1	1đ,2	^{2,3}	11 ,^{1}	đ-2đ
percent	P*article*	1,22	^{2,3}1	^{3}1,3	^{3}1,1	^{3}1,3	13,3	2đ,^{1}	12 -12
retained,	*size,*	đ,33	33,3	31,3	32,đ	32,đ	31,^{2}	^{1}3,đ	32 -^{1}đ
a *i,*μ	*mm*	đ,311	^{1}2,3	^{1}1,1	^{1}3,3	^{1}2,3	^{1}đ,đ	^{2}2,^{2}	32 -^{3}đ
		đ,11	^{2}2,^{1}	^{2}3,đ	^{2}2,đ	^{2}3,^{1}	^{2}2,3	^{2}1,3	^{3}đ -$_{1}$đđ
C*ontent,* μ		ζ đ,11	^{1}1,3	^{1}1,đ	12,đ	13,3	^{1}1,^{1}	12,1	ζ $_{1}$đ
f*ine ness* mod*ulus,* m$_k$			2,1^{2}	2,2	2,2	2,2	2,1	2,3	2,đ -3,3
S*and classification*						C*oarse sand*			
R*emark*						f*ai l*			P*ass*

4. Conclusion and recommendations

T*he particle size of the coal ashes are varied, depending on the technology and input materials of the plants*$_{V}$ a *t each plant, there is also a certain nonuniformity due to the difference between the batches*$_{V}$

a *ccording to the standards for particle size grade, the* a *n* K*hanh coal ashes are suitable for natural materials of grades* C *or* D, *so they can be recycled directly as natural materials for pavement structure*$_{V}$ C*ao* N*gan coal ashes are not able to directly reuse, to re-use them as natural materials, we need to change their grade according to natural grade type* C *or* D$_{V}$

ω*i th the ability to reuse ash for concrete aggregate and construction mortar, the coarse aggregates from* a *n* K*hanh ashes can be used directly in concrete or add a content from* $_{2}$ *to* $_{23}$μ *to particle size* $_{2}$đm m-$_{1}$đ mm$_{V}$ me*anwhile, the fine aggregate of the ashes at both plants are not up to standard, we need to change the particle size to meet the requirements*$_{V}$

$_{I}$*n order to completely evaluate the reuse of coal ash as natural materials, concrete aggregate and construction mortar*c ω*e need to study more characteristics according to the specialized standards*$_{V}$

References

δ$_1$γ a *merican* C*oal* a *sh* a *ssociation* ($_{2}$đ đ$_{3}$) $_{V}$ f*ly ash facts for highway engineers,* τ S D*epartment of* T*ransportation,* f *ederal* h *ighway* a *dministration*$_{V}$

δ$_2$γ b *ehera,* R$_{V}$ K$_{V}$ ($_{2}$đ$_{1}$đ) $_{V}$ C*haracterization of* f*ly ash for their effective management and utilization*$_{V}$

δ$_3$γ b *ui* a *nh* T*uan* ($_{2}$đ$_{13}$)$_{V}$ T*o study the proper use of waste ash from coal power plants in road construction*$_{V}$ P*h*D *thesis,* τ *niversity of* T*ransport,* h *anoi*$_{V}$

δ$_1$γ C*hu* T*hi* h *ong* N*han,* T*ran* N*goc* h *uy and* N*guyen* h *uu* T*ri* ($_{2}$đ$_{11}$)$_{V}$ g *ravel aggregate in fly ash cement coated with asphalt mortar for rural roads*$_{V}$ a *nnual* S*cientific and* T*echnological* C*onference,* $_{I}$*nstitute of* T*ransport* S*cience and* T*echnology*$_{V}$

δ$_2$γ D*o* v *an* N*u* ($_{2}$đ$_{1}$ đ)$_{V}$ T*he application of new technologies and materials in the construction of rural roads*$_{V}$ D*epartment of* S*cience and* T*echnology of* h *ung* ι *en* P*rovince*$_{V}$

δ$_3$γ e*di l,* T$_{V}$b $_{V}$,h $_{V}$a $_{V}$a *costa and* C$_{V}$h $_{V}$b *enson* ($_{2}$đđ$_{3}$)$_{V}$ "S*tabilizing soft fine-grained soils with fly ash*$_{V}$" J*ournal of* m *aterials in* C*ivil* e*ng ineering* $_{1}^{2}$($_{2}$) d$_{2}^{2}$ $_{3}$ -$_{2}^{3}$ $_{1V}$

δ^{1}γ $_{I}$*smaiel,* h $_{V}$a $_{V}$h $_{V}$($_{2}$ đđ$_{3}$) $_{V}$ T*reatment and improvement of the geotechnical properties of different soft fine-grained soils using chemical stabilization,* S*haker*$_{V}$

δ^{2}γ N*guyen* m*anh* T*huy and* D*o* D*uc* T*uan* ($_{2}$đđ$_{2}$)$_{V}$ S*ome results of researching reinforced soil material by fly ash cement in the pavement structure in* T*ay* N*inh province*$_{V}$ T*he* ^{3}*t h* S*cience and* T*echnology*

C*onference*, h *o* C*hi* m*inh* C*ity* τ *niversity of* T*echnology*$_V$

$\delta^3\gamma$ R*evathi*, v $_V$ ($_2đđ^3$) $_V$ "S*tudies on the properties of* h *igh volume fly ash gypsum slurry* ω*i th quarry waste and its use in* P*avement base course*$_V$"

$\delta_1đ\gamma$ TCv N $^{22}{}_2{}^1$d $_2đ_{11}$ ($_2đ_{11}$) $_V$ N*atural* a *ggregate for* R*oad* P*avement* l*ay ers* S*pecification for* m*aterial*, C*onstruction and* a*cce ptance*$_V$ h*a* N*oi*$_V$