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**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



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Quang Binh, 21&22 September 2018

INTERNATIONAL CONFERENCE VIETGEO 2018

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DEVELOPMENT OF INFRASTRUCTURE**

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**21&22 September 2018
QUANG BINH, VIETNAM**

Organized by

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Hanoi University of Mining and Geology (HUMG)
Quang Binh Department of Science and Technology
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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 (VietGeo 2012), the second in Hanoi (HanoiGeo 2012), the third in Ha Long (VietGeo 2013), the fourth international conference will be officially named VietGeo 2018. VietGeo 2018 is co-organized by the Vietnam Association of Engineering Geology and the Environment (VAEGE) - Hanoi University of Mining and Geology (HUMG), Quang Binh Department of Science and Technology (QBDST), Yamaguchi University, Japan, Suranaree University of Technology, Thailand, Tongji University, China, Ho Chi Minh University of Technology (HCMUT), VNU - University of Science, Vietnam National University Hanoi (VNU-HUS), Hue University of Sciences - Hue University (HUSC), Hydraulic Construction Institute (HC1) and Technical World Co., Ltd (TWO) on 21st and 22nd September 2018 in Dong Hoi city, Quang Binh province, Vietnam.

VietGeo 2018 will focus on the following themes:

- 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 materials.

VietGeo 2018 has received many kind supports from Quang Binh Department of Science and Technology, Technical World Co., Ltd (TWO), FECON Corporation, GMCI Investment and Development Co., Ltd (GMCI), Research Center for Technology and Industrial Equipment (ReCTIE), Union of Survey and Construction JSC (USVC), geotechnical Research Centre - HUMG, Nam Mien Trung Co., Ltd, Hanoi Construction Design Investigation Consultants JSC (HVIC), Power Engineering Consulting JSC (PEC1), Hydraulic Construction Institute (HC1).

The 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.

We 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

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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

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Abstract This 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 graded material for pavement, cement concrete aggregate and building mortar. The objects of this study are the ashes from a n Khanh and Cao Ngan CTPP, Thai Nguyen province. The particle size of the ashes are analysed then compared to national standards (TCVN). The results indicated that the ash from a n Khanh CTPP belongs to C or D grade, which can be used directly to form natural materials. In contrast, the particle size of the ash from Cao Ngan CTPP needs to be improved for the standard grade for forming cement concrete aggregate and construction mortar, both ashes from two CTPPs need to be improved particle size for standard grade.

Keywords: ash, particle size, coal thermal power plant, aggregate

1. Introduction

The ash from CTPPs has been studied to use in various fields by researchers around the world. The results that applying in transport field such as American Coal Ash Association (ACAA), Behara (2011), Revathi (2013), Cetin, Aydin et al also studied CBR parameters and elastic modulus of mix of ash with recycled materials to form pavement as well as recommended fly ash content in soil treatment field, Ismaiel (2013), Edil, Costa et al (2013) studied the usage fly ash from CTPPs for fine grained soils. Those results showed a prospect using the waste ash from coal thermal power plants on the world.

In Vietnam, 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. Many CTPPs have been built such as Na Duong, a n Khanh, Cao Ngan, Thai Binh, Vinh Tan, Duyen Hai, etc. In the last decades, however, the biggest problem of CTPPs is the ash (fly and bottom ash), which is light in weight, easily dispersible with metal components. They will be

sources of environmental and ecological pollution when accumulated. Currently, there were some studies about ash to use for roads by Bui Anh Tuan (2013), Chu Thi Hong Nhan, Tran Ngoc Huy et al (2011), Do Van Nu (2011), Nguyen Manh Thuy and Do Duc Tuan (2012) however, 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.

2. Materials and procedure

The object of the study is the ashes from CTPPs of a n Khanh and Cao Ngan, Thai Nguyen province. The samples of ashes were taken in waste disposal sites of these CTPPs. The principle of sampling according to two steps: (1) preliminary dividing areas that have uniform particle size on the basis of the survey all of the dumping sites and (2) taking representative samples for areas that have the difference of identical particle size in the step 1.

To determine the particle size of ash to evaluate the reuse them as natural materials for pavement structure according to TCVN 222-1:2011 (2011), we conducted particle size test according to TCVN

$1_{22}^1 - 2d_{2dd_3} (2dd_3)$ using sieve size $2dc_{22} c^3 c_{2c}$ $1_{2c}^1 - 2c_{d_{122} c} d_{v1}^1 mm_V$ To determine the particle size of ash to evaluate the reuse them as concrete aggregate and construction mortar according to TCVN $1_{22}^1 - 2d_{2dd_3} (2dd_3)_V$ with raw coarse aggregate on 2mm sieve, using screen sieve of $1dc^1 dc^1 dc^1 dc^2 mm_V$ with fine aggregate using sieve size $2v2c^1 - 2c^2 d_{v33} c d_{v312}$ and $d_{v11} mm_V$

The ash samples were processed by (1) drying in windy condition, (2) divided into 1 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 (TCVN $22^1 - d_{2d_{11}})_V$ 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, Dmax and Dmin of aggregates to compare with the allowable limits of particle size in the standard (TCVN $1_{22}^1 - 2d_{2dd_3})_V$

Testing were conducted at geotechnical laboratory la S - χD_{32}^2 , engineering geology Department, hanoi university of mining and geology.

3. Results and discussion

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

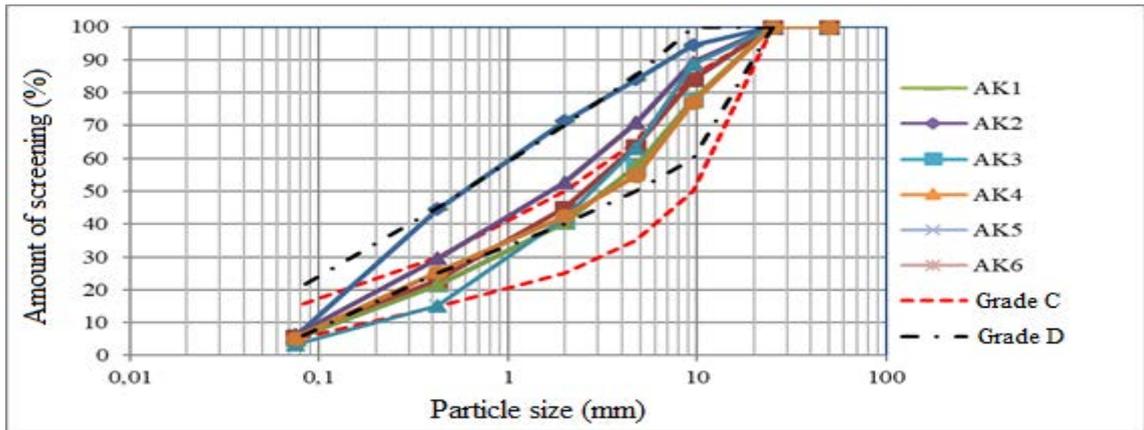
The results of particle size analysis from samples taken at a n Khanh and Cao Ngan plants are shown in Table 1 - 2 and figure 1 - 2. The results showed that the coal ash from a n Khanh plant (Table 1, fig 1) has coarse particle size and non-uniform are much more than coal ash from Cao Ngan plant (Table 2, figure 2).

Tab_{V1V} Particle size of ash samples from a n Khanh plant

Particle size, mm	Screening (square sieve), μ mass					
	a K ₁	a K ₂	a K ₃	a K ₁	a K ₂	a K ₃
$2d$	$1dd,d$	$1dd,d$	$1dd,d$	$1dd,d$	$1dd,d$	$1dd,d$
22	$1dd,d$	$33,d$	$32_{,2}$	$32_{,2}$	$1dd,d$	$32_{,3}$
$3_{,2}$	$3_{1,1}$	$2_{,3}$	$11_{,1}$	$23_{,2}$	$3d_{,3}$	$11_{,d}$
$1_{,2}^1$	$2_{1,d}$	$33_{,1}$	$2_{,2}$	$1d_{,2}$	$32_{,1}$	$21_{,2}$
$1_{,2}^1$	$1_{1,1}$	$12_{,d}$	$1d_{,3}$	$22_{,2}$	$13_{,3}$	$12_{,2}$
$d_{,122}$	$11_{,2}$	$23_{,d}$	$21_{,2}$	$2_{,3}$	$1_{,3}$	$22_{,1}$
d,d^1_2	$1_{,1}$	$3_{,2}$	$1_{,2}$	$3_{,2}$	$1_{,3}$	$2_{,1}$
$\zeta d,d^1_2$	$d_{,1}$	$d_{,1}$	$d_{,1}$	$1_{,2}$	d,d	$d_{,1}$

Tab_{V1V} Particle size of ash samples from Cao Ngan plant

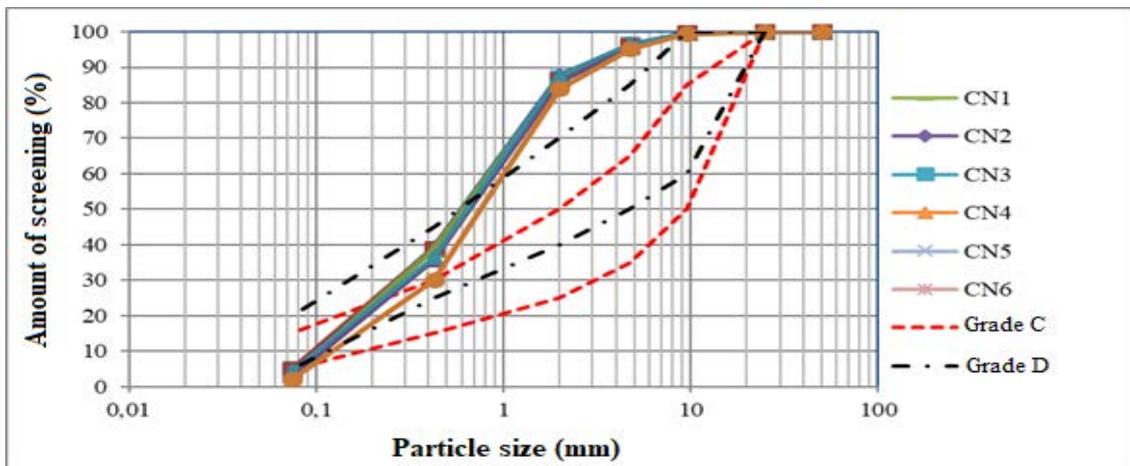
Particle size, mm	Screening (square sieve), μ mass					
	CN ₁	CN ₂	CN ₃	CN ₁	CN ₂	CN ₃
$2d$	$1dd$	$1dd$	$1dd$	$1dd$	$1dd$	$1dd$
22	$1dd$	$1dd$	$1dd$	$1dd$	$1dd$	$1dd$
$3_{,2}$	33_{V3}	$33_{,1}$	$33_{,1}$	33_{V2}	$33_{,2}$	33_{V1}
$1_{,2}^1$	3_{3Vd}	3_{3V1}	3_{3V2}	3_{2V3}	3_{3V3}	3_{2V2}
$1_{,2}^1$	$21_{,2}$	2_{3V2}	$21_{,d}$	2_{2V3}	$21_{,3}$	2_{1Vd}
$d_{,122}$	3_{3V2}	3_{3Vd}	2_{3V}	$32V^2$	$33V1$	$3d_{Vd}$
d,d^1_2	$3V2$	$2Vd$	$3V3$	$3Vd$	$1V2$	$2V1$
$\zeta d,d^1_2$	d_{V2}	d_{V1}	d_{V2}	d_{V2}	d_{V2}	d_{V2}



fig_{V1V} Particle size of ash samples from a n Khanh plant and standard grade range

Tab_{V3V} Particle size of natural grade according to TCv N²²₂^{1d} ₂^d₁₁ (₂^d₁₁)

g rade	Screening (square sieve), μ mass						
	₂ ^d m m	₂₂ m m	₃ ² m m	₁ ¹ ₂ m m	₂ ^d m m	_d ¹ ₂₂ m m	_d ¹ ₂ m m
a	₁ ^d _d	-	₃ ^d - ₃₂	₂₂ - ₂₂	₁₂ - ₁ ^d	₂ ² - ₂ ^d	₂ ² - ₂ ²
b	₁ ^d _d	₁ ² - ₃ ²	₁ ^d - ₂ ¹	₃ ^d - ₃ ^d	₂ ^d - ₁₂	₁₂ - ₃ ^d	₂ ² - ₂ ^d
C	-	₁ ^d _d	₂ ^d - ₂ ²	₃₂ - ₃₂	₂₂ - ₂ ^d	₁₂ - ₃ ^d	₂ ² - ₁₂
D	-	₁ ^d _d	₃ ^d - ₁ ^d _d	₂ ^d - ₂ ²	₁ ^d - ₁ ^d	₂₂ - ₁₂	₂ ² - ₂ ^d



fig_{V2V} Particle size of ash samples from Cao Ngan plant and standard grade range

according to Table 3, the coal ash from Cao Ngan plant (figure 2) is not classified as standard grade, while the coal ash from a n Khanh plant (figure 1) is classified as type C (₁^{P₃ samples) and as type D (₂^{P₃ samples).}}

according to the standard of particle size, the coal ash from a n Khanh plant is capable of direct reuse as a natural materials for the road pavement

structure. Cao Ngan coal ash can not be re-used directly. It is also necessary to add coarse grains and reduce fine grains according to the method of grade change. The particle size of ash was calculated for CN₁ in accordance with natural grade of types C and D as shown in Tables 1 and 2. Other samples may use the same method to adjust the grade in accordance with standards.

Tab_{VIV} Calculation sheet for ash particle size in accordance with grade C (TCv N^{22,1}d₂d₁₁) for CN₁ - Cao Ngan plant

Particle size, mm	g grade Standard, type C	CN ₁				
		Screening, μ	Content, μ	a ddReduce μ	New content μ	a djusted screening, μ
d_2	-	$1dd$	d,d		d,d	$1dd$
22	$1dd,d$	$1dd,d$	d,d	$+d$	d,d	$1dd$
$3_{,2}$	$2d - 2_2$	$33_{,3}$	$d_{,1}$	$+12$	$12_{,1}$	$2_{1,3}$
$1_{1,2}$	$32 - 32$	$3_{3,d}$	$3_{,2}$	$+2d$	$23_{,2}$	$31_{,d}$
2	$22 - 2d$	21_2	$2_{,2}$	$+3$	$11_{,2}$	3_2
$d_{,122}$	$12 - 3d$	$3_{,2}$	$1_{,3}$	$-2_{,d}$	$2d_{,3}$	$2_{,2}$
d,d^1_2	$2 - 12$	$3_{,2}$	$32_{,3}$	$-2d,d$	$12_{,3}$	$13_{,2}$

Tab_{V2V} Calculation sheet for ash particle size in accordance with grade D (TCv N^{22,1}d₂d₁₁) for CN₁ - Cao Ngan plant

Particle size, mm	g grade standard type C	CN ₁				
		Screening μ	Content μ	a ddReduce μ	New content, μ	a djusted screening, μ
d_2	-	$1dd$	d		d,d	$1dd$
22	$1dd$	$1dd,d$	d,d	$+d$	d,d	$1dd$
$3_{,2}$	$3d - 1dd$	$33_{,3}$	$d_{,1}$	$+d$	$d_{,1}$	$33_{,3}$
$1_{1,2}$	$2d - 2_2$	$3_{3,d}$	$3_{,2}$	$+d$	$3_{,2}$	$3_{3,d}$
2	$1d - 1d$	21_2	$2_{,2}$	$+d$	$2_{,2}$	21_2
$d_{,122}$	$22 - 12$	$3_{,2}$	$1_{,3}$	d,d	$2_{1,3}$	$3_{3,2}$
d,d^1_2	$2 - 2d$	$3_{,2}$	$32_{,3}$	$-13_{,d}$	$3_{1,3}$	$3_{1,2}$
$\zeta d,d^1_2$		$d_{,2}$	$3_{,1}$			

from the calculation tables, it is necessary to change the particle size (Table 1) to conform to the grade C_v. To be consistent with the grade D (Table 2), we need to reduce the particle size $d_{v,d_2} - d_{v,122}$.

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

Results of particle analysis to evaluate the reuse of ash for concrete aggregate and construction

mortar from samples taken at a n Khanh and Cao Ngan plants are shown in Table 3_{-11V}. The cumulative residues of the a n Khanh ash samples are shown in Table 3 and the Cao Ngan plant in Table 1_v according to the data, ash content of both plants has both coarse aggregate (rubble) and fine aggregate (sand)_v.

Tab_{V2V} The cumulative residues of the an Khanh ash samples

Particle size, mm	The cumulative residues a _i , μ					
	a K ₁	a K ₂	a K ₃	a K ₁	a K ₂	a K ₃
^{-1}d	d,d	d,d	d,d	d,d	d,d	d,d
$_{2}d$	$d_{,2}$	$d_{,2}$	$_{1,}^3$	$_{1,}^1$	d,d	$_{1,}^3$
$_{1}d$	$_{2,}^2$	$_{12,}1$	$_{1,}^3$	$_{,}^2$	$_{1,}^2$	$_{22,}3$
$_{2}$	$_{13,}^2$	$_{3,}^2$	$_{13,}^2$	$_{31,}^1$	$_{2,}^2$	$_{2d,}^1$
$_{2>2}$	$_{3d,}1$	$_{2,}^1$	$_{31,}d$	$_{21,}^2$	$_{23,}3$	$_{33,}1$
$_{1>22}$	$_{33,}1$	$_{31,}d$	$_{33,}^1$	$_{2,}^2$	$_{32,}d$	$_{3,}^1$
$d_{,33}$	$_{12,}1$	$_{1d,}^3$	$_{3,}^1$	$_{33,}1$	$_{1,}^2$	$_{2,}^3$
$d_{,311}$	$_{33,}^3$	$_{2,}^1$	$_{3,}^2$	$_{12,}^2$	$_{2,}^3$	$_{2,}^2$
$d_{,11}$	$_{1,}^1$	$_{3,}^2$	$_{22,}^2$	$_{1,}^2$	$_{3,}^1$	$_{21,}^1$
Content μ						
$\zeta d_{,11}$	$_{22V2,}^1$	$_{13V11}$	$_{11V2,}^3$	$_{11V2,}^3$	$_{2V1d}$	$_{12V,}^{13}$

Tab_{V3V} The cumulative residues of the Cao Ngan ash samples

Particle size, mm	The cumulative residues a _i , μ					
	CN ₁	CN ₂	CN ₃	CN ₁	CN ₂	CN ₃
^{-1}d	d,d	d,d	d,d	d,d	d,d	d,d
$_{2}d$	$d_{,1}$	$d_{,2}$	$d_{,1}$	$d_{,2}$	$d_{,1}$	$d_{,1}$
$_{1}d$	$_{1,}^2$	$_{1,}2$	$_{3,}3$	$_{1,}2$	$_{3,}d$	$_{2,}2$
$_{2}$	$_{11,}3$	$_{11,}3$	$_{13,}d$	$_{11,}2$	$_{11,}2$	$_{13,}2$
$_{2>2}$	$_{22,}^1$	$_{23,}d$	$_{21,}1$	$_{22,}^2$	$_{1,}^3$	$_{22,}d$
$_{1>22}$	$_{33,}2$	$_{3,}^1$	$_{33,}2$	$_{3,}^2$	$_{33,}^1$	$_{1d,}1$
$d_{,33}$	$_{3,}^1$	$_{2,}^2$	$_{2,}^1$	$_{3,}^3$	$_{1d,}1$	$_{1,}^1$
$d_{,311}$	$_{2,}^3$	$_{2,}^3$	$_{2,}^3$	$_{1,}^2$	$_{2,}^3$	$_{2,}^2$
$d_{,11}$	$_{33,}^2$	$_{33,}^3$	$_{3,}^3$	$_{33,}^3$	$_{3,}^1$	$_{33,}^2$
Content, μ						
$\zeta d_{,11}$	$_{13V2,}^2$	$_{13V3d}$	$_{13V,}^{32}$	$_{12V1,}^2$	$_{1Vd2}$	$_{11V21}$

The results of the coarse grained (rubble) analysis show that the ash from a n Khanh plant (Table 2) has a coarse grained content of $_{13V2,}^2$ to $_{2dV3,}^1$, and Cao Ngan ash (Table 3) has a coarse grained content of $_{2V,}^{32}$ to $_{1V,}^2$ accordingly, ash from a n Khanh plant has 3 samples that meet the standards of grading, 3 samples do not reach grade for the use of coarse aggregate, we only need to

add individual residue a_i (a K₁d a₁d k + 2μ, a K₁d a₁d k + 3μ, a K₂da₁d k + 23μ) after remove fine grain to achieve cumulative residue at $_{1d-2dm}$ m particle size, a s for Cao Ngan ash, the grading is not within the permitted range, in order to use them, we need to adjust the particle size to conform to the standard of grading method as shown in Table 1-2V

Tab_{V1V} Content of coarse grained grade (rubble) according to standards and ash samples from a n Khanh plant

Properties		a K ₁	a K ₂	a K ₃	a K ₁	a K ₂	a K ₃	vN Standard	
		¹ <i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>		
Cumulative percent retained, a i,μ	Particle size, mm	¹ <i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	
		² <i>d</i>	3	2	1	2	<i>d</i>	1	<i>d</i> - ¹ <i>d</i>
		¹ <i>d</i>	32	¹ <i>d</i>	13	31	¹	12	¹ <i>d</i> - ¹ <i>d</i>
		2	¹ <i>dd</i>	³ <i>d</i> - ¹ <i>dd</i>					
D _{max}		² <i>d</i>	² <i>d</i>	² <i>d</i>	² <i>d</i>	² <i>d</i>	² <i>d</i>	² <i>d</i>	
D _{min}		2	2	2	2	2	2	2	
Remark		fail	Pass	Pass	fail	fail	Pass	Pass	

Tab_{V2V} Content of coarse grained grade (rubble) according to standards and ash samples from Cao Ngan plant

Properties		CN ₁	CN ₂	CN ₃	CN ₁	CN ₂	CN ₃	vN Standard	
		¹ <i>d</i>	<i>d</i>	1	2	3	1	2	
Cumulative percent retained, a i,μ	Particle size, mm	¹ <i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	
		² <i>d</i>	1	1	2	1	3	2	<i>d</i> - ¹ <i>d</i>
		¹ <i>d</i>	22	23	23	22	23	23	¹ <i>d</i> - ¹ <i>d</i>
		2	¹ <i>dd</i>	³ <i>d</i> - ¹ <i>dd</i>					
D _{max}		² <i>d</i>	² <i>d</i>	² <i>d</i>	² <i>d</i>	² <i>d</i>	² <i>d</i>	² <i>d</i>	
D _{min}		2	2	2	2	2	2	2	
Remark		fail	fail	fail	fail	fail	fail	Pass	

The results of the fine grained grade (sand) analysis showed that the a n Khanh ash (Table ¹*d*) had a fine grained content of ¹_{11V}³ to ³_{3dV2μ} V Cao Ngan ash had the fine grained content of ¹_{12V1} to ¹_{1V1μ} V accordingly, the ashes from both plant did

not meet the particle size requirements for construction concrete when 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 Table ¹-_{2V}

Tab_{V3V} Content of fine grained grade (sand) according to standards and ash samples from a n Khanh plant

Properties		a K ₁	a K ₂	a K ₃	a K ₁	a K ₂	a K ₃	vN Standard	
Cumulative percent retained, a i,μ	Particle size, mm	² ₂	¹ ₃ <i>d</i>	³ ₁ ₂	³ ₁ <i>d</i>	³ ₂ ₃	³ ₁ ¹	² ₂ ₂	<i>d</i> - ² <i>d</i>
		¹ ₂ ₂	² ₃ ₃	¹ ₁ ₂	¹ ₁ ₁	³ ₃ ₂	¹ ₁ <i>d</i>	³ ₃ ₂	¹ ₂ - ¹ ₂
		¹ ₃ ₃	³ ₁ ₁	² ₂ ₃	² ₂ ₃	² ₂ ²	³ ₁ ₂	¹ ₁ ¹	³ ₂ - ¹ ₁ <i>d</i>
		¹ ₃ ₁ ₁	² ₃ ²	¹ ₂ ₃	¹ ₁ ₂	³ ₃ ² ₃	² ₁ ₃	³ ₃ ²	³ ₂ - ³ ₃ <i>d</i>
Content, μ	ζ	¹ ₃ ₁ ₁	³ ₃ ₂	¹ ₂ ₃	² ₂ <i>d</i>	¹ ₁ ₃	² ₂ ₁	¹ ₁ <i>d</i>	³ ₂ - ¹ ₁ <i>dd</i>
		³ ₃ ₂	³ ₃ ₂	² ₁ ₁	² ₂ <i>d</i>	² ₂ ₁	³ ₁ ₁	² ₃ <i>d</i>	ζ ₁ <i>d</i>
fineness modulus, m _k		² ₂ <i>d</i>	² ₁ ¹	² ₂ ²	² ₂ ¹	³ ₃ ₁	² ₂ ₁	² ₂ <i>d</i> - ³ ₃ ₃	
Sand classification					Coarse sand				
Remark				fail				Pass	

Tab_V¹ Content of fine grained grade (sand) according to standards and ash samples from Cao Ngan plant

Properties		CN ₁	CN ₂	CN ₃	CN ₁	CN ₂	CN ₃	vietnam Standard
Cumulative percent retained, a i,μ	Particle size, mm	$d_{2,2}$	$d_{1,3}$	$d_{1,1}$	$d_{1,2}$	$d_{2,3}$	$d_{1,1}$	$d_{-2,d}$
		$d_{2,22}$	$d_{1,3}$	$d_{1,1}$	$d_{1,3}$	$d_{1,3}$	$d_{1,3}$	d_{-12}
		$d_{2,33}$	$d_{3,3}$	$d_{3,3}$	$d_{3,2}$	$d_{3,2}$	$d_{3,2}$	$d_{-1,d}$
		$d_{2,311}$	$d_{2,3}$	$d_{3,3}$	$d_{2,3}$	$d_{1,d}$	$d_{2,2}$	$d_{-3,d}$
Content, μ	fine ness modulus, m _k	$d_{2,11}$	$d_{2,3}$	$d_{2,3}$	$d_{2,1}$	$d_{2,3}$	$d_{2,3}$	$d_{-1,d}$
		$d_{2,11}$	$d_{1,3}$	$d_{1,3}$	$d_{1,3}$	$d_{1,3}$	$d_{1,3}$	$d_{-1,d}$
Sand classification					Coarse sand			
Remark					fail			Pass

4. Conclusion and recommendations

The particle size of the coal ashes are varied, depending on the technology and input materials of the plants. At each plant, there is also a certain nonuniformity due to the difference between the batches.

According to the standards for particle size grade, the Khanh coal ashes are suitable for natural materials of grades C or D, so they can be recycled directly as natural materials for pavement structure. Cao Ngan 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.

With the ability to reuse ash for concrete aggregate and construction mortar, the coarse aggregates from Khanh ashes can be used directly in concrete or add a content from 2 to 23% to particle size 2.5 mm - 1.18 mm. Meanwhile, 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.

In order to completely evaluate the reuse of coal ash as natural materials, concrete aggregate and construction mortar, we need to study more characteristics according to the specialized standards.

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Conference, h o Chi minh City τ niversity
of Technology_v
δ_γ Revathi, v_v (2d³)_v "Studies on the
properties of h igh volume fly ash gypsum
slurry ωi th quarry waste and its use in
Pavement base course_v"

δ_γ TCv N ²²2¹d 2d₁₁ (2d₁₁)_v Natural
a ggregate for Road Pavement lay ers
Specification for material, Construction
and acce ptance_v ha Noi_v