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<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Researcher</th>
<th>Page</th>
</tr>
</thead>
</table>
| TEC-01 | Optical Tomography for Visualizing Solid Flow in Air                  | Sallehuddin Ibrahim, Mohd Amri Md Yunus and Wahid Ali Hamood Altwayti  
Department of Control and Instrumentation Engineering,  
Faculty of Electrical Engineering,  
Universiti TeknoLOGI Malaysia, Skudai,  
81300 Johor, Malaysia.  
e-mail: salleh@lke.utm.my | 1    |
| TEC-02 | Reduction of Iron Content in Waste Water Through Electrocoagulation Using Graphite of Waste Battery as Cathode | Sutanto, Danang Widjajanto  
Electrical Engineering, State Polytechnic Jakarta.  
Jl Prof. Dr. G.A. Siwabessy, Kampus Universitas Indonesia, Depok  
e-mail: stanto09@gmail.com | 5    |
| TEC-03 | Density Affects The Impact Strength of Carbon-Carbon Composites Made from Organic Waste | Agus Edy Pramono  
Mechanical Engineering Department, Politeknik Negeri Jakarta, Kampus Baru UI, Depok 16425  
eaepram@yahoo.com | 11   |
| TEC-04 | Representative Sample Size for Hydraulic Conductivity Measurement of Compacted Clay Soil Liners for Waste Containment Structures | Putera Agung MA and Budi Darmanto  
Civil Engineering Department of State Polytechnic of Jakarta (PNJ)  
e-mail: putera_agung2002@yahoo.com; budi.damianto@yahoo.com | 19   |
Mechanical Engineering Department, State Polytechnic of Jakarta, Indonesia | 33   |
| TEC-06 | Visualization Introduction to The Flores Ball Game (Ball Humanity) Based on Multimedia | Margareth Rozady  
Department Engineering Informatics, University of Nusa Nipa, Maumere-Flores.  
margareth_85@yahoo.com | 37   |
| TEC-07 | Development Length of Reinforcing Steel Bar in Precast Concrete Using Epoxy | Anis Rosyidah, Praganif Sukarno and I Ketut Sucita  
Civil Engineering Department of State Polytechnic of Jakarta. Jl. GA. Siwabessy, Kampus UI Depok 16455  
Anis.rosyidah@gmail.com | 45 |
| TEC-08 | Performance of Hot Mix Asphaltic Concrete with Various Filler Affected by Flood | Eva Azhia Latifa, Nuzul Barkah Prihutomo, Mulyono  
Civil Engineering Department, Jakarta State Polytechnic. Jln GA Siwabessy, Kampus baru UI Depok 16425  
e-mail: evaall@yahoo.com | 51 |
Program Studi Teknik Informatika, Program Pasca Sarjana Institut Informatika dan Bisnis Darmajaya, Bandar Lampung  
suhendro@darmajaya.ac.id; zz.grh@yahoo.co.id | 59 |
| TEC-10 | Paper Making Anti Termite Using Chitosan | Muryeti and Margetty  
State Polytechnic Jakarta, Kampus Baru UI Depok | 63 |
| TEC-11 | Improving Quality of Cementtreatedbase (CTB) Aggregate Steel Slagproducts on Composite Pavement Layerwithpolymer Flexon Andstyrene Butadiene Rubber (SBR) | Nunung Martina, Eka Sasmitamulya  
Department of Civil Engineering, Jakarta State Polytechnic  
e-mail: nunung.martina@yahoo.com | 67 |
| TEC-12 | Production of Fish Seed by Using Mechatronics Technology for Sex Manipulation | R Edy Purwanto, Eka Mandayatma, Totok Winarno  
Politeknik Negeri Malang. Jl. Soekarno Hatta 9, Malang  
rmedyprink@yahoo.com | 75 |
| TEC-13 | The Application of The Excentrix Press Tool Aids for Plate Ring Maker as Product Diversification for Kerosene Stove Industries | Zulhendri$^1$, Yuliarman$^2$, Reni Endang$^3$, Yusril$^4$  
$^{1,2,4}$ Mechanical Engineering Department, Padang State Polytechnic  
$^3$Accounting Department, | 81 |
| TEC-14 | Examining the implementation of ISO 9001 in Indonesian construction companies | Padang State Polytechnic  
e-mail:  
lzulhendri_05@yahoo.co.id,  
HP.081363241541 | Debby Willar  
Civil Engineering Department,  
Manado State Polytechnic  
Kampus Politeknik Kelurahan Buha Manado 95254 Indonesia  
e-mail:  
debby_willar@yahoo.com | 87 |
| TEC-15 | An Alternative Energy Produced from Kalimantan Local Commodities by 'Zero-Waste Production Process' | Hesty Heryani  
Department of Agroindustrial Technology, Faculty of Agriculture,  
Lambung Mangkurat University  
Jl. Ahmad Yani Km. 36,  
Banjarbaru, Kalimantan Selatan, Indonesia 70714  
e-mail:  
hesty.iddhin@yahoo.com | 97 |
Mechanical Engineering Education Department, Faculty of Engineering, UNIMA  
UNIMA Fatek Kampus Tondano Minahasa, North Sulawesi, Indonesia  
e-mail:  
parabelem_rompas@yahoo.com | 101 |
| TEC-17 | Experimental and Theoretical Study on Lateral and Radial Deflection Relationship of The Cantilever Beam System Shaft | Victus Kolo Koten  
Departement of Mechanical Engineering, Faculty of engineering University of Atma Jaya, Makassar 90000.  
e-mail:  
victus_koten@yahoo.com | 109 |
| TEC-18 | Analysis of Factors That Affect Taxpayer Compliance Retail Merchants in Bandung Electronic Centre West Java | Yana Maulana, Saadudin Saptayani  
Mahasiswa Politeknik Praktisi Bandung | 115 |
| TEC-19 | Improving Photovoltaic/Thermal (PV/T) by Using Heat Pipe as Heat Conductor | R. Subarkah, R. Filzi  
Jurusan Teknik Mesin, Politeknik Negeri Jakarta | 121 |
<table>
<thead>
<tr>
<th>TEC-20</th>
<th>The Influence of Silicon (Si) Alloying to Homogenize the Bainitic Structure Formation on Bainitic Nodular Cast Iron</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Jl. Prof. Dr. G.A. Siwabessy, Kampus UI, DEPOK 16425, Indonesia</td>
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<tr>
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<tr>
<td>Jl. Kanayakan 21 Dago Bandung 40135</td>
<td></td>
</tr>
<tr>
<td>e-mail: <a href="mailto:benybj@yahoo.com">benybj@yahoo.com</a></td>
<td></td>
</tr>
<tr>
<td>TEC-21</td>
<td>Making Steel Products by Investment Casting Method Using Local Materials</td>
</tr>
<tr>
<td>Wiwik Purwadi¹, Cecep Ruskandi², Dewi Idamayanti³</td>
<td></td>
</tr>
<tr>
<td>¹,²,³Teknik Pengecoran Logam Politeknik Manufaktur Negeri Bandung</td>
<td></td>
</tr>
<tr>
<td>Jl. Kanayakan 21 Bandung, 40135</td>
<td></td>
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<td>e-mail: <a href="mailto:wiwik@polman-bandung.ac.id">wiwik@polman-bandung.ac.id</a></td>
<td></td>
</tr>
<tr>
<td>TEC-22</td>
<td>The Microstrip Log Periodic Dipole Array Antenna for Television Broadcast Reception</td>
</tr>
<tr>
<td>Yulindon¹, Firdaus Nursal², Hendrick³</td>
<td></td>
</tr>
<tr>
<td>¹,²,³Electrical Engineering Department, State Polytechnic of Padang, Kampus Limau Manis, Padang, 25163, Indonesia e-mail: <a href="mailto:yulindon@polinpdg.ac.id">yulindon@polinpdg.ac.id</a>, <a href="mailto:firdaus@polinpdg.ac.id">firdaus@polinpdg.ac.id</a>, <a href="mailto:hendrickpnp77@gmail.com">hendrickpnp77@gmail.com</a></td>
<td></td>
</tr>
<tr>
<td>TEC-23</td>
<td>Trend and Issues of Optical Motion Capture for Animation</td>
</tr>
<tr>
<td>Joko Sutopo¹, Adhi Susanto², Insap Santosa³, Teguh Barata Adji⁴</td>
<td></td>
</tr>
<tr>
<td>¹Student in Electrical Engineering Departement of Electrical Engineering, Gadjah Mada University Jl Grafika 2 Yogyakarta 55281 Indonesia <a href="mailto:jksutopo@gmail.com">jksutopo@gmail.com</a></td>
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</tr>
<tr>
<td>²,³,⁴Electrical Engineering Departement of Electrical Engineering, Gadjah Mada University</td>
<td></td>
</tr>
<tr>
<td>TEC-24</td>
<td>Utilization of Residues from The</td>
</tr>
<tr>
<td>Ahmad Maksum¹, Iwan</td>
<td></td>
</tr>
<tr>
<td>viii</td>
<td>Proceeding of Annual South East Asian International Seminar (ASAIS) 2012</td>
</tr>
</tbody>
</table>
| TEC-25 | Rice Husks Extraction Process as A Composite Filter | Susanto², dan Budi Prianto²  
1Mechanical Engineering Dept, State Polytechnic of Jakarta, Depok  
maksum.ahmad@gmail.com  
²Mechanical Engineering Dept, State Polytechnic of Jakarta, Depok |
|-------|--------------------------------------------------|-----------------------------------------------------------------|
| The Potential of Micro Hydro at UI Lake Area | Adi Syuriadi, Gun Gun RG, Fachruddin  
1Mechanical Engineering Dept, State Polytechnic of Jakarta, Depok. isyur_me@yahoo.com |
| TEC-26 | Green Construction Management Concept Compilation Application at Service of Construction Management | Afrizal Nursin, Immanuel Pratomojati, Sidiq Wacono  
Civil Engineering Department of State Polytechnic of Jakarta |
| TEC-27 | Automatically Temperature Control of Coffee Drying Machine | Isdawimah¹, Silo Wardono¹, Ismujiarto¹  
¹Department of electrical Engineering, State Polytechnic of Jakarta  
Jln. Prof. Dr. G.A. Siwabessy University of Indonesia Depok 16425  
*e-mail : atadawim@gmail.com |
| TEC-28 | Effect of Fines Spons on Mechanical Properties of Concrete | Amalia¹ dan Djedjen Achmad  
¹Civil Engineering Department, The State Polytechnic of Jakarta, Jl. Prof. Dr GA. Siwabessy Kampus UI, Depok 16424  
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An Alternative Energy Produced from Kalimantan Local Comodities by Zero-Waste Production Process

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Abstract

Kalimantan is considered as a megadiverse island in the world because of its wide variety of species of plants. This potency must be managed to obtain optimum added values. In the Master Plan of Development and Acceleration of Indonesian Economic (MP3EI), Kalimantan was programmed to be the center of mining processing and national energy reservoir. Energy based on renewable resources must be continually developed. Tarap fruit (Artocarpus sp) is a typical fruit of Kalimantan, which the pulp part can be consumed and the seed can be processed for kind of flour, while its bark can be processed for briquette with addition of spent bleaching earth (by product of refinery process of palm oil production). The aims of this study was to obtain alternative energy, in form of briquette, based on Kalimantan local commodities through a zero waste production process. First of all, we optimized the formula of product, which consisted of two components: Tarap fruit waste and spent bleaching earth. Then the quality of each formula was examined. The optimum formula was obtained with its characteristics as follows: calorific value: >4700 kcal kg\(^{-1}\), combustion ashes: < 16.20 %, water content: 11 %, sulphur content: 0.0098 (< 1 %), and compressive strength value was 13.7 kg cm\(^{-2}\). Based on those results, the waste of Tarap fruit could be developed and used as a source of renewable briquette.

Keywords: zero waste, MP3EI, Tarap (Artocarpus sp), spent bleaching earth (SBE)

1. INTRODUCTION

Briquette is a means to convert biomass residues through simple technology that is inexpensive and suitable to be managed by small communities or private firms [1]. In this research, investigation were carried out on properties of briquettes produced from spent bleaching earth (SBE) and Tarap husk.

Numerous agricultural residues and wastes are generated in Kalimantan. They are poorly utilized and badly managed. Tarap husk are left to decompose or they are burned in the field [2]. Agricultural and agro-industrial waste which is gradually increasing due to more product.

Following the distribution sector of MP3EI (Masterplan of Acceleration and Enlargement of Indonesia Economic Development), Kalimantan was programmed as a production center of mining resources and a center of energy. Fossil based energy is non-renewable; therefore alternative energy forms based on renewable resources need to be developed continuously [1].

The aim of this study was to obtain an alternative energy in the briquette form using a formulation of Kalimantan’s local commodities and spent bleaching earth (SBE) through a production process with zero waste concepts. SBE produced from vegetable oil recovery process was combined with the biomass of Tarap fruit husk to produce a briquette with more efficient process and the same quality with fossil coal.

2. THEORY

Spent Bleaching Earth (SBE) is a solid waste material generated as a part of the refining process in a Vegetable Oil Industry worldwide [3].
It was usually disposed of in landfills, normally, paid for by the refinery. Pre-treatment of crude oil in refinery involves degumming and bleaching which generates plenty of Spent Bleaching Earth.

SBE serves as a by-product, which contains high percentage of oil [4]. SBE acted as oilfield and had contained harsh oleaginous till 30% when it was recovered via solvent or supercritical fluid extraction (SC-CO2)[5]. Fuel properties of methyl ester (ME) produced from residual SBE oil, especially sulphur content 0.04 (wt%) [3]. It was compared to the same product produced using fossil material, sulphur content more than 1% so that they are very relevant with the zero-waste concept.

Carbon source used in briquette formula was from burned and pyrolysis (anaerobic combustion). Taraf husk was chosen because it represented local commodity and society only consumed its kernel, so that from 100% of fruit’s component almost 78% was waste having potency to be made as carbon substance by zero-waste concept. Taraf was different to Cempedak whose inner skin where the fruits placed called 'dami' could be made to be a typical food called 'Mandai' [2].

Development of production process with zero waste concepts was focused on following area (1) cleaner production, an effort to reduce the environmental pollution of production process; (2) producers and consumers should apply a 6R concept (refine, reduce, recycle, recovery, and retrieve energy); (3) closed loop system, a commitment of industries to develop a process with zero waste; and (4) bio-society, an environmental friendly production deliver a good and efficient environments. These concepts are relevant to the three types of national technology (domestic oriented technology, green technology, and inclusive technology)[6].

3. METHODOLOGY
3.1. Briquette Production Process
SBE as main material was obtained from refinery process of vegetable oil industries in South Kalimantan Provinces. Sample analysis of SBE was performed to identify the bulk density, proximate data, pH, and oil content [8]. The husk was burned using a furnace, and crushed into 60 mesh [9,10] and it was formulated by SBE by adding cassava starch as much 2.5% from the weight of previous result of formulation. The procedure of renewable briquetting was shown at Fig. 1.

![Fig. 1 – The procedure of renewable briquetting](image)

Then, that mixed material was pressed and molded using a pressing machine (Fig. 2).
4. RESULTS AND DISCUSSION

The best quality product was resulted from a formula with 1:1 ratio of SBE and carbonated Taraf husk with 2.5% of adhesive material (cassava starch). This product has calorific value >4700 kcal kg⁻¹, combustion ashes < 16.20% (15.08%), water content after pressing process (11%), final water content (6.50 – 7.80%), with sulphur content (0.0098 %) (Table 1). With lower sulphur content (less than 1%), this formula and production process were able to reduce the environmental pollution especially caused by sulphur contained highly in SBE form. The resistance of pressure was achieved at 13.7 kg cm⁻².

Table 1. Characteristics of renewable briquette

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water content (%)</td>
<td>6.50 – 7.80</td>
</tr>
<tr>
<td>Combustion ashes (%)</td>
<td>15.02 - 16.13</td>
</tr>
<tr>
<td>Calorific value (kcal kg⁻¹)</td>
<td>4796 - 5310</td>
</tr>
<tr>
<td>Sulphur content (wt%)</td>
<td>0.0090 - 1.1182</td>
</tr>
<tr>
<td>Compressive strength value</td>
<td>11.86 – 13.98 (kg cm⁻²)</td>
</tr>
</tbody>
</table>

5. CONCLUSION

The waste of SBE and carbonated Taraf husk (60 mesh) with 2.5% of adhesive material (cassava starch) can be the potential developed source of alternative energy to the matter of all parameters test of the quality of briquette are equivalent to fossil-based briquette as coal. In the meaning of bio-energy the renewable briquettes are able to compete with the unrenewable resources and they even are able to produce air pollution, sulphur compound, under 1% so that they are very relevant with the zero-waste concept.
6. ACKNOWLEDGEMENTS
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7. REFERENCE


