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“Intellectual Property Right Based on Green Social Dynamics, Business and Science-Tech”

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"Intellectual Property Right Based on Green Social Dynamics,
Business and Science-Tech Intellectual Property Right Based on
Green Social Dynamics, Business and Science-Tech"

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Table of Contents

Plenary Speaker

*Intellectual Property Right Roles in Green Business and Technology*
Zulkifli Mohamed Udin ................................................................. 1

*Standardization and Preparation of Active Constituent Rich Herbal Extracts*
Pharkphoom Panichayupakaranant .................................................. 8

*Rare Earth Elements: Impact on Green Technology*
Anwaruddin Hisyam ...................................................................... 11

*Green Environmental Education*
Armin A. Fullante ........................................................................ 16

**Economic**

*Adaptation Process of Livelihood Change from Agriculture to Community-Based Tourism: A Study on Community in Merapi Slope, Sleman Post Merapi Eruption 2010*
Anggi Rahajeng, Saiqa Ilham Akbar .............................................. A-1

**Health**

*Impact of Insurance Status on Appropriate Utilization Antihypertensive Medications Based on JNC-7 and Clinical Outcomes Inpatients of “X” Hospital Bantul*
Rahmawati, F., Akrom., Supadmi, W. .............................................. B-1

*The 4R Community Empowerment Program: Utilizing waste products from the PKU Muhammadiyah Yogyakarta Hospital Waste*
Triyani Marwati, Edwin Daru Anggara ........................................... B-10
Science

Effect of Ethanol Extract Flower (Chrysanthemum cinerariaefolium Trev) on Mortality Mosquito Larvae of Aedes Albopictus (Skuse)
Trianik Widyaningrum, Eka Lusiana .................................................. C-1

Natural Products-Based as an Alternative Approach on Acne Treatment
Yulisna Hawarya, Irfan Yunianto .................................................. C-11

The Comparison of Antibacterial Activity of Kefir Cow’s Milk and Kefir Goat’s Milk Against Escherichia Coli
Muhammad Iqbal, Dwi Suhartanti .................................................. C-17

Analysis of pH on Various Herbal Lipsticks
Yuningsih, Irfan Yunianto .................................................. C-24

The Comparison of Antibacterial Activity of Kefir Cow’s Milk and Kefir Goat’s Milk Against Salmonella Thypusa
Mei Fajar Nugroho, Dwi Suhartanti .................................................. C-30

Effects of Carica Papaya (Caricaceae) Fruit Juice on the Histopathological Image of Mice (Mus Musculus) Testis Strain Swiss Exposed to Cigarette Smoke
Novi Febrianti, Annisa Ika Putri Ariyana .................................................. C-37

A Hybrid Particle Swarm Optimization Steepest Descent Direction
Iwan Tri Riyadi Yanto .................................................. C-43

Analysis of Tree Vegetation Degree in Boyong River Riparian Area, Yogyakarta as a Biology Learning Resource
Trikinasih Handayani, Lusi Tranwinarti .................................................. C-52

Antioxidant Activity of Chloroform and Methanol Extract of Piper spp. Leaves
Ambar Pratiwi, L. Hartanto Nugroho, Yekti Asih Purwestri ..................... C-59

Kinetics Evaluation on Oleic Acid Ethyl Ester Synthesis Using Lipase From Rice Bran (Oryza sativa) and Germinated Jatropha Seeds (Jatropha curcas. L)
Indro Prastowo, Chusnul Hidayat, Pudji Hastuti ..................................... C-64

Technology

Image Processing Application for Detecting the Ripeness of Watermelon Based on Features of the Rind Texture
M. Norman Salim, Murinto ................................................................. D-1

The Development of User Experience Website Design Using Kansei Engineering by Flat and Adaptive Technology Towards Clothing Store to Increase the Simplicity and the Comfort of
Afriq Yasin Ramadhan, Fiftin Noviyanto .................................................. D-13

Improvement of Working Position on Frying Pan Lathing Process Using The Ergonomics Approach (A Case Study at WL Alumunium metal casting, Yogyakarta)
Agung Kristanto, Dalih Firman Fanany ................................................. D-21

Biodiesel Production from Rubber Seed Oil with Trans-esterification Process
Siti Salamah, Wahyu H, Setya A., W .......................................................... D-34

Internet Network Configuration Using Mikrotik RouterOS
Nur Rochmah Dyah P.A., Tri Wulan Suci Meiwardi .................................. D-40

Automata Language Theory Learning Media at Push Down Automata Material Based on Multimedia
M Khairul Ridho Dhilon, Wahyu Pujiyono ............................................... D-49
Conceptual Model of Consumers' Intention to Participate in Cellphone Take Back Program
Siti Mahsanah Budijati, Subagyo, M. Arif Wibisono, Nur Aini Masruroh...D-60

Utilization of Heat Loss by Flue Gas in Using Solid Fuel Furnace to Increase Heat Efficiency
Martomo Setyawan .................................................................D-74

The Use of Plug-In As Implementation To Visualize 3D Graphics On the Web (A Study On X3D And WebGL)
Mursid W. Hananto ...............................................................D-81

The Effect of Condenser Heat Transfer Area to the Condensed Liquid Smoke Volume as the Result of Coconut Shell Pyrolysis
Siti Jamilatun, Nurkholis ......................................................D-91

Location Based Service Application Design for Mobile Promotion SME's Product and the Nearest Bank Service Information
Merlinda Wibowo, Herman Yulianyeh .....................................D-98

SI/TI Strategic Plan Model Designing in Homestay Venezia
Nur Cholis Habib, Risa Aditia Wijaya, Sri Handayaningsih ..........D-107

Designing Room Access Control Information System
Ika Arfiani ...........................................................................D-117

The Use of Multimedia Aplication for Diagnosing Human Skin Deaseas
Sri Winiarti, Reni Andriyani ..................................................D-122

B2C (Business To Consumer) E-Payment Model for Online Shop’s Customers
Arfiani Nur Khusna ..............................................................D-132

Clustering The Number of Passengers of Trans Jogja Bus for Evaluation
Lisna Zahrotun .................................................................D-141
The Building Design of Case-Based Reasoning for Diagnosing the Cow Diseases
Murien Nugraheni ................................................................. D-148

Prototyping with Bayesian Method for Bicycle Purchase Recommendation
Anna Hendri Soleliza Jones ....................................................... D-157

The solution of the Maximum Weighted Matching problem (MWM) using Primal Dual Algorithm
Tedy Setiadi ........................................................................... D-166

Prototype of House Security System Using Infrared Receptor and Fbus Technology on Mobile Phone
Yana Hendriana ....................................................................... D-174

A Design and Development of Basic Math Game on Windows 8 Operating System for Indonesia Elementary School
Ahmad Sholikin, Andri Pranolo .................................................. D-187

Genetic Algorithm in Solving the TSP on Route Distribution of Mineral Water
Mutamimmul Ula, Richki Hardi ................................................ D-193

Crosscurrent Batch Leaching of Rice Husk Ash Using Distilled Water
Endah Sulistiawati, Imam Santosa ............................................. D-203

KWh-meter Number Recognition using Normalized Cross-Correlation Technique
Kartika Firdausy ....................................................................... D-211

Draft Utilization Google Calendar for Management Agenda and Invitation to Event Administration in UAD to Support Paperless Office
Ali Tarmuji ................................................................................ D-220
Crosscurrent Batch Leaching of Rice Husk Ash Using Distilled Water

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Abstract. Agricultural wastes such rice husk have a possibility to be used as a renewable source for production of energy, silica, and the soaking liquor in making fiber from bamboo. Ash extract of rice husk can be made by solid-liquid extraction process. Leaching or solid-liquid extraction is the removal of a soluble fraction (solute) from the solid phase. In the leaching operation, alkali, as solute, is removed from rice husk ash. The solute is measured as active alkali by titration. The solid (rice husk ash) contains solute and inert. It needs solvent, water, to remove the solute. The objective of this research was to study the effect of ash-solvent weight ratio and the number of crosscurrent in batch leaching of rice husk ash.

Ash of rice husk (200, 250, 300, 350, and 400 g) and 1000 ml of distilled water were put into a beaker glass, stirred well during 5 minutes (assume equilibrium). After that, the mixture was filtered by Buchner funnel and vacuum pump perfectly. The volume of filtrate (overflow) was measured, and also determined the content of alkali active by acid-base titration. The residue (underflow) was added by 1000 ml fresh distilled water, mixed well and filtered again. The batch leaching operation on the underflow was repeated until 5 times.

Distilled water is good solvent for leaching of rice husk ash. The ash extract of rice husk contains potassium 84.7969 mg/L, silica 0.8255 mg/L, carbonat 12.2 mg/L, sodium 38.075 mg/L, and magnesium 5.006 mg/L.

Keywords: ash extract, crosscurrent, leaching, rice husk.

1 Introduction

Rice husks, the most abundant waste material in agricultural country, is the one of the renewable source for production of energy, and the soaking liquor (for delignification) in making fiber from bamboo. Nagrale et al [4] have studied about utilization of rice husk ash (RHA). There are many applications of RHA, such as aggregates and fillers for concrete and board production, a source of silicon, insulation powder in steel mills, repellents in the form of "vinegar-tar", a release agent in the ceramics industry, an insulation material for homes and refrigerants.

Other research, leaching treatment proper to extract the silica. The solvent generally used in that process are: sulphuric acid (H₂SO₄), hydrochloric acid (HCl), nitric acid (HNO₃), and alkali solution [1, 2]. Beside hazardous to the environment and humans, the strong acid and base leaching treatment also has an economical problem due to a necessary use of expensive materials with corrosion resistance to strong acid and a special disposal treatment of used strong acids and base.
Ash extract of rice husk (as a soaking liquor in the delignification of bamboo) can be made by solid-liquid extraction process. Leaching or solid-liquid extraction is the removal of a soluble fraction (solute) from the solid phase [3]. In the leaching process, alkali, as solute, is removed from rice husk ash. The solute is measured as active alkali by titration. The solid contains solute and inerts. It needs solvent, water, to remove the solute. The objective of this research was to study the effect of weight ratio of ash to water, and crosscurrent number in batch leaching of rice husk ash using distilled water.

2 Materials and Method

The experiments were run in the Laboratory of Chemical Engineering, Ahmad Dahlan University. The materials consist of rice husk ash (RHA), and distilled water (as solvent). Ash of rice husk (200, 250, 300, 350, and 400 g) and 1000 ml of distilled water were poured into a beaker glass (2 Liter capacity), stirred well during 5 minutes. After that, the mixture was filtered by Buchner funnel and vacuum pump perfectly, until there was no drop again from the filter. The volume of overflow (or filtrate) was measured, and also determined the content of alkali active by acid-base titration. The underflow (raffinate or residue) was added by 1000 ml fresh distilled water, mixed well and filtered again. The leaching batch operation on the underflow (raffinate) was repeated until 5 times.

Figure 1 Crosscurrent Batch Leaching of Rice Husk Ash
3 Result and Discussion

3.1 Leaching of Rice Husk Ash

Ash of rice husk 200 g and 1000 ml of distilled water were put into a beaker glass, stirred well during 5 minutes. It was assumed that the operation will be in equilibrium after 5 minutes. The filtrate is known as ash extract, then treated analytically by acid-base titration, to evaluate the alkali concentration. The ash extract purposes to be a soaking liquor in delignification process of bamboo, so that it must be known the concentration of alkali. Generally, the content of ash extract from rice husk is shown in Table 1. This result was determined by AAS Method in Laboratory of Balai PIPBPJK Dinas PU, and ESDM, Daerah Istimewa Yogyakarta, Indonesia.

Table 1 The Content of Ash Extract of Rice Husk

<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
<th>mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Potassium</td>
<td>84.7969</td>
</tr>
<tr>
<td>2</td>
<td>Silica</td>
<td>0.8255</td>
</tr>
<tr>
<td>3</td>
<td>Carbonate</td>
<td>12.2</td>
</tr>
<tr>
<td>4</td>
<td>Sodium</td>
<td>38.075</td>
</tr>
<tr>
<td>5</td>
<td>Magnesium</td>
<td>5.006</td>
</tr>
</tbody>
</table>

Figure 2 shows the concentration of alkali in ash extract, as the result in each batch leaching with fresh distilled water. It shows the first batch leaching will give the highest concentration. The concentration will decreases after the second, third, fourth, and fifth batch leaching.

![Figure 2 Concentration of Alkali in Ash Extract of RHA](image)

Efficiency of leaching is defined as multiplication of volume and alkali concentration of extract. In figure 3, it shows that the efficiency of first batch leaching is the lowest, because water is absorbed in the pores of solids. The second leaching has the highest efficiency, 83.4% for ratio (ash/water) 0.25.
Figure 3 The Efficiency of Batch Leaching

Figure 4 shows the total volume accumulated of ash extract after fifth leaching. It demonstrates that the increasing weight of solid will decreasing the total volume accumulated. In five times leaching, it needs 5000 ml of distilled water, but the total accumulated volume of extract after leaching maximum 4474 ml, or 89.5%.

Figure 4 The Total Volume of Extract Removed

The total alkali removed from RHA leaching after fifth batch is shown in figure 5. The total removed tends increasingly with increasing the solid weight, because the total solute in solids is proportionally.
3.2 The Effect of Weight Ratio of Solid to Solvent (Ash/Water)

In its elemental form, a leaching system consists of three components: inert, solute, and solvent. Inert is insoluble solids, a solute a single nonadsorbed solute, which may be liquid or solid; and a single solvent. Thus, it is a ternary system, by virtue of the total mutual "insolubility" of two of the phases and the simple nature of equilibrium. The composition of a typical system is satisfactorily presented in the form of a diagram [3]. Those diagrams are plot of mass fraction of solvent against mass fraction of solute (Fig. 6). In figure 6, X is ratio of solute to (solute+solvent+inerts), and Y is ratio of solvent to (solute+solvent+inerts). The diagrams in figure 6 shows polynomial order 2, with $R^2 > 0.97$. Increasing weight ratio of solid to solvent will tend to increase ratio of solute to (solute+solvent+inerts).

3.3 The Effect of Number of Crosscurrent in Batch Leaching

The influence of N are shown in figure 7. The diagrams are plot of mass fraction of inert against mass fraction of solute. $X'$ is ratio of solute to (solute+solvent), and $Y'$ is ratio of inert to (solute+solvent). Increasing N will increase total solute removal. The chart represents by logarithmic function with $R^2 > 0.89$. 
Figure 6  Plot of mass fraction of solvent against mass fraction of solute
Crosscurrent Batch Leaching Of Rice Husk Ash Using Distilled Water

![Graphs showing mass fraction plots for N=1 to N=5](image)

**Figure 7** Plot of inert mass fraction against solute mass fraction

4 Conclusion

Distilled water can be used as solvent in leaching of rice husk ash. In the batch crosscurrent method, weight ratio of ash to water influence the result (alkali removal) and efficiency. The number of current also effect the alkali removal. The best performance is weight ratio (ash/water) = 0.25 and N=2, give efficiency 83.8%.
5 Acknowledgement

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6 References


