KEMENTERIAN KESEHATAN REPUBLIK INDONESIA

farmalkes

GERMAS
Gerakan Masyarakat Hidup Sehat

WATER HYACINTH (EC.GONDOK) AS FIBER REINFORCEMENT COMPOSITE FOR PROSTHETICS SOCKET

POLITEKNIK KESEHATAN KEMENTERIAN KESEHATAN JAKARTA I

DHANNY WIDHATA MAHARDHIKA, B.SC.PO

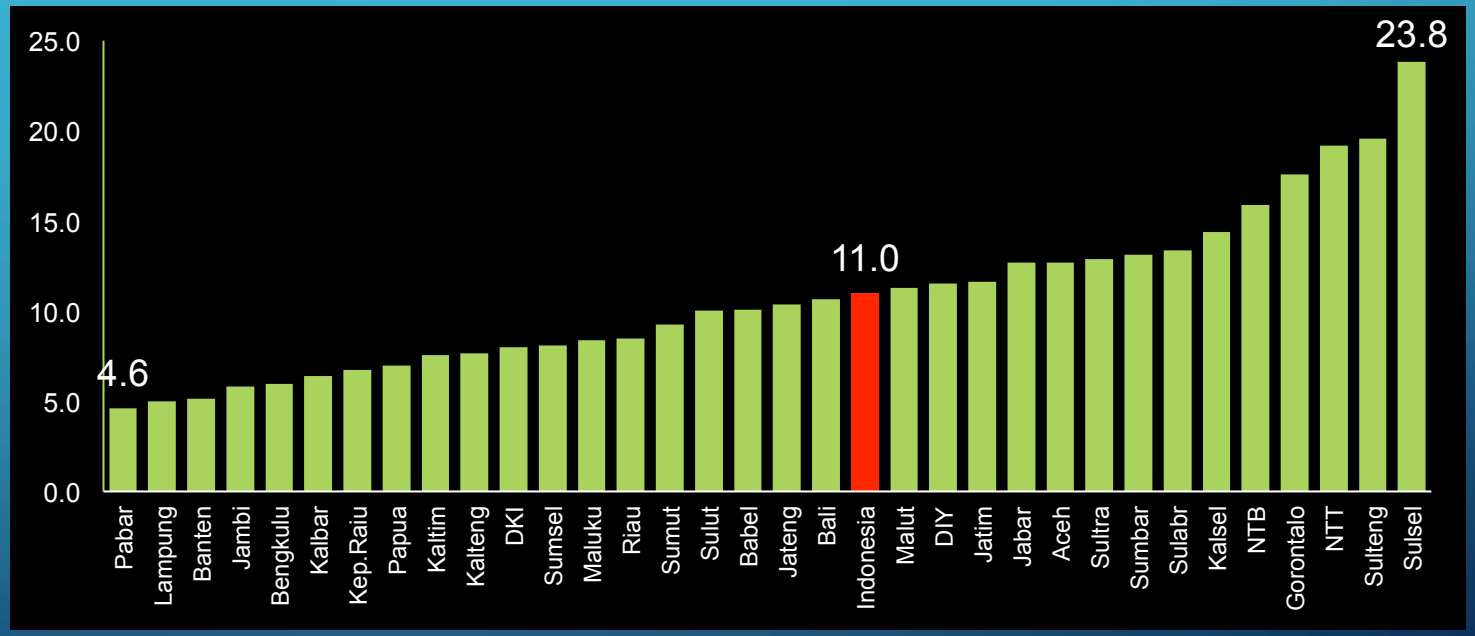
Lembaga Ilmu Pengetahuan Indonesia
Pusat Penelitian Biomaterial
Indonesian Institute of Sciences
Research Center for Biomaterials

DIPONEGORO UNIVERSITY
CBIOM3S

TECHNO FARMALKES

BACKGROUND

- People with disabilities in Indonesia by WHO 2011; 15%
- SUSENAS 2009, 33.75% overall disabilities
- RISKESDAS 2018, 11 % extremity disability



- Needs for the assisted device

REPUBLIKA.CO.ID

Indonesia Masih Bergantung pada Alat Kesehatan Impor

SUARA.COM

92 Persen Kebutuhan Alat Kesehatan Masih Impor

Teror Eceng Gondok di Danau Limboto

kompasiana

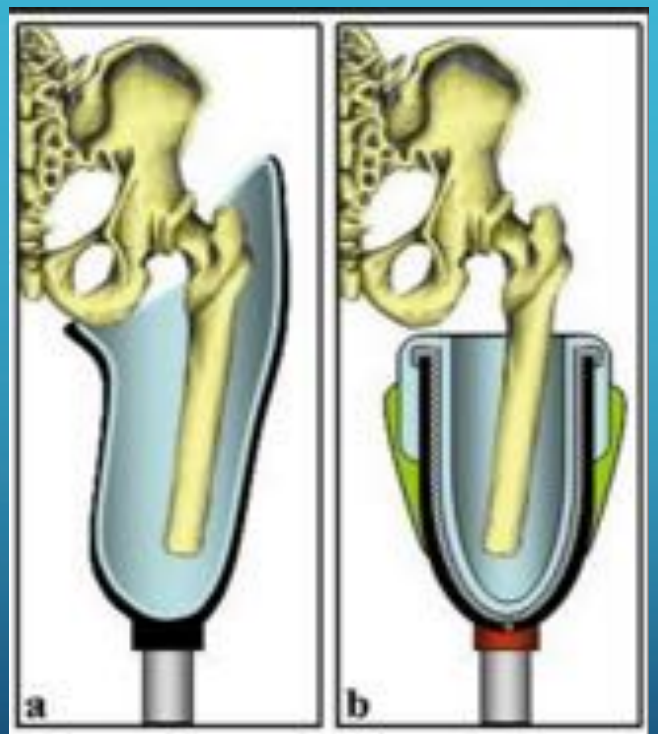
Eceng Gondok di Rawa Pening

Wow, Butuh 13 Tahun Bersihkan Eceng Gondok di Danau Tondano, Jika Hanya Satu Alat

Laporan Wartawan Tribun Manado Ryo Noor

TRIBUNMANADO.CO.ID, TOMOHON - Perkiraannya membutuhkan waktu 13 tahun untuk membersihkan masalah eceng gondok jika mengandalkan satu unit mesin pembasmi eceng gondok, Aquatic Weed Hunter (AWH) di Danau Tondano.

COMMON PROSTHETICS SOCKET MADE OUT OF PLASTIC



Examples of transfemoral sockets: (a) Ischial Containment and (b) Sub-ischial.


Environmental Problem

SOLUTION :
WATER HYACINT AS REINFORCEMENT COMPOSITE MATERIALS

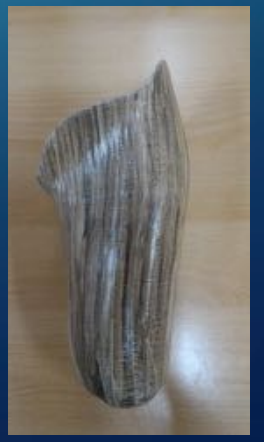
Fresh Plant

Dried Proccess

Weaving

laminated

socket



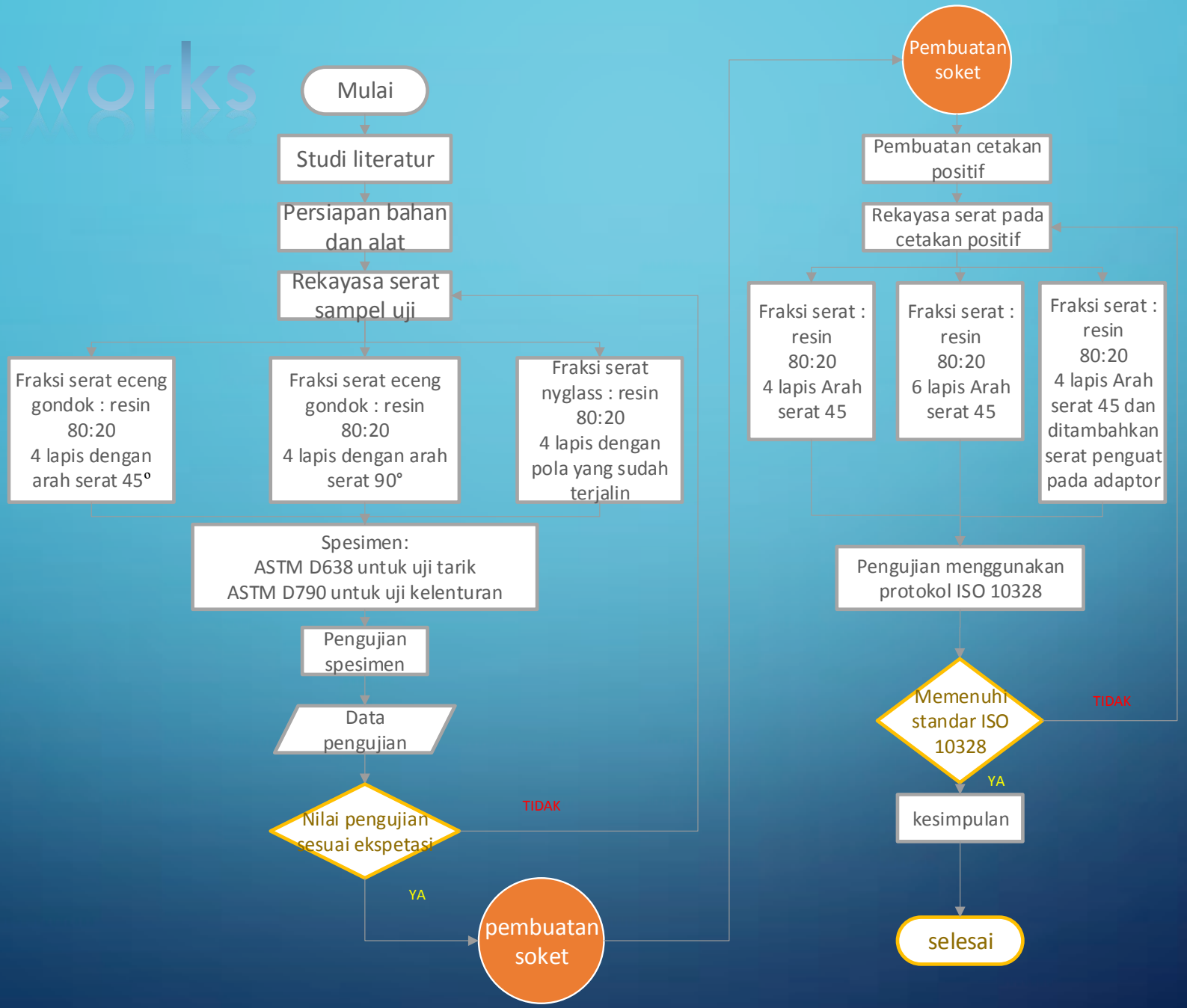
assembly

users

WHY MUST BE WATER HYACINTH

- Is a natural fiber
- **Go Green**, this fiber can be composed by nature
- The production process is easy to apply and has economic value
- Empowering the community
- Not as rubbish but as a solution
- Used as other things in the form of household industries and handicrafts: bags, sandals, mats, etc.

Frameworks

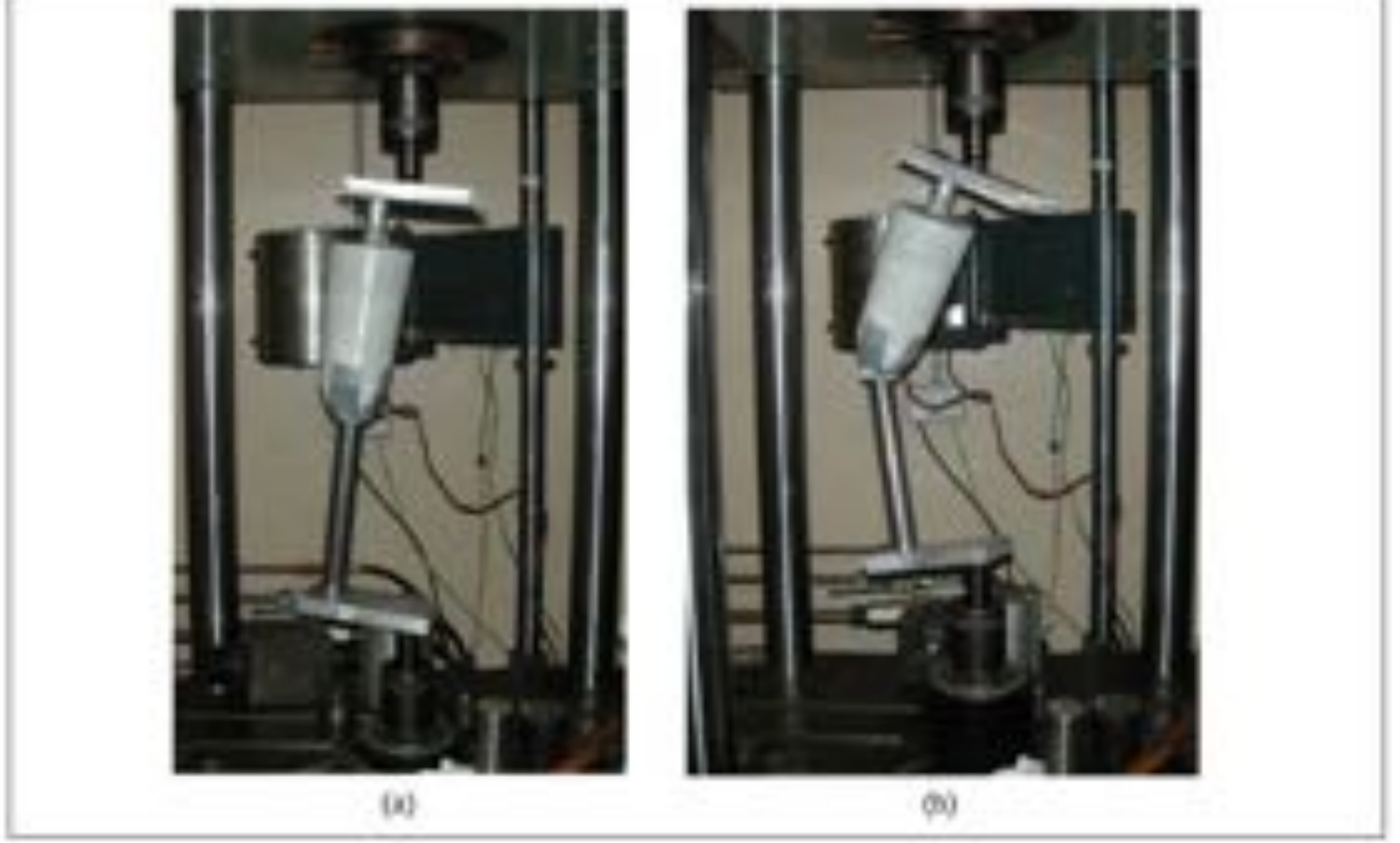

Mulai
Studi literatur
Persiapan bahan dan alat
Rekayasa serat sampel uji
Fraksi serat eceng gondok : resin 80:20 4 lapis dengan arah serat 45°
Fraksi serat eceng gondok : resin 80:20 4 lapis dengan arah serat 90°
Fraksi serat nyglass : resin 80:20 4 lapis dengan pola yang sudah terjalin
Spesimen: ASTM D638 untuk uji tarik ASTM D790 untuk uji kelenturan
Pengujian spesimen
Data pengujian
Nilai pengujian sesuai ekspetasi
TIDAK
YA
pembuatan soket
Pembuatan soket
Pembuatan cetakan positif
Rekayasa serat pada cetakan positif
Fraksi serat : resin 80:20 4 lapis Arah serat 45
Fraksi serat : resin 80:20 6 lapis Arah serat 45
Fraksi serat : resin 80:20 4 lapis Arah serat 45 dan ditambahkan serat penguat pada adaptor
Pengujian menggunakan protokol ISO 10328
Memenuhi standar ISO 10328
TIDAK
YA
kesimpulan
selesai

FAILURE ANALYSIS

- Maximum stress theory
- Maximum strain theory
- Possibility modes of failure:
  - First – Ply Failure
  - Ultimate Laminate Failure (ULF)
  - Inter – laminar failure

LITERATURE REVIEW

Prosthetic limb sockets
plant-based composite



(a) (b)

Figure 5. The standard layup socket mounted on the force loading machine (a) before and (b) after loading to destruction. Failure of the socket occurs at the distal end where the pyramid connector is attached to the socket.

Table 1. The fibre and resin combinations used for the four test sockets and their loadings at failure. The plant oil resin and ramie fibres socket fails at a higher loading than the standard layup. All sockets were manufactured with a final layer of Perlon stockinette. The plant oil resin and Nyglass socket (4a) test was repeated (4b) due to foaming of the resin (see text for explanation).

Socket	Fibres	Resin	Wall thickness at distal end (mm)	Loading at failure (N)
1	Ramie stockinette	Plant oil resin	9.5 ± 0.7	6180
2	Nyglass stockinette	80:20 Acrylic resin	4.5 ± 0.6	5808
3	Ramie stockinette	80:20 Acrylic resin	6.0 ± 0.3	4657
4a	Nyglass stockinette	Plant oil resin	–	2223
4b	Nyglass stockinette	Plant oil resin	6.5 ± 0.4	4255

Table 2. Average (of five) ultimate tensile strength test results of the plant oil resin and natural fibre composite test pieces. For comparison, the data for test pieces made with the mineral fibres glass and carbon are included. Our results show that the combination of the plant oil resin with banana or ramie fibres gives the highest ultimate strength.

Fibre	Tensile strength (MPa)	Strain (%)	Young's modulus (GPa)
Banana	82.7 ± 5.0	3.1 ± 0.4	3.4 ± 0.005
Ramie	80.8 ± 8.2	3.1 ± 0.7	4.0 ± 0.007
Seacell	66.1 ± 2.8	7.3 ± 0.6	2.5 ± 0.009
Flax	59.5 ± 5.0	2.7 ± 0.3	2.8 ± 0.007
Soya	55.8 ± 2.7	14.8 ± 1.2	1.7 ± 0.007
Corn	38.9 ± 0.8	36.5 ± 5.0	1.5 ± 0.001
Cotton	36.0 ± 4.1	3.8 ± 0.2	1.6 ± 0.002
Bamboo	29.9 ± 3.4	10.9 ± 2.9	1.1 ± 0.002
Carbon	1227.5 ± 208.9	2.0 ± 0.2	66 ± 0.046
Glass	56.8 ± 5.0	3.1 ± 0.1	2.4 ± 0.001
Neem (plant oil resin)	28.4 ± 7.3	19.5 ± 10.0	1.0 ± 0.001

RESULT OF TENSILE TEST

- composition water hyacinth : matrix = 80 : 20
- 4 layer

Arah serat	Nomor Speciment	Tensile strength (σ) Mpa	Rerata tensile strength (σ) Mpa	Maximum Load (Kg)/ mm^2	Rerata maximum Load (Kg)/ mm^2
Arah serat 0°	1A	42.4	44.10	122	138.6
	1B	46.02		157	
	1C	43.9		137	
Arah serat 45°	2A	47.5	47.19	172	168.6
	2B	46.02		157	
	2C	48.06		177	
Arah serat 90°	3A	46.02	46.34	157	160.3
	3B	47.5		172	
	3C	45.5		152	
Nyglass fibre	4A	43.9	42.93	137	127.1
	4B	42.4		122	
	4C	42.5		122.5	

RESULT OF FLEXURE TEST

- Composition of fibre with 45° : matrix = 80 : 20
- 4 layers

Jenis Komposit	No Spesimen	Maksimum Strain Nilai Kelenturan (%)	Modulus of Rupture (MoR) / Nilai Patahan (N/ mm2)	Maksimum Force (N)
Serat 45°	E 45 1	2.75653	20.2013	128.125
	E 45 2	5.52325	21.9643	120.313
	E 45 3	3.52984	23.4091	117.188
	E 45 4	4.06293	23.7069	129.688
	E 45 5	5.77104	23.8955	151.563
	E 45 6	4.13012	25.6649	148.438
	E 45 7	3.32711	20.3639	142.188
	E 45 8	3.62162	23.3749	148.438
	E 45 9	3.97362	19.8024	148.438
	E 45 10	3.21202	24.2178	139.063
Rerata		3.93828	82.698	178.125

LAMINATING PROCESS OF SOCKET PROSTHESIS

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