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Studying to use volcanic ashes and felsic volcanic rocks in Vietnam teritory as the treatment materials for environment pollution – preliminary results

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Abstract: The felsic volcanic rocks and tuff aged from Late Mesozoic to Kainozoic occur in many places in Viet Nam Territory, such as Tu Le area (in Northwest Region), Binh Gia area, Binh Lieu area (Northest Reigion), Nha Trang area, Dalat area (Central Region). The mafic volcanic ashes aged from Late Neogen to Quarternary distribute in central part of Vietnam such ash Con Co Island, Van Hoa High land. The samples of the tuff rock of Don Duong Stratum collected from field trip in Da Lat area have been treated (burned) at 650ºC, 750ºC, 900ºC. The experimental results show that these materials, after treatment (heating in funace at the temperature 650ºC, 750ºC and 900ºC) expressed absortion capacity up to 90% of selected organic matters (MO, MD) and heavy Metal (Pb^{2+}) in the testing solutions. Among them, the sample heating at 900oC is the best material for Pb^{2+} absorption. The preliminary results show that the volcalnic felsic rocks and volcanic ashes in Viet Nam, after suitable treatments, can be used as an enviroment treatment materials.

Key words: *Environment, perlit, tuff, Vietnam*

INTRODUCTION

Felsic volcanic rocks and volcanic ash formation consist of microscopic minerals and glass volcanic rock types in amorphous state, which contain a relatively high amount of water, usually formed by effusive and eruption processes. The geological, composition study of the geology, material composition and origin of felsic volcanic rocks in the world is often accompanied by studies on the classification of volcanic rocks. Classification and nomenclature of volcanic rocks in general and volcanic clasts in particular by the IUGS Sub-Committee [1] on Geological Nomenclature as follows:

Volcanic ash is the term for volcanic eruptions containing crushed rocks pieces formed during volcanic eruptions with a diameter of less than 2 mm. This is also used in a broader sense to refer to all erupted products (more commonly referred to as tephra or pyroclast - volcanic material), including those larger than 2 mm in size.

The mineral composition of the volcanic ash depends on the source of the magma. Basalt effusions usually have dark ash with about 45-55% silicon oxide and are rich in Fe and Mg. Felsic volcanic rocks (eg. rhyolite) often produce light colored ash with high silicon oxide content (> 69%). Ash dust from intermediate magma has a silicon oxide content of around 55-69%. In the ashes usually contain cations Na^+, K^+, Ca^{2+}, Mg^{2+} ... and the Cl^-, F^-, SO_4^{2-}. The volcanic gases are water vapor (H_2O), CO_2, SO_2, H_2S, CO and HCl. When lava is erupted onto the ground, these gases partially drain out of the environment, or trapped in rocks and glass as liquid-gas inclusions.

Felsic volcanic rocks and pyroclasts are formed by erupting or effusive activities. The main materials that make up the felsic eruptions are the microcryts and phenocrysts of quartz, feldspar and glass. Material sources of volcanic rocks include pebbles, boulders, dust ash with the composition same as lava. Volcanic ash layers are distributed or are the bottom parts of real volcanic layers. The subject of investigation, research of this project is the ashes, volcanic ash (tuff ash), composed of particles of size <2mm. Tuff rocks have a very diverse composition, roughly equivalent to the real volcanic rocks. To classify the tuffs often add the names of the corresponding volcanic rocks. For example, the term basalt ash tuff is fully understood as a volcanic

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clast rock, with very fine particle size (<2mm) which accounts for over 75% of rock mass, chemical composition is equivalent or close to basalt.

The natural volcanic rocks as described above contain many materials in the glass state, such as volcanic ash tuff, volcanic felsite, which have many properties that can be used to produce materials in many different directions:

- As filter materials: clean water for drinking, sewage treatment, beverage filter, use for food processing [2];
- Supporting materials for plant care: use in tree nursing, nursery, soil porous improvement, plant and flower nutrition as well as application for clean vegetables, vegetable cultivation by hydroponic method [3];
- Other using sectors: Rich natural glass products are also used as materials for heat-insulating products, fireproofing, heat-insulating concrete, and porous concrete [2-6]. Perlite for gas separation and air separation for gas separation towers.

These materials have been used in many countries of the world. In Vietnam, raw materials processed from volcanic rock such as perlite and basalt have started to be used. The research on the application of natural rock materials in the field of production of environmental treatment materials and fertilizer derivatives for plants in Vietnam is very limited, only some researches related to the use of clay bentonite and diatomite as filter material. The use of highly active basalt as an additive for roller compacted concrete has been conducted in some hydropower works such as Plei Krong (Kon Tum), Ban Ve (Nghe An). Rotary kiln cement plants use basalt as an active adder to produce PPC cement [7].

However, the use of volcanic ash (mafic) and perlite (felsic) rocks for the production of environmental treatment materials as well as water-retaining materials (fertilizer derivatives) for crops is almost not to be research interests and applications. Most recently Nguyen and Doan [8] in the work "Initial research results on the ability to use weathering basalt on the islands of Ly Son and Con Co in the production of heavy metal adsorption in water pollution treatment" presented some results of research on environmental geochemistry and the ability to use weathering basalt in Con Co and Ly Son islands to serve the sustainable development of the sea and islands of Vietnam.

Up to the present time, all of these materials used in environmental and agricultural sectors are almost still imported from overseas such as Taiwan, Korea. Finding the source of raw materials for domestic production will have significant socio-economic implications.

To clarify the use of volcanic ash and volcanic ash, the authors of the University of Mining and Geology has been allowed by the Ministry of Education and Training to conduct research on the use of felsic volcanic felsic eruption and volcanic ash in the environment (Project B2016-MDA-16DT). The following is the preliminary research results of the authors.

AN OVERVIEW OF THE DISTRIBUTION OF FELSIC ERUPTIONS AND VOLCANIC ASH IN VIETNAM

In the Vietnamese territory, volcanic rocks as well as magmatic rocks in general have been studied, which have been mapped in detail on small to medium scale geological maps. According to the published geological data [11-15], the geological complexes of the volcanic rocks are distributed in many age ranges, especially the late Mesozoic and Cenozoic volcanic rocks. On maps, they are divided into facies, subordinates according to the principle of mapping the rock facies. The object of concern is the perlite and glass-rich felsic volcanics in the late Mesozoic to Cenozoic periods as well as tuff rocks and volcanic ash in the Cenozoic basalt effusions.

Modeling Late Mesozoic and Cenozoic felsic rocks

Late Mesozoic-Cenozoic felsic rocks are distributed in Tu Le (Yen Bai), Lang Son, Tan Mai (Quang Ninh), Muong Hinh (Thanh Hoa), Deo Ngang (Quang Binh), Mo Ray (Kon Tum), Mang Giang (Gia Lai), coastal areas from Quy Nhon to Nha Trang, and Da Lat area. The mass of volcanic rocks predominates, in which many places, have described perlitic rocks, non-phenocryst felsic rocks [11, 13]. The above rocks are mainly located at the top of the lava flows. They are capable of being used in the environment as perlite.

Fig 1 Outcrop of tuff rock of Don Duong stratum (PY19) in Da Lat area of Lam Dong province (Lâm Đồng)

In the study work on geology of Son La hydropower work, on the profile of Nam Chien stream, the description of Le (2001) [9] confirmed the presence of colored patches rocks with thickness of tens meters are partially weathered into kaolinite.

The description of Do and Nguyen [10] showed that the volcanic rocks of the Song Hien stratum in Binh Gia district (Lang Son province) have a recrystallized glass ground up to 75-80%. These rocks may have potential for use in environmental and agricultural purposes as described above.

Basalt and tuf ash in the Cenozoic basalt eruption

Basalt Cenozoic volcanic are widely distributed in Phu Quy (Nghe An), Quang Tri, Van Hoa plateau (Phu Yen) and Central Highlands (Gia Lai, Dak Nong, Dak Lak). They form layers with thickness ranging from a few meters to several hundred meters above the pre-Cenozoic geologic formations. According to published documents, the largest thickness of the basalt at Pleiku is to about 550m.

In the distribution fields of the Cenozoic basalt volcanics, in addition to the real effusions, there are significant amounts of volcanic clastic rocks. According to the classification of the IUGS, they include tuff agglomerate, tuff clasts, glass tuff, debris basalt tuff. Notably, the presence of volcanic ash tuffs. These volcanic ash, due to their formation conditions, often have large amounts of amorphous silicon. Facilitate the formation of technological characteristics that can be used in the field of environment and agriculture.

The glass-rich volcanic rocks have been studied and recorded the widespread distribution in the territory of Vietnam. However, the studying works on their application in life are few. A number of studies have been conducted in the field of science and technology, published in articles in the Journal of Geology. However, most of these works are only interested in the active index of basalt material (fresh and sub-weathered rocks) and weathered soil layer from them. Completely absent from research works and production of materials from perlite and felsitic glass volcanics.

Fig 2 Outcrop of volcanic ash (dark color) of Dai Nga stratum in Kbang area (Gia Lai).

Mineralogical and chemical composition of typical felsic volcanic rocks and volcanic ash

Mineralogical composition

The results of the study published by many authors (e.g. Le and Pham [14], Nguyen and Doan [8], Tran et al. [17], Do and Le [15], Dao and Huynh [13], Bui et al. [16]) and the results of the analysis of the authors showed that in the felsic volcanic rock of Don Duong stratum has the major mineralogical components include: Phenocrysts (15-17%) include plagioclase, potassium feldspar, quartz, biotite and less hornblende. Groundmass includes micrograins of feldspar, quartz, few of sericite, chlorite, and epidote. Minor (accessory) minerals are magnetite, hematite, ilmenite, pyrrhotine, apatite, and zircon.

The mineral composition of the Cenozoic basalt rocks has been studied by the authors of geological maps 1: 200,000 and 1.50.000 initially: in which rocks the main rock-forming minerals in most of the basalt rocks in the Central Highlands include: olivine (Ol), orthopyroxene (Opx), clinopyroxene (Cpx), plagioclase (Pl); secondary minerals: amphibole (Am), biotite (Bi), potassium feldspar (Fsp); accessory minerals: magnetite (Mt), ilmenite (Ilm), spinel (Spl).

Chemical composition

The chemical composition of typical felsic volcanic rocks (Tu Le Stratum in the North and Don Duong Stratum in the South) are shown in Fig 1 and Table 1.

Table 1 Chemical composition of typical Mesozoic-Cenozoic felsic volcanic rocks in Viet Nam (%)

TT	Complex	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O
1	**Felsic rocks of Tu Le Stratum**	68,37	0,26	10,86	4,84	2,37	0,22	3,72	1,49	3,83	2,77
2		69,00	0,35	13,00	2,65	1,30	-	0,64	0,20	3,56	8,90
3		69,82	0,38	12,49	5,52	-	0,20	-	1,36	3,01	4,58
4		72,00	0,77	12,89	3,12	0,50	-	0,21	-	4,46	5,23
5		72,08	0,34	11,40	5,39	-	0,40	0,15	0,50	3,86	4,53
6		72,52	0,16	13,58	3,58	1,24	-	0,11	0,10	4,60	4,30
7		74,10	0,44	12,84	0,74	2,06	0,08	0,10	0,35	3,00	4,90
8		74,80	0,38	11,46	1,57	1,38	0,08	1,25	0,14	3,15	4,36
9		76,50	0,38	10,49	2,85	1,45	0,03	0,35	0,28	3,10	4,26
10		77,8	0,85	9,90	1,90	0,97	-	0,50	0,13	3,80	3,33
11	Felsic rocks of Don Duong Stratum	61,58	0,62	15,98	2,00	3,80	0,24	1,87	4,82	3,34	2,60
12		62,00	0,66	17,13	2,27	3,74	0,08	1,98	3,75	3,52	2,83
13		63,36	1,31	14,39	1.35	4,48	0,1	2,40	4,13	3,29	3,02
14		63,92	0,98	14,28	1,47	4,16	0,11	1,75	4,06	3,48	4,41
15		66,68	1,05	14,50	4,09	0,43	0,25	0,78	2,69	4,56	2,52
16		67,88	-	14,43	4,19	1,87	0,10	0,40	0,12	3,48	4,60
17		68,46	0,59	13,67	1,23	3,51	0,06	0,65	2,10	3.32	2,67
18		71,08	0,18	14,43	0,10	1,53	0,09	0,26	1,20	5,53	4,14
19		71,24	0,92	12,95	1,94	1,38	0,04	0,80	1,33	4.22	3,51
20		74,06	0,2	13,92	1,05	0,75	0,02	0,70	0,70	2,40	3,68

(Source: Geology of Việt Nam: Vol II. Magmtic formations, 1995)

The chemical composition of the Cenozoic basalt rocks is presented in Table 2.

Table 2 Chemical composition of major components of Cenozoic basalt rocks in Vietnam (%).

TT	Rock Name	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O
1	Rich Aluminum Basalt	48,98	1,83	17,06	4,25	5,72	0,15	3,20	8,01	3,05	1,76
2	Andesite Basalt	53,19	1,40	15,03	3,62	6,75	0,64	5,45	7,80	2,64	0,69
3	Tholeite Basalt	49,34	1,83	14,19	5,01	6,62	0,19	6,82	7,74	2,76	1,24
4	Dolerite Basalt	50,37	1,68	14,14	4,11	6,06	0,14	6,72	8,35	2,61	0,82
5	Alkaline olivine Basalt	49,79	2,13	14,13	4,72	7,33	0,21	8,33	8,52	3,07	1,43
6	Basaltite	43,26	2,58	14,33	5,54	6,76	0,15	8,60	8,68	3,01	1,97
7	Trachite Basalt	52,99	1,05	15,80	5,23	4,36	0,15	4,50	3,66	4,83	2,84
8	Phonolite Basalt	56,60	0,26	18,74	3,19	2,24	0,11	0,30	2,40	7,00	6,00

(Source: Magmatic activities in Vietnam, Institute of Geology and Minerals, 2010)

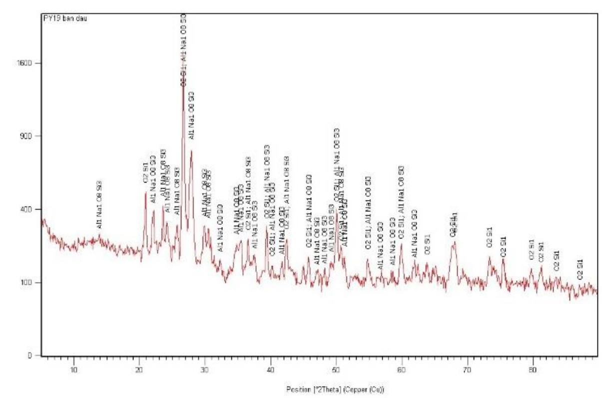
PRELIMINARY RESEARCH RESULTS ON THE CAPACITY OF HEAVY METAL ADSORPTION OF FELSIC VOLCANIC ROCKS AND VOLCANIC ASH

In order to evaluate the heavy metal adsorption capacity of the felsic volcanic rocks, we selected the typical samples from the tuffs of the Don Duong formation in the Da Lat area (Sample PY19) (Fig 1). The samples were milled to a particle size of <0.001mm and placed in the porcelain cup and covered with the lid, then placed in the furnace. Perform heating 3 times at 650ºC, 750ºC, 900ºC for 3 hours. After the heating process has finished, return the sample to its normal temperature and take out the cup.

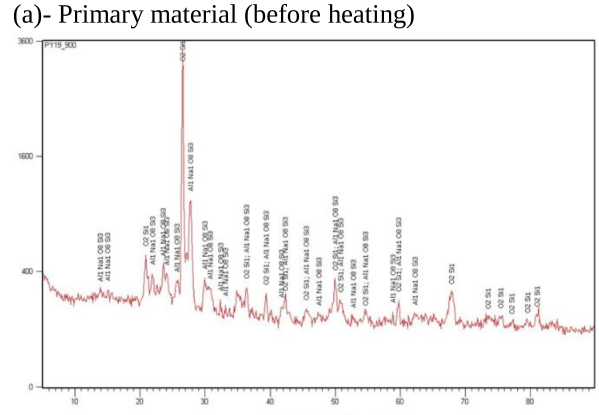
Characteristic analysis of structure and properties of PY19 material

Determine the structure of PY19 by X-ray diffraction (XRD). Sample material was spotted with X'Pert PRO at the Institute of Chemistry-Materials, Military Science and Technology Institute. The result is that the XRD spectrum has characteristic peaks of the material from which it is compared to the standard spectrum.

As can be seen in Fig 3a,b, PY19 after heating at 900^0C retains the same strong strength peaks as PY19 at the 2θ (theta) angles of 21°, 27°, 50° and four weak strength peak at 2θ (theta) angles of 21°. 24,5º; 31º and 68º. These are the typical peaks of the material. The most obvious difference of PY19 after heating is increased peak height. Specifically, the primary material had a peak height of more than 1600 and the material after baking peaked at 3600. The change in peak height after heating due to the material after heating liberated the bonding water, leaded to expansion of material and thereby, increasing the absorption capacity of the material. In order to know the morphology, the structure of the material, we continue to carry out SEM in the next experiment.



(a)- Primary material (before heating)

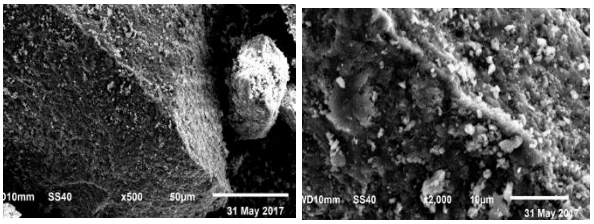


(b)- After heating at 900ºC

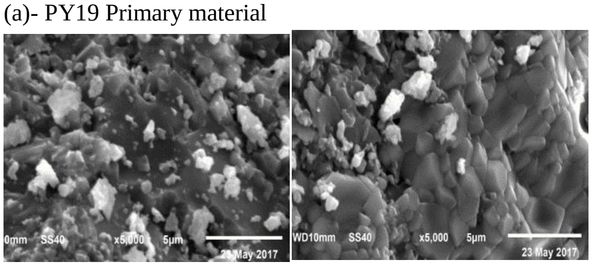
Fig 3 XRD analytical results of sample PY19

Determination of surface morphology of PY19 by scanning electron microscope (SEM). Material samples were taken by HITACHI S - 4800 at the Institute of Chemistry, Vietnamese Academy of Science and Technology.

The result is an SEM image, which indicates the external morphology and particle size of the material.



(a)- PY19 Primary material



(b)- PY19 material after heating at 900^{o}C

Fig 4 Scanning electron microscope of material from sample PY19

Observation in Fig 4 shows that the initial PY19 material (Fig 4a) is in cubic form, with crystal structure, on the surface being the different composition of the material. After heating at 900^{0}C (Fig 4b), the material is no longer in the form of a cube, but is spread out because the released water molecules produce more porous material with crystalline phases clearly visible when heated in the high temperature and composition are not changed.

Adsorption capacity of MB, MO, Pb^{2+} from primary PY19 and denaturation (modified) materials.

- Select the concentration of adsorbent solution of 10 mg/l to examine the primary PY19 material.
- The experiment is conducted as follows:

Step 1: Accurately weigh 0.01 g of material and put into a 100ml glass; Step 2: Take 50ml of Pb^{2+} solution, MB, MO in each cup; Step 3: Stirring the mixture for 2 hours then filtering the solution and conduct measuring atomic absorption spectrometry for Pb^{2+} samples and photometry measuring for MB, MO samples to determine the concentration after treatment.

(1) Examination of Pb^{2+} adsorption capacity of modified PY19 material. According to the Vietnamese Standards (QCVN-40-National Technical Regulation on Industrial Wastewater), the maximum permission limit of Pb^{2+} is 0.5 mg/l (for wastewater discharged into the non-domestic use purpose sources), so in this study, the selected initial Pb^{2+} concentration was 20 mg/l (40 times higher than that of QCVN 40) to investigate Pb^{2+} absorption capacity of the material. Experimental conditions: Treatment of Pb^{2+} at a concentration of 20 mg/l at 25^{o}C, normal light; pH = 6.01. Experiment with different time intervals: 30, 60, 120, 240, 480 minutes. (2) Investigate the effect of pH on the Pb^{2+}adsorption capacity. Experimental conditions: Treatment of Pb^{2+} at a concentration of 20 mg/l at 25^{o}C, normal light; pH = 6.01. Select the optimal time in Experiment 1 with different pH ranges: 2, 4, 5, 6, 7, 9. (3) Investigate the effect of concentration on adsorption capacity of Pb^{2+}. Experimental conditions: Treatment of Pb^{2+} at concentrations of 10, 20, 50, 75, 100, 200mg/l to describe linear adsorption until saturated, at 25^{o}C, pH= 6.01. Select optimal time in experiment 1, pH optimal in Experiment 2 for experiments. (4) Determine the maximum adsorption capacity. Based on the results in Experiment 3 to calculate the adsorption capacity from which the maximum adsorption capacity is determined. (5) Determination of Pb^{2+} concentration The Pb^{2+} content was determined by atomic absorption spectrometry on the CONTRAA 700 in the analytical Lab, the Institute of Chemistry and Materials, the Military Science and Technology Institute; Institute of Tropical Technology, Vietnamese Academy of Science and Technology. Construct the Pb^{2+} concentration gauge linear equation. Prepare a series of 10 pods with 25-ml volumetric, numbered from 0 to 9 and extract the volumes according to Table 3, set to the mark with distilled water, shake well and measuring the Abs value of the solution at a wavelength λ = 283nm. (6). Test results: Investigation results of MB, MO, Pb^{2+} adsorption in water environment using materials from PY19 sample are shown in the Table 4.

Table 3 Standard table set the Pb^{2+} level

TT	Extract volume (ml) C_{lv} = 10mg/l	Norm (ml)	C (mg/l)	Abs
0	0	25	0	0
1	0,5	25	0,2	0,00742
2	1,0	25	0,4	0,01491
3	1,5	25	0,6	0,02044
4	2,0	25	0,8	0,02828
5	2,5	25	1,0	0,03609
6	5,0	25	2,0	0,06938
7	10	25	4,0	0,13589
8	15	25	6,0	0,18533
9	20	25	8,0	0,24184

The determined standard calibration curve is:
y = 0.0304x + 0.004; R2 = 0.9971

From the standard construction curve (Fig 5), it is found that in the MB concentration range of 0 to 8 mg/l, the optical absorption level depends linearly on the Pb^{2+} concentration according to the Lamber-Beer law. Therefore, when determining the concentration of Pb^{2+} in the sample we need to set up to this concentration.

c) Calculation method for results

- Calculate the concentration:

$$C_{do} = (Abs-b)/a \quad => \quad C_m = C_{do} * f$$

where:
Cm: Pb^{2+} concentration in the primary sample
Cđo: Pb^{2+} concentration in sample after normalising
f: dilution factor
- Calculate the efficiency and absorption capacity:

$$H = \frac{(C_o - C_t)}{C_o} \times 100\% \quad \text{and} \quad Q = \frac{(C_o - C_t) \times V}{m}$$

where:
H: adsorption efficiency (%)
Q: Adsorption capacity (mg/g)
C_o: Initial concentration of adsorbent solution (mg/l)
C_t: Solution concentration after adsorption by the material (mg/l)
V: Volume of adsorption solution (liter)
m: Sample volume (g).

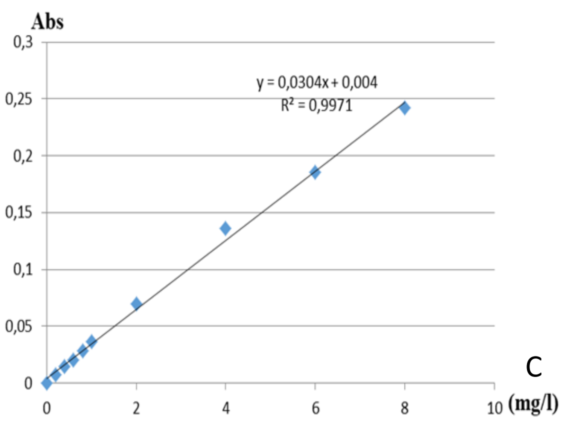


Fig 5 Graph showing the standard deviation of Pb^{2}

Table 4 Adsorption capacity of MB, MO, Pb^{2+} in water environment by PY19 raw material.

Absortion Solution	MB	MO	Pb^{2+}
Volume (ml)	50	50	50
Material quantity (g)	0,01	0,01	0,01
Initial concentration (mg/l)	10	10	10
Concentration after treatment (mg/l)	1,755	6,057	1,316
Eficiency (%)	82,45	39,43	86,84

Table 4 shows that in normal conditions, PY19 material has the ability to adsorb MB, MO and Pb^{2+} in water environment. Specifically, Pb^{2+} adsorption efficiency was 86.84%; MB is 82.45% and MO is 39.43%. From the above results, the adsorption efficiency of $Pb^{2+,}$ MB of PY19 is higher than MO adsorption, which can be caused by MB and Pb^{2+} with positive charge while PY19 material with negative charge so more easy absorption. Therefore, the subject using adsorbent solution is Pb^{2+} to investigate material PY19.

Table 5 Pb^{2+} adsorption in water environment by PY19 material at different heating temperatures.

Material	PY19-Raw	PY19 650°C	PY19 750°C	PY19 900°C
Pb^{2+} initial concentration (mg/l)	17,97	17,97	17,97	17,97
Pb^{2+} concentration after treatment (mg/l)	4,342	2,438	2,17	1,743
Hiệu suất (%)	75,84	86,43	87,92	90,3

The results shown in Table 5 indicates that the heating material at 900°C has the highest adsorption efficiency of 90.3%, so the material is heated at 900°C as adsorbent for subsequent experiments.

Investigation of the effect of concentration on Pb^{2+} adsorption capacity on modified PY19 material
Experimental conditions: Pb^{2+} adsorption with different concentrations of 10, 20, 50, 75, 100, and 200 mg / l with the quantity of 0.01 g material at 25^0C, normal light, pH = 7 for 2 hours. The results are summarized and presented in Table 6 and Fig 6

Table 6 The effect of concentration on Pb^{2+} adsorption capacity on modified PY19 material.

TT	C_o (mg/l)	C_t (mg/l)	Q_t (mg/g)	C_t/Q (g/l)	Adsorption efficiency (%)
1	8,98	0,842	40,69	0,021	90,63
2	17,97	1,25	83,6	0,015	93,04
3	47,63	6,25	206,9	0,03	86,88
4	73,19	15,197	289,965	0,0524	79,23
5	95,26	24,704	352,78	0,07	74,06
6	182,77	76,84	529,6	0,145	57,96

Table 6 indicates that the material adsorbs Pb^{2+} only at a certain concentration, so the higher the concentration, the adsorption efficiency will be decreased. Specifically, the adsorption level of Pb^{2+} is best from 8.98 to 47.63mg/l with an efficiency of 80%. From 47.63 to 182.77 mg/l, the adsorption capacity is reduced, resulting in a decrease to bellow 80%.

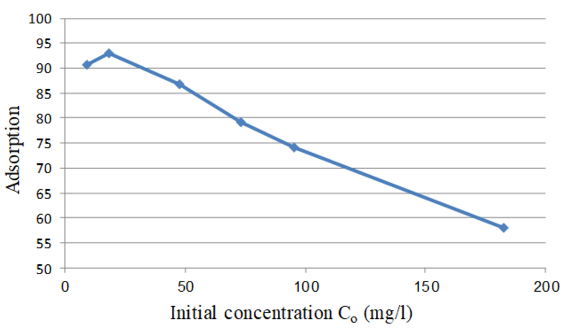


Fig 6 Effect of concentration on Pb^{2+} adsorption capacity of PY19 material heating at 900°C

Test to determine the Pb^{2+} maximum adsorption capacity Pb^{2+} maximum adsorption capacity was determined by Langmuir adsorption model. Based on the results in Table 6, the graphs are shown in Fig 7 and Fig 8.

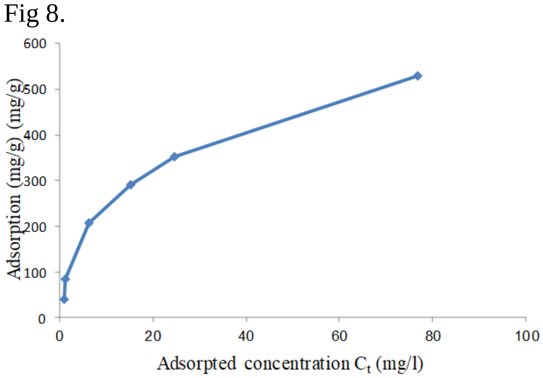


Fig 7 Isothermal Langmuir Line

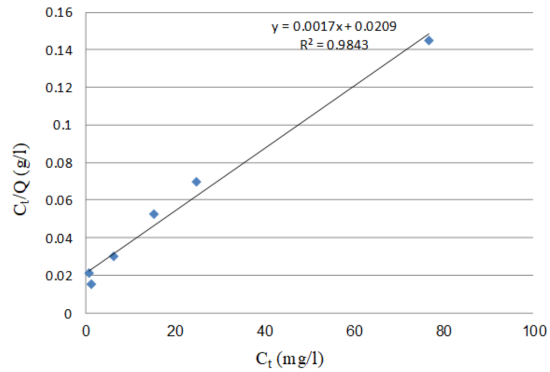


Fig 8 The depending of Ct/Q on C_t

From Fig 8, the maximum adsorption capacity of the Pb^{2+} adsorption material is:

$$Q_{max} = \frac{1}{0,0017} = 588,24 (mg/g)$$

The results showed that with 1 gram of PY19 material can absorb maximum 588.24 mg Pb^{2+} in water environment.

In summary: The experiment showed that the PY19 material was modified by calcination and exploring the Pb^{2+} adsorption capacity in the waste water samples lead to the following results:

- Made of modified PY19 material. The using X-ray diffraction and SEM have proven that the material is crystalline state with the regular distribution of Si, O, Al, and Na elements in each region and closely linked each other to help form strong affinities with capable of adsorbing Pb^{2+}.
- Investigated the Pb^{2+} adsorption capacity of the modified PY19 material, which showed that the Pb^{2+} adsorption process was good at 2 hours. The optimum pH value for adsorption is 7 and the best adsorption range is 8.98 - 47.63 mg/l. The Pb^{2+} maximum adsorption capacity is 588.24 mg/g.

CONCLUSION

The young felsic volcanic rocks and volcanic ashes (Late Mesozoic-Cenozoic ages) are widely distributed in the West and North East of Vietnam as well as in the Central coastal area and Central Highlands. Among them, tuff and basalt ash distributed quite widely in the Central Highlands with high amorphous silica content (glass) which is of great potential for use in the environment. Initial test results from the authors showed that, for lead (Pb^{2+}), depending on the concentration of the solution and the environmental conditions (pH), the modified material (heated at 900 ° C) can have adsorption capacity from 57% to over 93% of lead ion in solution. This is only the initial result, but it is also an encouraging premise for further research to comprehensively assess the size and range of these materials and their adsorption capacity for other objects (heavy metals, organic complexes, etc.) in order to assess their applicability in the environment.

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