Minerals compositions in wood processing waste for geopolymer base ingredient

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Abstract. Geopolymer is a material with pozzolan characteristic which can come from nature or artificially made. Pozzolan characteristic material contain silica (SiO2) and alumina (Al2O3) (Davidovits, 2008). Both compounds can be found in nature (such as metakaolin and volcanic material) or in human activities waste (fly ash and ash from rice processing). In Papua, especially in Kabupaten Manokwari forestry wood products are abundant as well as its utilization. Utilization of wood processing had produce solid waste such as wood chip, wood scraps and sawdust. This study aims to understand the mineral compositions of wood waste ash in Kabupaten Manokwari for its possibility as geopolymer base ingredient. The wood waste came from merbau (Instia sp.) tree and compare to ash from mix wood. The study result shows that ash from wood waste consist of minerals such as; Calcite (CaCO3), 50.1% and 58.7%; Quartz (SiO2), 27.4% and 24.8%; Mica/Muscovite (KAl2(OH)2Si3AlO10), 11.0% and 16.5%; Pyrite (FeS2), 11.5%.

1. Introduction
Geopolymer is aluminosilicate compound which found in 1978 by Joseph Davidovits (Davidovits, 1994). Geopolymer is a material with pozzolan characteristic which can come from nature or artificially made. Pozzolan characteristic material contain silica (SiO2) as source of Si and alumina (Al2O3) as source of Al (Davidovits, 2008). Based on previous researches on natural source of pozzolan such as wood waste and slug can be used as base material for geopolymer due to its Al and Si content (Xu and Van Deventer, 2009). The geopolymer or can be called inorganic geopolymer, evolved as important technical material on environmentally friendly construction industry (Duxson, et.al, 2007). In Papua, especially in Kabupaten Manokwari forestry wood products are abundant as well as its utilization. Utilization of wood processing had produce solid waste such as wood chip, wood scraps and sawdust. To get benefit as base material for geopolymer, wood waste has to burn to ash. The wood that used in this study came from Merbau (Instia sp.) tree from around Kabupaten Manokwari and also mix wood as comparison data. The study aims to understand the mineral
compositions of wood waste ash in Kabupaten Manokwari for its possibility as geopolymer base ingredient.

2. Method and Material
This study conducting in descriptive manner, the study material came from Kabupaten Manokwari, Provinsi Papua Barat while the test was conducted at the Geology Engineering laboratory, the University of Gadjah Mada Yogyakarta.

2.1. Sample preparation
Wood processing waste such as wood chip, wood scraps and sawdust burned to become ash (figure 1). Then, the ash produced put in trough 200 mesh sieve (figure 2).

2.2. Method
The 200 mesh ash then tested using X-ray Diffraction Spectrometer (XRD) Rigaku Brand (Figure 3). The result from XRD then analyst with Joint Committee on Powder Diffraction Standards (JCPDS) database and Match! 3 software to determined its mineral composition. The test conducted on two different samples of waste ash which are differentiate as merbau wood waste and mix wood waste.

3. Result and Discussion
The test result of the wood waste can be seen at figure 4, 5, 6 and figure 7.

Figure 4. Merbau (*Instia sp.*) Ash Test Result (using JCPDS database)

Figure 5. Merbau (*Instia sp.*) Ash Test Result (using Match!3 software)
The result graph shows highest peak follow by several lower peaks. The peaks indicated mineral domination on testing material. Based on testing result on merbau waste ash, the domination minerals (from highest to lowest) are 50.1% Calcite (CaCO$_3$), 27.4% Quartz (SiO$_2$), 11.5% Pyrite (FeS$_2$), and 11.0% Mica/Muscovite (KAl$_2$(OH)$_2$Si$_3$AlO$_10$). Based on testing result on mix wood waste ash, the domination minerals (from highest to lowest) are 58.7% Calcite (CaCO$_3$), 24.8% Quartz (SiO$_2$), and 16.5% Mica/Muscovite (KAl$_2$(OH)$_2$Si$_3$AlO$_10$).

Generally, both testing shows relatively the same result, the difference is the occurrence of Pyrite (FeS$_2$) in Merbau (*Instia sp.*) waste ash. To explained the difference, further study should be conducted by competent researcher on this disciplined. Moreover, the study describes that base on the mineral composition both Merbau (*Instia sp.*) and mix wood waste ash can be use as base ingredient of...
geopolymer. These because of both samples have the same mineral; Calcite, Quartz, Mica/Muscovite which are dominance sources of Si and Al.

4. Conclusion

The composition of mineral in wood waste at Kabupaten Manokwari consist of mineral Calcite, Quartz, Plagioclase, Mica/Muscovite which are the dominance sources of Si and Al. The wood waste in Kabupaten Manokwari have potency to become base ingredient of geopolymer.

5. References

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