LAMPIRAN

1. Instrumen Penelitian

No	Fasilitas/Instrumen	Variabel	Lokasi	Luaran Tahun
	ALAT UJI			
1.	Timbangan digital (*digital scale*)	Densitas material dan berat kompsoit	Lab. Pengujian Bahan UR	I
2.	SEM + EDAX	Distribusi serat kelapa sawit, graphite, serat baja, alumina, dan resin termoset pada pelat komposit	Sentra Teknologi Polimer, BPPT Serpong	I, II
3.	*Compression test* (*stress train diagram*)	Kekuatan tekan, modulus elastisitas, poisson rasio pelat komposit	Sentra Teknologi Polimer, BPPT Serpong	I
3.	*Abrasion wear test*	Ketahanan aus (abrasif)	Sentra Teknologi Polimer, BPPT Serpong	I, II
4.	*Thermographimetry Analysis* (TGA)	Stabilitas termal dan berat komposit	Sentra Teknologi Polimer, BPPT Serpong	I, II
	PERALATAN PRODUKSI			
1.	Cetakan Spesimen	Pembuatan pelat komposit dengan bahan pengisi limbah kelapa sawit dan beberapa bahan aditif	Lab. Teknologi Mekanik UR	I, II
2.	Cetakan kanvas rem bahan komposit	Pembuatan kanvas rem bahan komposit	Lab. Teknologi Mekanik UR	II, III
3.	Alat bantu lain	Persiapan spesimen	Lab. Pengujian Bahan UR	I, II, III

2. Personalia dan Kualifikasi Tenaga Peneliti

No	Nama/NIDN	Instansi Asal	Bidang Ilmu	Alokasi Waktu (jam/minggu)	Tugas dalam Tim
1	Muftil Badri M, ST, MT NIDN. 0028078001	Jurusan Teknik Mesin, Fakultas Teknik Universitas Riau	Material dan Struktur	15jam/minggu	✓ Koordinator dan penanggungjawab seluruh kegiatan. ✓ Mengkaji perilaku tekan, kekerasan, keausan, dan termal komposit dengan pengisi partikel limbah kelapa sawit dan bahan aditif lain. ✓ Menyusun strategi dalam tim. ✓ Menulis laporan.
2	Dr. Adhy Prayitno, M.Sc. NIDN. 0003095604	Jurusan Teknik Mesin, Fakultas Teknik Universitas Riau	Teknologi Desain dan Manufaktur	12 jam/minggu	✓ Analisis tingkat keberlanjutan ✓ Analisis desain dan manufaktur sebagai upaya peningkatan performa kanvas rem bahan komposit dengan pengisi partikel limbah kelapa sawit. ✓ Menulis laporan
3.	Dodi Sofyan Arief, ST, MT NIDN. 0009018204	Jurusan Teknik Mesin, Fakultas Teknik Universitas Riau	Marketing,Analisis Dampak Ekonomi	12 jam/minggu	✓ Menerapan teknologi produksi kanvas rem bahan komposit dengan pengisi limbah kelapa sawit bagi usaha kecil menengah (UKM). ✓ Menulis laporan

3. Publikasi Ilmiah

International Society of Ocean, Mechanical & Aerospace
-scientists & engineers-
Perkumpulan Ahli Kelautan, Mekanik & Ruang Angkasa -Ilmuwan & Insinyur-
Registration No: MENKUMHAM, AHU-00111.60.10-2014

Proceeding of Ocean, Mechanical & Aerospace
-Science and Engineering- (ISSN: 2443-1710)
Special Issues on Mechanical and Production in Engineering

REVIEW LETTER

No: 8/10/2015/POMAse/Vol.2/P-ST-04 8 October 2015

Dear Respect Prof/Dr/Mr/Mrs:
Muftil Badri, Dodi Sofyan Arief, Adhy Prayitno

Thank you for your manuscript.

Below are comments for paper entitled: **Compressive Strength and Wear Behavior of Palm Slag Composites Using Various Percentage Weight of Materials Content.**

Comments
Comments of reviewer as follows:

1. English should be improved

Editor
It is required for the authors to revise the paper according comment from reviewer as mentioned above and resubmit by **20-October-2015.**

Yours Sincerely,

PAKMA INTERNASIONAL ILMUWAN INSINYUR

Hj. Jaswar Koto,
Prof, Dr, Eng, CEng, CMarEng

Chief-in-Editors,
Proceeding of Ocean, Mechanical & Aerospace -Science and Engineering-

International Society of Ocean, Mechanical & Aerospace
-scientists & engineers-
Perkumpulan Ahli Kelautan, Mekanik & Ruang Angkasa -Ilmuwan & Insinyur-
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Proceeding of Ocean, Mechanical & Aerospace
-Science and Engineering- (ISSN: 2443-1710)
Special Issue on "Mechanical & Production Engineering of Maritime"

ACCEPTANCE LETTER

No: 6/11/2015/POMAse/Vol.2/ST-004-2015 10 November 2015

Dear Respect Prof/Dr/Sir/Madam,
Muftil Badri, Dodi Sofyan Arief, Adhy Prayitno.

Articles for Proceeding of Ocean, Mechanical & Aerospace -science and engineering- **(POMAse):**

"Compressive strength and wear behavior of palm slag composites using various percentage weight of materials content"

I refer to the matter above.

I am pleased to inform you that the above-mentioned article had been accepted and Insya Allah, will be published online in POMAse, Vol.2, Special Issues on "Mechanical & Production Engineering of Maritime" on November, 2015 in the following link: http://isomase.org/POMAse.php.

On behalf of POMAse, I wish to express our gratitude for your full cooperation and contribution in supporting our continuous effort of maintaining the publication of high quality articles in our Proceeding

Yours Sincerely,

PAKMA INTERNASIONAL ILMUWAN INSINYUR

Chief-in-Editors,
Proceeding of Ocean, Mechanical & Aerospace -science and engineering-

Compressive strength and wear behavior of palm slag composites using various percentage weight of materials content

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ABSTRACT

The compressive response of palm slag composites is an essential part of basic property data required for optimized design of composite structure. The compressive strength and wear rate behavior at room temperature of palm slag composites was experimentally investigated using various percentage weight of materials content. The six recipes of various composition materials content were compacted for the green body of palm slag composites (palm slag, phenolic resin, steel fiber, graphite, and alumina). Each recipe was mixed to obtain a homogenous mixture and then the mixtures were prepared by compression molding. The compressive strength of palm slag composites was determined by a universal testing machine. The wear behavior of palm slag composites was calculated from the data determined using polisher grinding machine. The SEM micrographs were used for surface observation. The compressive strength of palm slag composite was determined and it was found the compressive strength increases with increasing steel fiber content and palm slag content decreased. The wear behavior decreases with increasing alumina content.

KEY WORDS: *compressive strength, wear behavior, palm slag composites, materials content*

1.0 INTRODUCTION

Palm slag is considered can be used effectively as alternative filler for the brake pad composite [1, 2]. Because of its advantages such as zero filler material cost, palm slag composites are prospective structural materials for automotive brake pad. The study on mechanical properties and morphology of palm slag has shown that palm slag has better wear properties than that of the conventional asbestos based brake pads [2].

The compressive response of palm slag composites is an essential part of basic property data required for optimized composite structure design [3, 4]. Although numerous studies relate to the compressive behaviors have been conducted, the effect of various composition materials content in compression has not been well understood.

In this paper, compressive strength and wear behavior of palm slag composites at room temperature using various composition materials content areobserved experimentally. The main objectives of this study are first to investigate the effect of various percentage weight (%wt) of materials content under compressive strength, wear behavior and then look into the abrasive wear mode on the microstructure.

2.0 EXPERIMENTAL METHOD

2.1 Specimen preparation

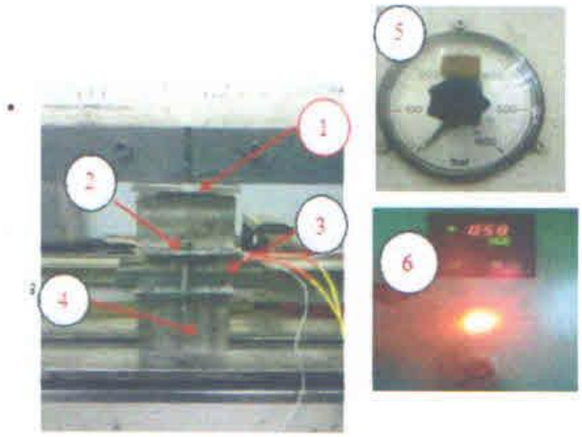
The composition of palm slag composites used in this study is shown in Table 1.

Table 1: Material content (%wt) in the composite brake pad material

Materials	No. specimen					
	1	2	3	4	5	6
Phenolic resin	20	20	20	20	20	20
Steel fiber	40	20	20	30	20	20
Graphite	10	30	10	10	20	10
Al_2O_3	10	10	30	10	10	20
Palm slag	20	20	20	30	30	30

Palm slag was obtained from local palm oil producer. Phenolic resin was selected as the binder steel fiber was used for reinforcement, graphite was used as the lubricant, and alumina was used as the abrasive [2] respectively.

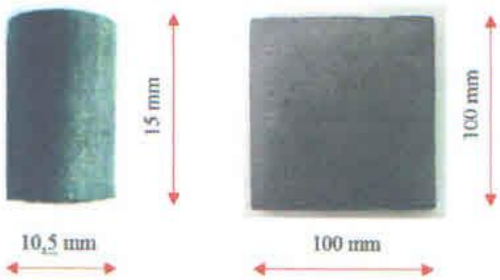
Each specimen was mixed to obtain a homogeneous mixture of ingredients. It is then compressed at a pressure of 15 MPa using a shearing bending machine for the plate of the brake pad composite. Then, the plate was compacted further and cured using a hot press at 150 °C with 60 tons of compressive molding pressure for ten minutes as shown in Fig. 1. At the end of the hot-pressing process, samples were taken out from the molds, to allowto coolat room temperature.



1. *Punch*
2. Dies
3. Heater
4. Support
5. Pressure gauge
6. Temperature control

Figure 1: Experimental setup of hot press for the brake pad composite preparation

2.2 Testing methods
The compressive strength of the brake pad composites was determined by a universal testing machine (UTM) at room temperature. Each sample, described by an initial cross-sectional area of 86.6 mm² as shown in Fig. 2, was placed between thelower cross member and lower cross head of the UTM, and the load was applied at a cross-head speed of 2.5 mm/min. The load at which failure occurred was used to calculate the compressive strength of the sample.



a. Compressive test b. Abrasion test

Figure 2: Dimensions and geometry of a specimen

The wear of the brake pad composites was calculated based ondetermineddata using a transversal polisher grinding machine (as per ASTM standard D4060-95 for abrasion resistance organic coatings by the steel abraser). For each material, six specimens, has nominal dimensions of 100×100×10 mm (Fig. 2b). The specimen was placed on a steel abraser with a load of 5 N and a wheel speed of 800 rpm. Before and after wear test, the surface of each specimen was observed under scanning electron microscope (SEM).

3.0 EXPERIMENTAL RESULTS and DISCUSSIONS

The typical density of palm slag brake pad composites using various percentage weight of materials content is shown in Fig. 3, respectively. The density of palm slag composite increases along with steel fiberincreasesin percentage. This is because the density of steel fiber is higher than that of other materials.

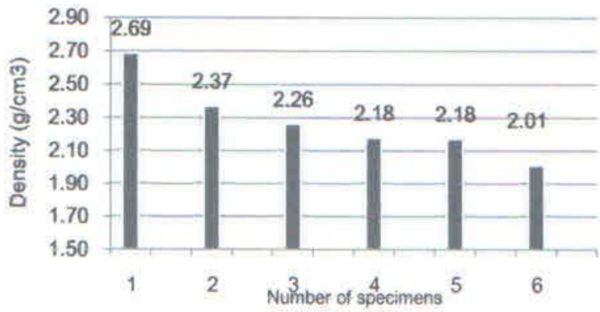


Figure 3: Density of brake pad composite using various percentage weight of materials content

Figure 4 shows the averaged compressive strength of brake pad composite using various percentage weight of materials content. It was observed in the current compressive test, as well as in Reference [2], that compressive strength dependence on percentage weight of steel fiber. Because of steel fiber as the reinforcement of composites, compressive strength of brake pad increased with the increase in percentage of steel fiber weight. With increasing percentage weight of steel fiber, the compressive strength of brake pad composite changes from low compressive strength and low density to more stable compressive strength behavior, see Figs 3 and 4.

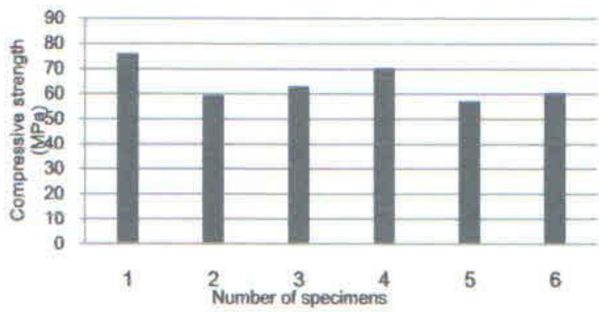


Figure 4: Compressive strength of brake pad composite using various percentage weight of materials content

Figure 5 shows the wear behavior of brake pad composite using various percentage weight of materials content. It is clearly seen that wear behavior decrease significantly with the increase of percentage weight of alumina. The abrasive material was used in brake pad composite is alumina. The wear behavior of brake pad composite depend on percentage weight of alumina. It is clearly seen that wear behavior of palm slag brake pad composite decrease significantly with alumina percentage weight.

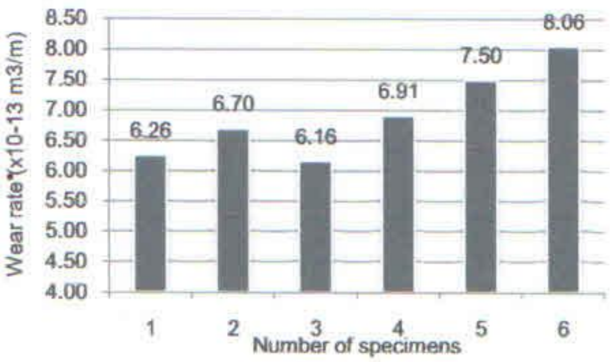


Figure 5: Wear rate of brake pad composite using various percentage weight ofmaterials content

Composition analysis of palm slag brake pad composite was examined by EDS. The microscopic surface of palm slag brake pad is shown in Figs. 6 and 7. The map sum spectrum indicates that compressive strength and wear behavior are known dependent on various percentage weight materials content. With increasing carbon percentage weight, higher wear behavior was occurred to each specimen. Note that the materials content indicated by EDS layered image in Fig. 6 is the specimen number 5.

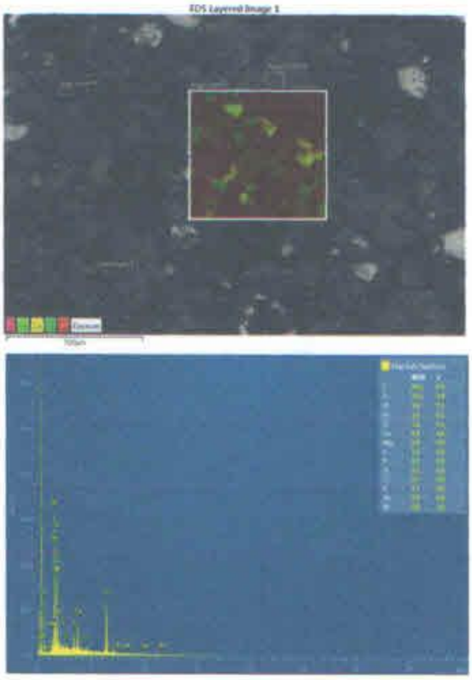
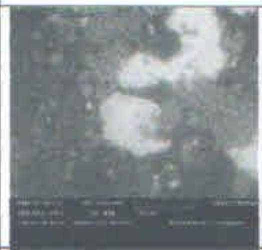
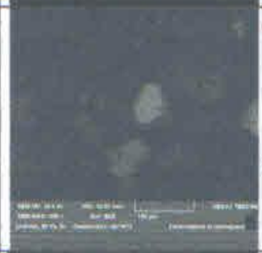
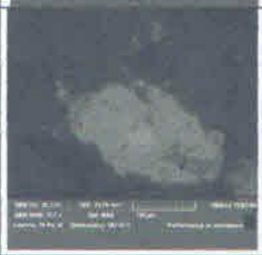
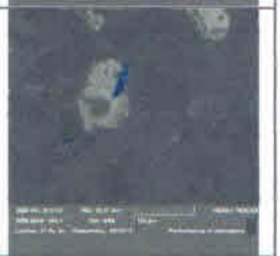
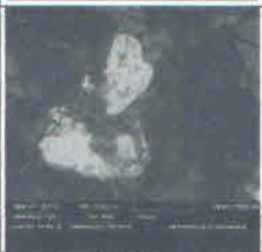
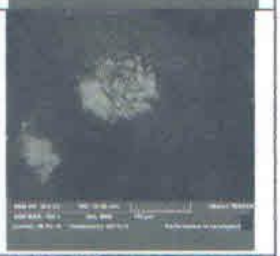
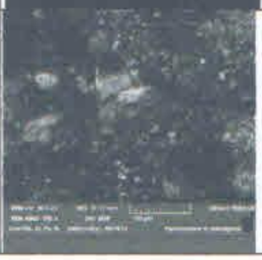
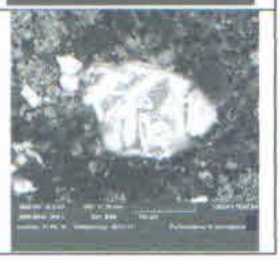


Fig. 6 EDS layered image of specimen no. 5

In order to understand the percentage weight materials content, SEM observation was conducted on each various specimen. Fig. 7 shows the SEM micrographs of microstructure before and after wear test of palm slag composites using various percentage weight of materials content. Based upon SEM images, it is clear that materials content change the microstructure of palm slag brake pad composite. The change in the distribution phenolic resin, steel fiber, graphite, alumina and palm slag of palm slag brake pad composite may be due to the changed microstructure which is influence for the compressive strength and wear behavior. Of course, further study is needed to fully understand the mechanism.

No. specmen	Before	After
1		
2		
3		
4		
5		

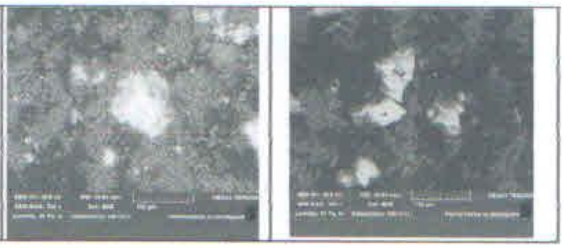
6		

Figure 7: Scanning electron micrographs of the surfaces of brake pad composites before and after wear test

The above results are facts value for engineers and technicians in the automotive industry who use non asbestos as a filler brake pad composite. Since the palm slag is considered able to be used effectively asalternative filler for the brake pad composite, understanding of their behavior under compressive and wear loading is essential and can be useful in finite element simulations of the structures made of these materials. The understanding of their behavior allows one to utilize that information for appropriate selection of palm slag brake pad composite based on certain design criteria or operational needed.

4.0 CONCLUSIONS

The compressive strength and wear behavior of palm slag composites using various percentage weight of materials content were studied experimentally. Six different weight percentage of materials content palm slag brake pad composite have been studied. The results are summarized as follows: (1) The compressive strength of palm slag composite was determined and it was found the higher compressive strength, the higher steel fiber content, the lower the percentage weight of palm slag. (2) Under abrasion loading, wear behavior of palm slag brake pad composite is dependence on percentage weight of alumina. The wear behaviorof palm slag brake pad composite decrease significantly with alumina percentage weight. (3) The compressive strength of palm slag brake pad composite around 76.2 MPa whereas the wear rate is around 6.26×10^{-13} m^3/m.

ACKNOWLEDGEMENTS

The authors sincerely acknowledge the Directorate General of Higher Education of Indonesia (DIKTI) which supported this research by Hibah Bersaing (Competitive Grant) program in 2015.

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Further studies on the compressive strength and wear behavior of palm slag brake pad composite

Muftil Badri M
Adhy Prayitno
Dodi Sofyan Arief
Department of Mechanical Engineering
Faculty of Engineering, Universitas Riau

Introduction

Palm slag is considered can be used effectively as alternative filler for the brake pad composite.

Palm slag composites are prospective structural materials for automotive brake pad.

The study on mechanical properties and morphology of palm slag has shown that palm slag has better wear properties than that of the conventional asbestos based brake pads.

Objectives

To investigate the compressive and wear behavior of palm slag brake pad composite.

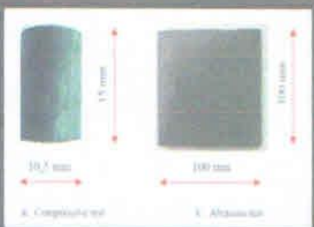
Experiment

The composition of palm slag brake pad composite:

Materials	No. specimen					
	1	2	3	4	5	6
Phenolic resin	20	20	20	20	20	20
Steel fiber	40	20	20	30	20	20
Graphite	10	30	10	10	20	10
Al_2O_3	10	10	30	10	10	20
Palm slag	20	20	20	30	30	30

- Mixing process: rotating 180 rpm, 15 minutes.
- Uniaxial compacted pressure: 15 MPa, at room temperature.
- Compacted and cured using hot press: 60 ton, 150°C, 5 minutes.
- After compacted: cooling at room temperature.

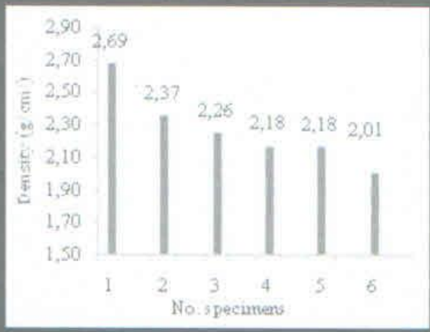
The compressive strength of the brake pad composites was determined by a universal testing machine (UTM) at room temperature.



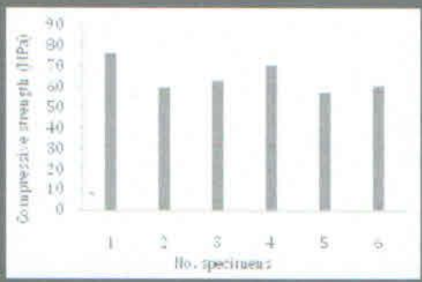
The wear of the brake pad composites was calculated based on determined data using a transversal polisher grinding machine for abrasion resistance organic coatings by the steel abraser.

Results

The typical density of palm slag brake pad composites using various percentage weight of materials content.

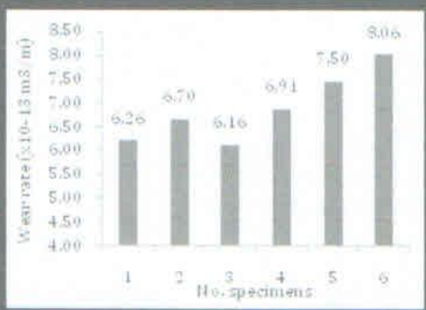


The averaged compressive strength of brake pad composite using various percentage weight of materials content.



It was observed in the current compressive test that compressive strength dependence on percentage weight of steel fiber.

The wear behavior of brake pad composite using various percentage weight of materials content. It is clearly seen that wear behavior decrease significantly with the increase of percentage weight of alumina.



The change in the distribution phenolic resin, steel fiber, graphite, alumina and palm slag of palm slag brake pad composite may be due to the changed microstructure which is influence for the compressive strength and wear behavior.

(No. 5, before wear test)

(No. 5, after wear test)

Conclusions

- The higher steel fiber content, the lower the percentage weight of palm slag.
- The wear behavior of palm slag brake pad composite decrease significantly with alumina percentage weight.
- The compressive strength of palm slag brake pad composite around 76.2 MPa whereas the wear rate is around 6.26×10^{-11} m^3/m.

Future Developments

- More work is needed to improve:
  - thermal properties of materials
  - design of palm slag brake pad.
- Prototype palm slag brake pad development.
- Manufacturing process optimization.

Acknowledgements

The authors sincerely acknowledge:
- Directorate General of Higher Education of Indonesia (DIKTI) which supported this research by Hibah Bersaing (Competitive Grant) program in 2015
- Community Service and Research Institute of Universitas Riau, LPPM UR
- Materials Testing Laboratory, Manufacturing Technology Laboratory, Universitas Riau.

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Proceeding of Ocean, Mechanical & Aerospace

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Special Issues on Mechanical and Production in Engineering

REVIEW LETTER

No: 8/10/2015/POMAse/Vol.2/P-ST-05 8 October 2015

Dear Respect Prof/Dr/Mr/Mrs:
Dodi Sofyan Arief, Muftil Badri, Adhy Prayitno

Thank you for your manuscript.

Below are comments for paper entitled: **Computational simulation in compactor components for plate product of palm slag composites.**

Comments

Comments of reviewer as follows:

1. Basic mathematical equation should be written in text
2. English should be improved

Editor

It is required for the authors to revise the paper according comment from reviewer as mentioned above and resubmit by **20-October-2015.**

Yours Sincerely,

PAKMA
INTERNASIONAL
ILMUWAN INSINYUR

Hj. Jaswar Koto,
Prof, Dr, Eng, CEng, CMarEng

Chief-in-Editors,
Proceeding of Ocean, Mechanical & Aerospace -Science and Engineering-

Jurnal
Teknologi

Full Paper

COMPUTATIONAL SIMULATION IN COMPACTOR COMPONENTS FOR PLATE PRODUCT OF PLAM SLAG COMPOSITES

Article history
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20 October 2015
Received in revised form
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Accepted
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Department of Mechanical Engineering,
Faculty of Engineering, Universitas Riau, Indonesia

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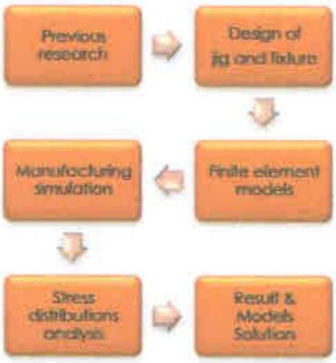
Graphical abstract



Abstract

Computational simulation of compactor components for plate product of palm slag composites has been investigated. The plate product of palm slag composites was compacted on a compression molding machinery using jig and fixture. Jig and fixture were modeled by finite element simulation to determine stress distributions of a jig and fixture. An advantage of having a finite element model of a compression molding machinery is that it can be quickly altered by designers. Further improvement of plate product compactnes can be tested through a manufacturing simulation. The influence of geometric shapes under static compression of compactor components was studied in detailed. The results shows that the geometric shapes of jig need to be improved against the stress concentration area. The length of fixture plate from supported location must be reduced against the maximum deflection at the end of fixture plate.

Keywords: Computational simulation, plate product, palm slag composites, jig and fixture

Abstrak

Simulasi komputasi komponen pemadat untuk produk pelat komposit slag sawit telah diteliti. Produk pelat komposit slag sawit dipadatkan pada mesin kompresi molding menggunakan jig dan fixture. Jig dan fixture dimodelkan dengan simulasi elemen hingga untuk menentukan distribusi tegangan dari jig dan fixture. Sebuah keuntungan dari menggunakan model elemen hingga dari mesin kompresi molding adalah bahwa hal itu dapat dengan cepat diubah oleh para perancang. Perbaikan lebih lanjut dari peralatan pemadat pelat produk dapat diuji melalui simulasi manufaktur. Pengaruh bentuk geometris bawah kompresi statis komponen pemadat dipelajari lebih rinci. Hasil penelitian menunjukkan bahwa bentuk-bentuk geometris dari jig perlu ditingkatkan terhadap daerah konsentrasi tegangan. Panjang pada pelat fixture dari lokasi pendukung harus dikurangi terhadap defleksi maksimum pada akhir pelat fixture.

Kata kunci: Simulasi komputasi, produk pelat, komposit slag sawit, jig dan fixture

1.0 INTRODUCTION

The simulation of jig and fixture subjected to compaction pressure is a complex problem due to interaction between jig and plate product of palm slag composite. A computational approximation has been developed for the jig and fixture interaction. In view of stress distribution and displacement of jig and fixture in compactor components for plate product is employed in this study. The objective of this study is to simulate a jig and fixture subjected to compaction pressure. The plate product of palm slag composite was compacted experimentally in hot static pressure in order to achieve more uniform compaction.

The computations of the pressure response are carried out using finite element codes. Information of stress distributions and displacement response of jig and fixture to compaction pressure is useful in manufacturing design to enhance their response to compaction pressure. Several simulations modeling, stress distributions and displacement of jig and fixture have been performed.

Consider the same 3D solid structure whose domain is divided in a proper manner into a number of tetrahedron elements with four nodes and four surfaces, as shown in Figure 1. A tetrahedron element has four nodes, each having three DOFs [1].

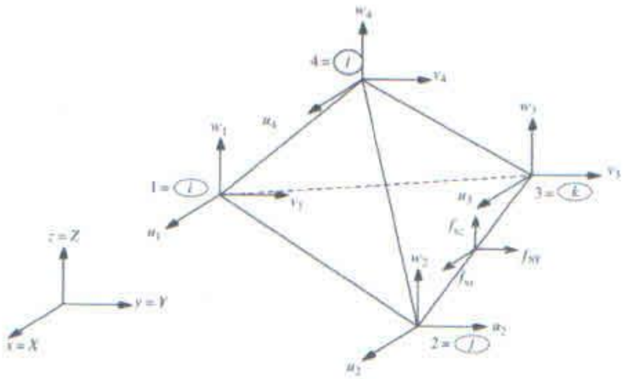


Figure 1: A tetrahedron element

(u, v and w), making the total DOFs in a tetrahedron element twelve, as shown in Figure 1. The nodes are numbered 1, 2, 3 and 4 by the right-hand rule. The local Cartesian coordinate system for a tetrahedron element can usually be the same as the global coordinate system, as there are no advantages in having a separate local Cartesian coordinate system. In an element, the displacement vector U is a function of the coordinate x, y and z, and is interpolated by shape functions in the following form, which should by now be shown to be part and parcel of the finite element method:

$$U^h(x,y,z) = N(x,y,z)d_e \tag{1}$$

It was mentioned that there are six stresses in a 3D element in total. The stress components are $\{\sigma_{xx}\ \sigma_{yy}\ \sigma_{zz}\ \sigma_{yz}\ \sigma_{xz}\ \sigma_{xy}\}$. To get the corresponding strains, $\{\varepsilon_{xx}\ \varepsilon_{yy}\ \varepsilon_{zz}\ \varepsilon_{yz}\ \varepsilon_{xz}\ \varepsilon_{xy}\}$:

$$\varepsilon = LU = LNde = Bde \tag{2}$$

where the strain matrix B is given by

$$B = LN = \begin{bmatrix} \partial/\partial x & 0 & 0 \\ 0 & \partial/\partial y & 0 \\ 0 & 0 & \partial/\partial z \\ 0 & \partial/\partial z & \partial/\partial y \\ \partial/\partial z & 0 & \partial/\partial x \\ \partial/\partial y & \partial/\partial x & 0 \end{bmatrix} N \tag{3}$$

2.0 COMPUTATIONAL SIMULATION

Figure 1 shows the compressive molding pressure, p that has been measured using pressure gauge during compaction process. The finite element model for compactor as shown in Figure 2 was creating using Autodesk Inventor [2]. In FEM model creation, compactor divided into two components: jig and fixture. The static compaction pressure was 59 MPa, the sintering temperature was 150°C [3]. The material properties of steel alloy were determined [4]. Jig and fixture volume were 1.64 mm³ and 1.16 mm³, the compactor is comprised entirely of tetrahedral elements.

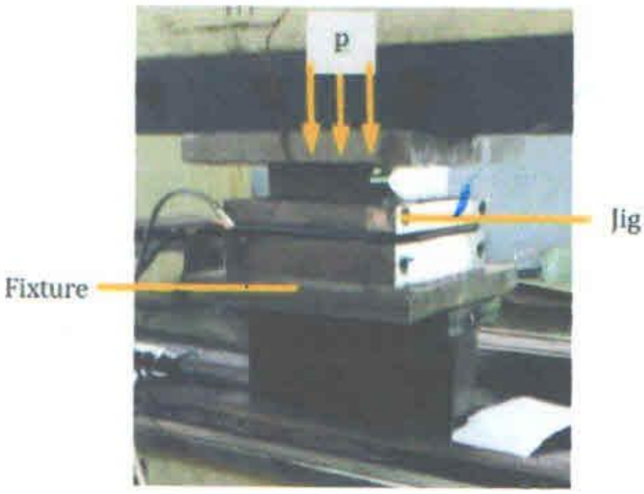


Figure 1: Jig and fixture for plate product of palm slag composites under investigation

Jig and fixture were subjected to constant displacement, the loading type was taken, instead of using constant compaction pressure as shown in Figure 2.

The boundary conditions were applied in stress analysis both jig and fixture. For jig simulation, the lateral deflection on four edges was constrained. For fixture simulation, the lateral deflection and rotational movement on four edges were constrained.

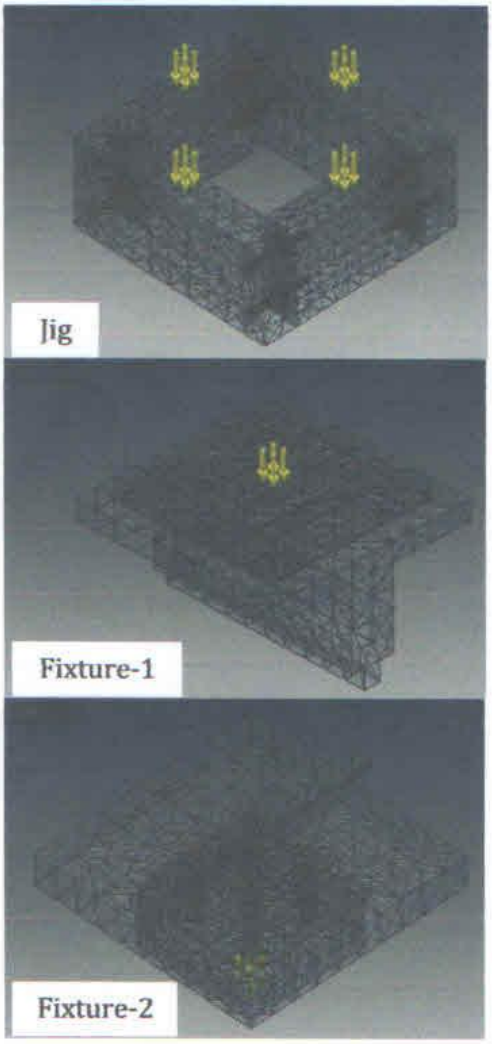


Figure 2: Finite element mesh of jig and fixture

3.0 RESULTS AND DISCUSSION

3.1 Stress distribution

The analysis of computational simulation in manufacturing components focuses on determination and estimation of the stress distribution and displacement during compaction process, which regarded as the critical location of the compactor components. In the case of stress distribution approach, it is assumed that a critical stress at the surface distributes on a preferred plane which the normal stress-strain reaches its maximum.

Figure 3 shows Von Mises stress distribution of jig and fixture components. Computational simulation identifies the critical jig element was occurred at the bottom of the jig plates. The critical fixture element was occurred at the contacting plate part direct with the plate product.

A comparison of the stress response for jig and fixture shows that at the bottom of plate is only 2.47% higher than that for fixture plate. The maximum stress for the centre of the bottom fixture is 67.37% higher than that the top plate of fixture. This indicates the contact location of fixture to the plate product has significant effect on the manufacturing process of palm slag composites whereas relatively less influences on the jig plate.

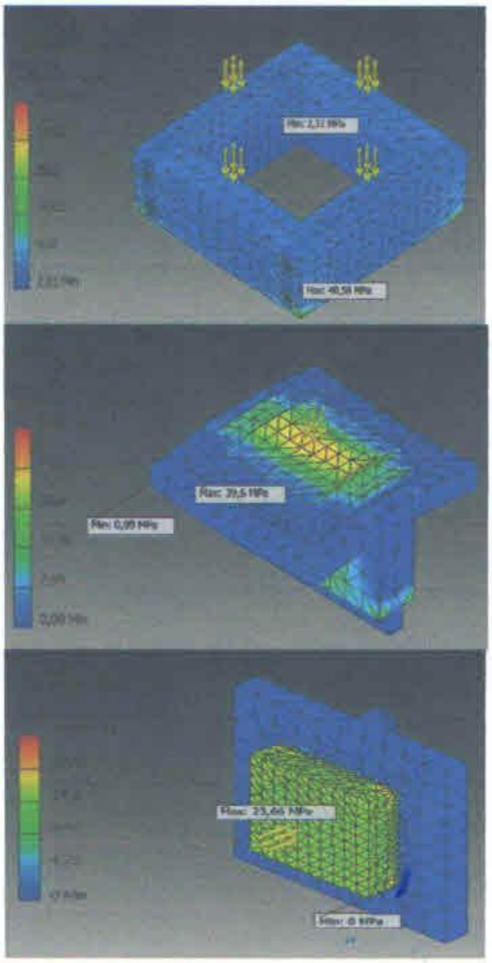


Figure 3: Von Mises stress distribution at p = 15 MPa

The location of jig and fixture components causes higher predictions of stress distribution on compacting process while the variation of compaction pressure gives a lower prediction of stress response. The stress behavior depends on geometric shapes of jig and fixture. Since the maximum values of stress was occurred at stress concentration area, this verifies that initiation of fracture was occurred around this location.

3.2 Displacement

In order to have a clear view of stress distribution of jig and fixture as shown in Fig. 3, let us observed the displacement of jig and fixture presented in Fig. 4. Computational simulation identifies the critical jig element was occurred at top of the jig plates. It is observed that the displacement response in fixture side exhibits much higher value than those other parts of fixture. It is due to the fact that the stress distribution influence displacement which causes a prediction of resulting response in fixture components. It is also observed that the values of displacement response for the jig components are lower than that of fixture components. The maximum value of displacement was not occurred at stress concentration area, whereas the maximum displacement occurred at the end of fixture plate. This is because the maximum displacement corresponds to the length of fixture plate from supported location.

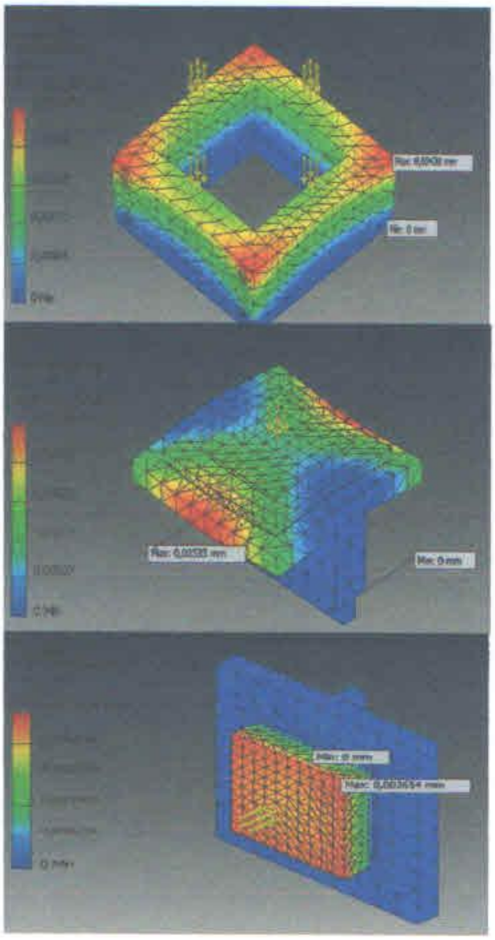


Figure. 4: Displacement of jig and fixture

Finally, it is considered important to evaluate a quantitative comparison among displacement of jig and fixture. A comparison of displacement response for jig and fixture shows that at the top of jig plate is 16.84% higher than that at the end of fixture plate. The maximum displacement for the end of fixture plate is only 2.1% higher than the maximum displacement at the jig plate.

4.0 CONCLUSION

In this paper, computational simulation of compactor components for plate product of palm slag composites was analyzed. The influences of geometric shapes on the static compression of compactor components were studied detailed and results show that the geometric shapes of jig must be improved against the stress concentration area. The length of fixture plate from supported location must be reduced against the maximum deflection at the end of fixture plate.

Acknowledgement

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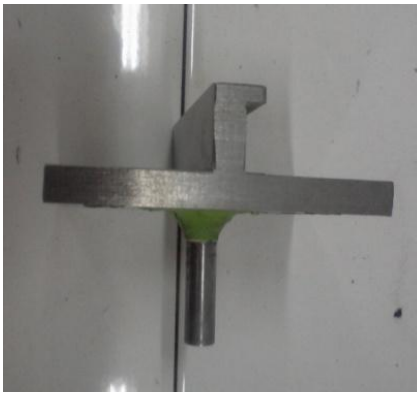
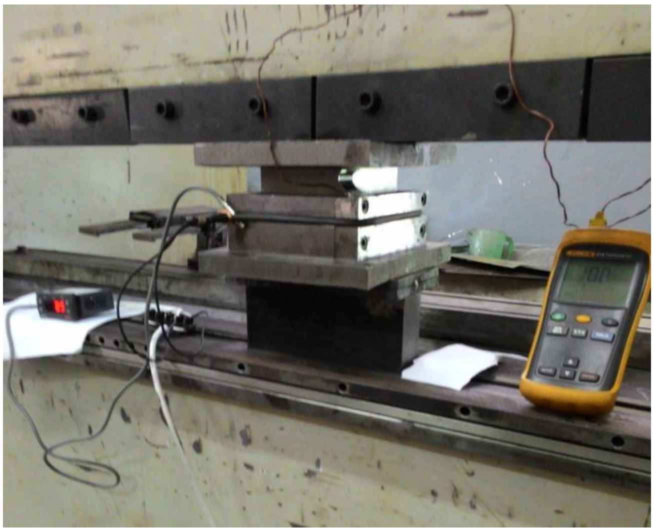
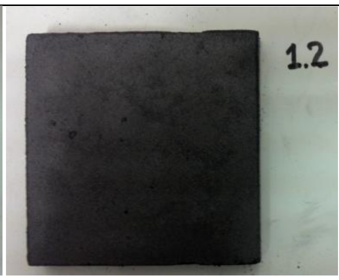
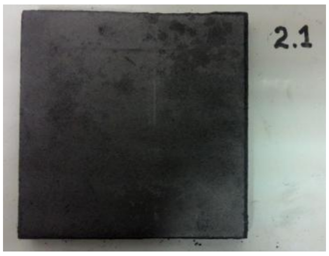
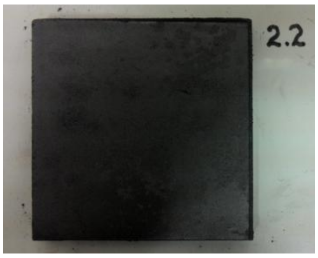
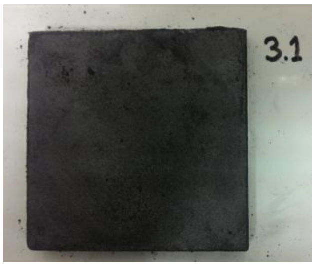
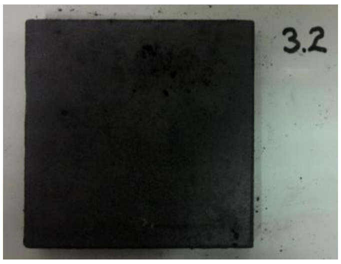
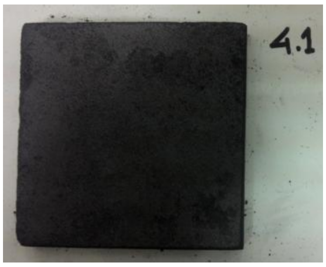
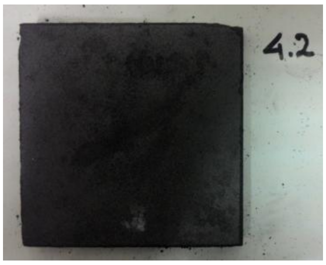
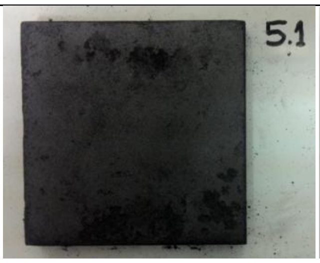
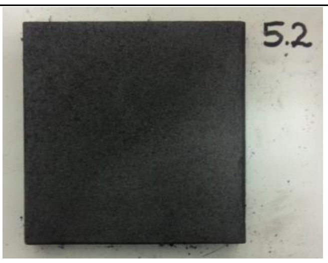
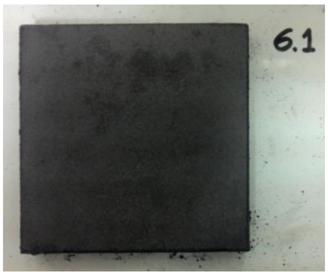
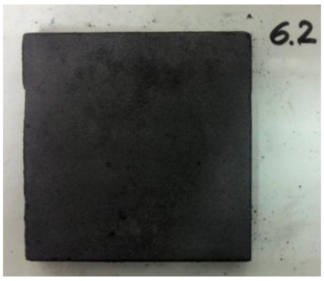
4. Produk Penelitian

No.	Nama Produk	Gambar/Foto Produk	Spesifikasi
1.	Peralatan Produksi Pelat Komposit sebagai Bahan Baku Kanvas Rem Cakram.	Desain: Peralatan produksi:   	

			
2.	Pelat Komposit dengan Massa Bahan Baku yang Bervariasi.	       	

		   	
3.	Prototipe Kanvas Rem Cakram		Komposisi: phenolic resin, steel fiber, alumina, graphite, palm slag. Dimensi standar Honda Supra-X