DOBIVANJE VLAKANA IZ LIGNOCELULOZNE BIOMASE

Zorana KOVAČEVIĆ[1], Mateja GRUBOR[2], Slaven ZJALIĆ[3]

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[2]Sveučilište u Zagrebu Agronomski fakultet, Zavod za mehanizaciju poljoprivrede
[3]Sveučilište u Zadru, Odjel za ekologiju, agronomiju i akvakulturu

UVOD

Iako je zbog pandemije COVID-19 došlo do privremenog smanjenja emisije stakleničkih plinova i dalje je zabilježen globalni rast koncentracije CO_2, CH_4 i N_2O plinova

Više od **1600** smrtnih slučajeva povezanih s toplinskim valovima i požarima

Pothranjenost **821 mil.** ljudi djelomično zbog suša

Više od **35 mil.** ljudi zahvaćeno poplavama

2018. god. je 31. uzastopna godina s **negativnom masenom ravnotežom ledenjaka**

Smanjenje razine kisika u oceanima za **1-2%** od sredine prošlog stoljeća

Acidifikacija oceana se nastavlja i **padaju globalne razine pH**

Klimatske promjene negativno utječu na **ekosustav tresetišta**

Raseljeno preko **2 mil.** ljudi uslijed katastrofa povezanih s vremenskim i klimatskim događajima (suše, poplave, oluje)

2020. je zabilježena kao **jedna od tri najtoplije godine** u povijesti praćenja podataka od 1880.

Izvor: Svjetska meteorološka agencija WMO (https://public.wmo.int/en)

UVOD

- PARIŠKI SPORAZUM (2015.)

Ograničenje globalnog zatopljenja na znatno ispod 2 °C

- PROGRAM ODRŽIVOG RAZVOJA UN-a do 2030. (2015.)

17 globalnih ciljeva održivog razvoja

- DIREKTIVA O ENERGIJI IZ OBNOVLJIVIH IZVORA 2009/28/EZ, preinaka: Direktiva EU 2018/2001) (2018.)

Udio energije iz obnovljivih izvora u ukupnoj potrošnji energije mora biti 32% do 2030. godine

L 328/102 HR Službeni list Europske unije 21.12.2018.

Primjenjuju se i sljedeće definicije:

1. „energija iz obnovljivih izvora" ili „obnovljiva energija" znači energija iz obnovljivih nefosilnih izvora, primjerice energija vjetra, solarna energija (toplinska i fotonaponska) te geotermalna energija, energija iz okoliša, energija plime, oseke i druga energija oceana, hidroenergija, biomasa, plin dobiven od otpada, plin dobiven iz uređaja za obradu otpadnih voda i bioplin;

- EUROPSKI ZELENI PLAN (2019.)

Smanjenje emisije stakleničkih plinova za najmanje 40 %
(s obzirom na razine iz 1990.) do 2030.
Klimatska neutralnost EU do 2050.

- PRVI EUROPSKI PROPIS O KLIMI (2020.)

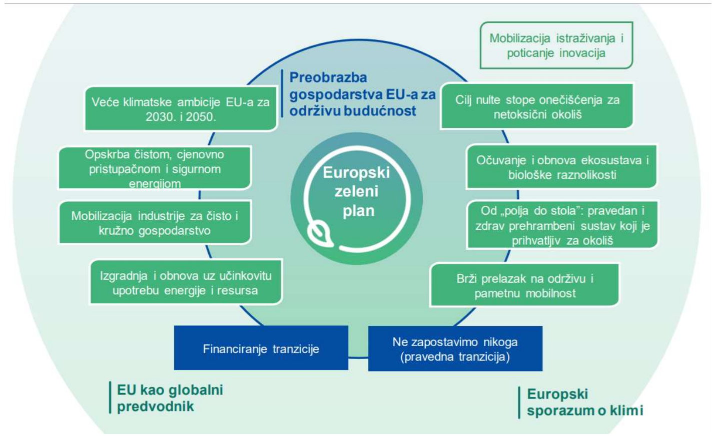
U EU zakonodavstvo ugrađen cilj utvrđen zelenim planom

- STRATEGIJA EU ZA BIORAZNOLIKOST do 2030. (2020.)

Ne nanositi štetu!!!!!
3 milijarde novih stabala u EU do 2030.

- PLAN ZA POSTIZANJE KLIMATSKOG CILJA DO 2030. (2020.)

Smanjenje emisije stakleničkih plinova za najmanje 55 %
(s obzirom na razine iz 1990.) do 2030.
Povećanje energije iz obnovljivih izvora u ukupnoj potrošnji energije s 32% na 38-40 % u 2030. godini

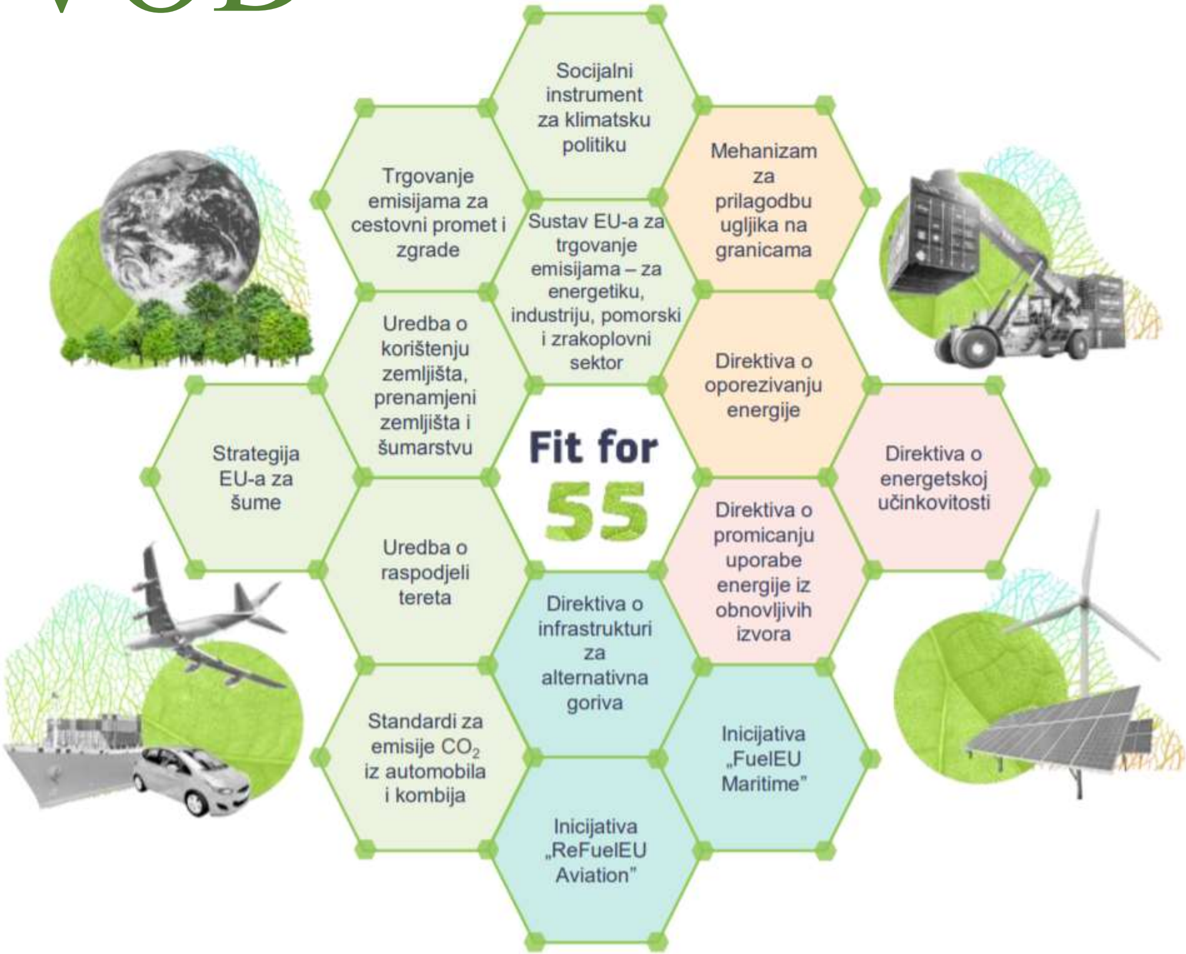


- DIREKTIVA O EKOLOŠKOM DIZAJNU 2009/125/EZ (2009.)
- AKCIJSKI PLAN ZA KRUŽNO GOSPODARSTVO (2020.)

Naglasak na sprečavanju nastanka otpada i na gospodarenju otpadom

- NOVA STRATEGIJA EU ZA ŠUME do 2030. (2021.)

UVOD



- SPREMNI ZA 55% (2021.)

Paket zakonodavnih prijedloga

Informacije, opcije i poticaji za građane EU

Priprema EU za klimatski neutralnu budućnost

European Commission

BIOMASA

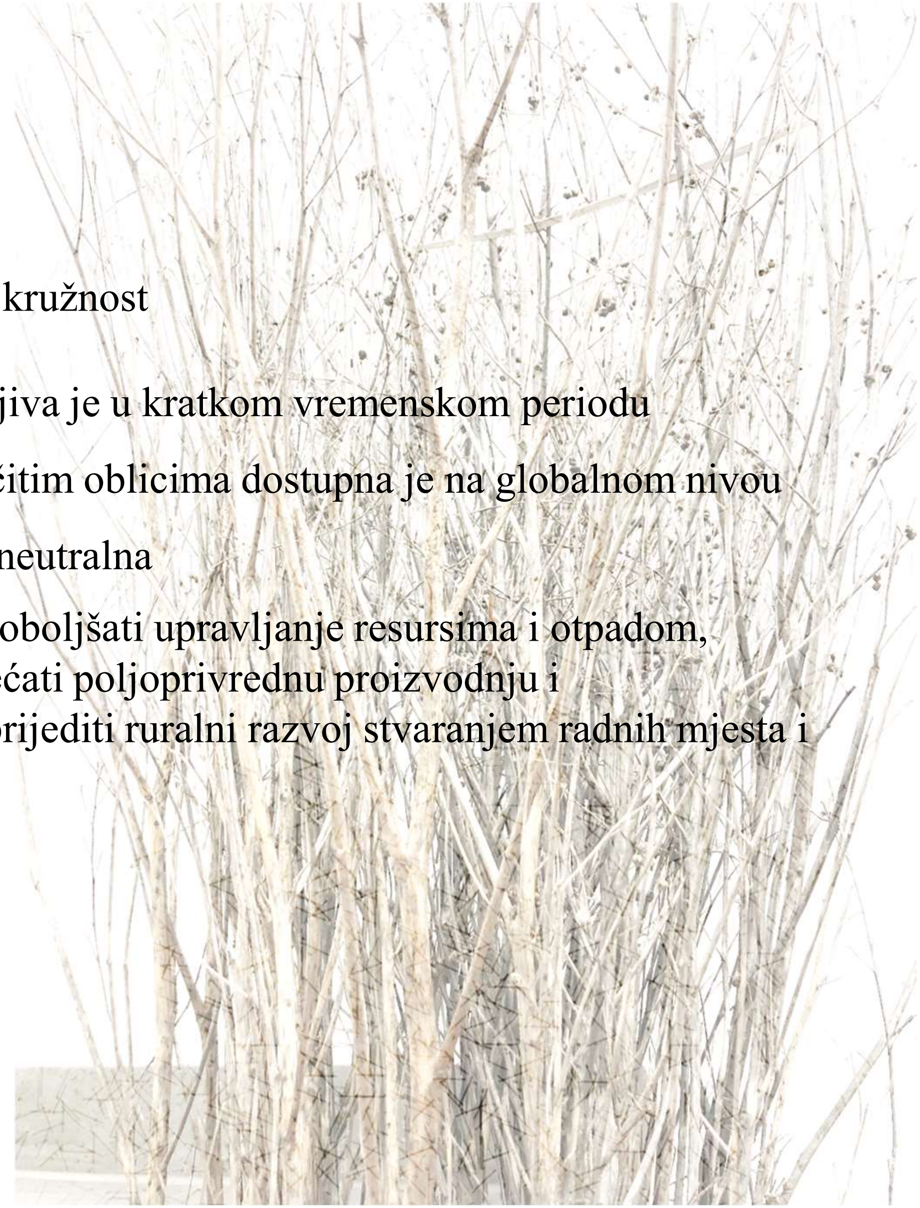
Zadani ciljevi ✓ → Europsko biogospodarstvo → Održivost i kružnost

Biomasa podrazumijeva biorazgradive dijelove proizvoda, otpada ili ostataka iz poljoprivrede, šumski otpad i otpad iz srodnih industrija kao i biorazgradive dijelove industrijskog i gradskog otpada. (Direktiva 2009/28/EZ)

Poljoprivredna biomasa – lignocelulozna biomasa

Sastav: celuloza	hemiceluloza	lignin	ostalo
38-50%	23-32%	15-25%	5-13%

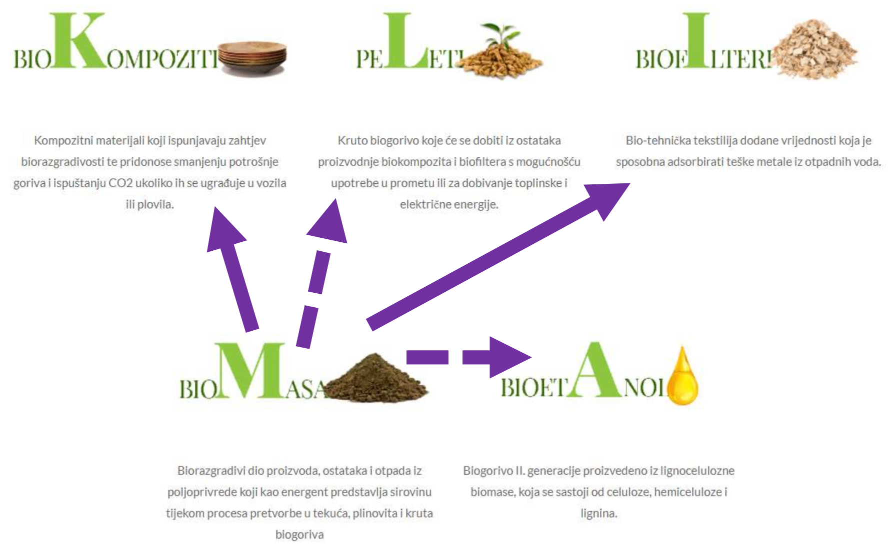
- ❑ Obnovljiva je u kratkom vremenskom periodu
- ❑ U različitim oblicima dostupna je na globalnom nivou
- ❑ CO_2 je neutralna
- ❑ Može poboljšati upravljanje resursima i otpadom, može povećati poljoprivrednu proizvodnju i može unaprijediti ruralni razvoj stvaranjem radnih mjesta i prihoda



KRUŽNO BIOGOSPODARSTVO

Nužno ukomponirati načela održivosti u sve dijelove proizvodnog procesa – Procjena utjecaja životnog vijeka proizvoda na okoliš **„LCA thinking"**

- Dizajn (ekološki dizajn, zeleni dizajn ili održivi dizajn),
- Upotreba održivih sirovina
- Održive metode prilikom uzgoja sirovina i izrade proizvoda
- Odlaganje otpada na kraju životnog ciklusa proizvoda.



Suradnja s agronomskim fakultetom

↓

Mogućnost stvaranja vrijednosti iz otpada!

prinos vlakana iz stabljike 8 – 15%

PARTNERSTVO

Sveučilište u Zadru
Universitas Studiorum
Jadertina | 1396 | 2002 |

Europska unija
Zajedno do fondova EU

https://pixabay.com/photos/corn-maze-corn-harvest-maze-4256692/
https://pixabay.com/photos/wheat-field-field-green-stalks-794077/

Dizajn naprednih biokompozita iz energetski održivih izvora

Proizvodnja hrane, biokompozita i biogoriva iz žitarica u kružnom biogospodarstvu

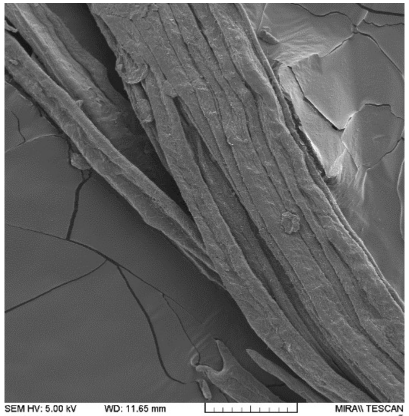
KUKURUZ

Prvenstveno u prehrambene svrhe – klip ili samo zrna kukuruza

https://pixabay.com/photos/corn-maize-crop-grow-agriculture-2655525/

Kukuruzovina:
Stabljika
Lišće

Ostaci u doradi:
Komušina
Oklasci

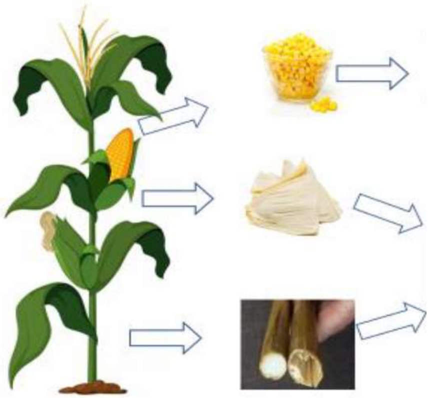


https://www.kindpng.com/imgv/ibhixb_corn-stalk-hd-png-download/

PEER-REVIEWED ARTICLE *bioresources.com*

Extraction, Chemical Composition, and Characterization of Potential Lignocellulosic Biomasses and Polymers from Corn Plant Parts

M.I.J. Ibrahim,[a,b] S.M. Sapuan,[a,c,*] E.S. Zainudin,[a] and M.Y.M. Zuhri[a]



Hrana

Vlakna

Termalna razgradnja vlakana pri 260 °C
uporaba kao ojačalo za **kompozitne materijale**

Material	Cellulose (%)	Hemicellulose (%)	Lignin (%)	Ash (%)	Moisture (%)	Density (g/cm^3)	Reference
Hull	15.30	40.4	2.87	0.88	8.59	1.3231	Current study
Husk	45.7	35.8	4.03	0.36	7.81	1.4913	Current study
Stalk	10.8	60.3	1.98	1.97	11.1	1.4164	Current study

Ibrahim *et al.* (2019). "Corn biomasses analysis," ***BioResources*** 14(3), 6485-6500.

EXTRACTION OF DISCARDED CORN HUSK FIBERS AND ITS FLAME RETARDED COMPOSITES

Lihua LV*, Jihong Bi, Fang YE, Yongfang QIAN, Yuping ZHAO, Ru CHEN, Xinggen SU

LOI 35,2 % ; savojna čvrstoća 84 MPa; vlačna čvrstoća 40 MPa; savojna žilavost 6.4 KJ/m2. **Uporaba:** materijali u građevinskoj industriji, namještaj, dekorativni materijali i dr.

Lv, L. & Bi, J. & Ye, Fang & Qian, Y. & Zhao, Y. & Chen, R. & Su, X.. (2017). Extraction of discarded corn husk fibers and its flame retarded composites. Tekstil ve Konfeksiyon. 27. 408-413.

Koay, Seong Chun & Maimunah, Tengku & Chan, Ming Yeng & Tshai, Kim Yeow & Ong, Thai Kiat. (2020). Properties of corn husk fibre reinforced epoxy composites fabricated using vacuum-assisted resin infusion. Journal of Physical Science. 31. 17-31. 10.21315/jps2020.31.3.2.

composite made from corn husk fibre mat treated with H_2O_2 bleaching treatment exhibited a lower water absorption, tensile strength and modulus approximately 28 MPa and 2605MPa, respectively. However, this composite is yet to achieve a mechanical strength like composites made from flax fibre and jute fibre. However, the epoxy/corn husk fibre composite still has the potential use in non-structural applications, such as car interior panel and seat back cover.

Acoustic Performance Of Corn Husk Fiber (*Zea Mays L*) Waste Composite As Sound Absorber With Latex Adhesive

Suryaning Berliandika[1], Iwan Yahya[1,a)] and Ubaidillah[2]

TABLE 1. The composition of the composite

Sample	Material (CHS's)	Thickness (mm)	CHF (%)	Latex (%)
A1	Raw	2	30	70
A2	Raw	4	50	50
B1	Treated NaOH 5%	2	30	70
B2	Treated NaOH 5%	4	50	50

(a)

(b)

FIGURE 2. (a) Composite from raw CHF: latex = 30:70 (left) and 50:50 (right), (b) composite from CHF treated NaOH 5%: latex = 30:70 (left) and 50:50 (right)

Suryaning Berliandika, Iwan Yahya, *and* Ubaidillah
, "Acoustic performance of corn husk fiber (*Zea mays L*) waste composite as sound absorber with latex adhesive", AIP Conference Proceedings 2088, 050001 (2019) https://doi.org/10.1063/1.5095335

Environmentally friendly cellulosic fibers from corn stalks

Article *in* Environmental engineering and management journal · July 2018
DOI: 10.30638/eemj.2018.175

4. Conclusions

Corn stalks can replace pulpwood in production of fibrous materials for paper industry and the main advantages refer to the fact that corn stalks contain less lignin than wood and can be delignified using less chemicals, lower temperatures and shorter time. The high content of extractives and ash are the main drawbacks of corn stalks as a raw material for pulp manufacture.

Chesca, Ana & Tofanica, Bogdan & Puitel, Adrian & Nicu, Raluca & Gavrilescu, Dan. (2018). Environmentally friendly cellulosic fibers from corn stalks. Environmental Engineering and Management Journal. 17. 1765-1771. 10.30638/eemj.2018.175.

PULPING OF CORN STALKS – ASSESSMENT FOR BIO-BASED PACKAGING MATERIALS

ANA-MARIA CHEȘCĂ,[*] RALUCA NICU,[*] BOGDAN MARIAN TOFANICA,[*]
ADRIAN CATALIN PUITEL,[*] ROXANA VLASE[**] and DAN GAVRILESCU[*]

The fiber length is similar to that of other short-fiber hardwoods, and the diameter of the fiber is small, resulting in lower pulp coarseness. These fiber dimensions provide an insight into the potential usefulness of these pulps in pulp and papermaking:[26] good fibers suitable for papermaking and good pulp strengths.

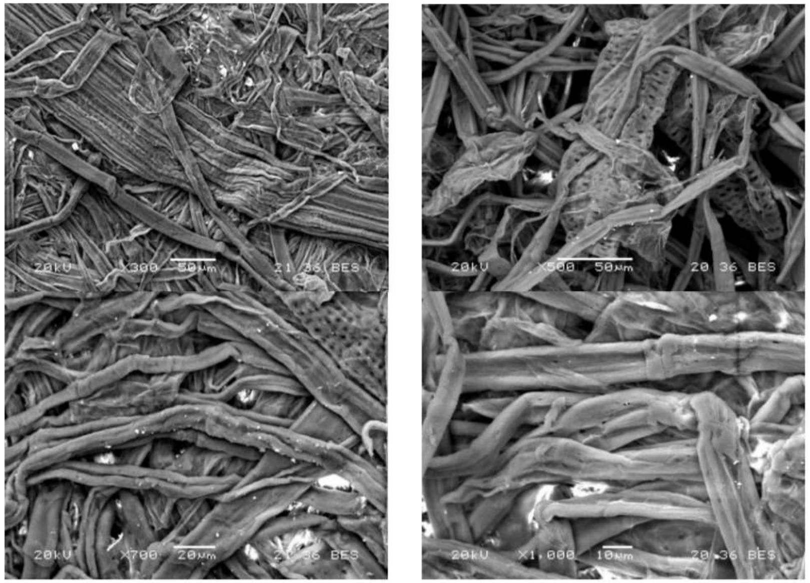


Figure 1: Micrographs of corn stalk fiber obtained by SEM (with different magnification)

Chesca, A., Raluca Nicu, B. Tofanica, A. Puițel, Roxana Vlase and D. Gavrilescu. "PULPING OF CORN STALKS – ASSESSMENT FOR BIO-BASED PACKAGING MATERIALS." Cellulose Chem. Technol., 52 (7-8), 645-653 (2018).

JEČAM

molecules MDPI

Article

Feasibility of Barley Straw Fibers as Reinforcement in Fully Biobased Polyethylene Composites: Macro and Micro Mechanics of the Flexural Strength

Ferran Serra-Parareda [1,*], Fernando Julián [1], Eduardo Espinosa [2,*], Alejandro Rodríguez [2], Francesc X. Espinach [1] and Fabiola Vilaseca [3,4]

Povećanjem volumnog udjela vlakana povećala se i vrijednost savojne čvrstoće za 42%, 103% i 147%

↓

Kompozitni materijali ojačani vlaknima iz ječma mogu se koristiti za razne inženjerske svrhe

Table 1. Chemical and morphological composition of barley straw and barley thermomechanical (TMP) fibers.

Composition/Morphology	Barley Straw	Barley TMP Fibers
Holocellulose (wt.%)	70.12 ± 0.54	77.67 ± 0.61
Klason lignin (wt.%)	16.45 ± 0.34	15.30 ± 0.46
Extractives (wt.%)	5.90 ± 0.76	2.73 ± 0.12
Ashes (wt.%)	7.1 ± 0.2	4.3 ± 0.3
Length [1] (μm)	-	745 ± 21
Diameter (μm)	-	19.6 ± 0.6
Aspect ratio (length/diameter)	-	38.0

[1] Length weighted in length.

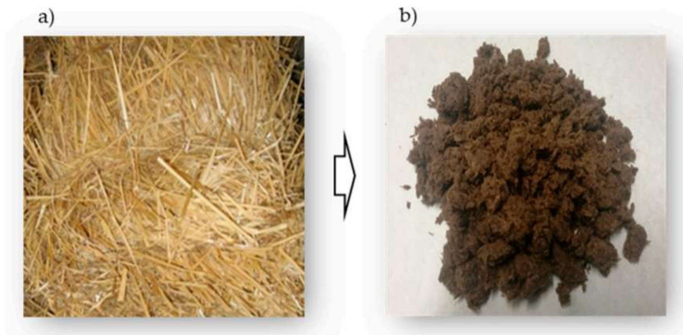


Figure 1. Barley straw images (**a**) before being treated and (**b**) after the thermomechanical process.

Serra-Parareda, F.; Julián, F.; Espinosa, E.; Rodríguez, A.; Espinach, F.X.; Vilaseca, F. Feasibility of Barley Straw Fibers as Reinforcement in Fully Biobased Polyethylene Composites: Macro and Micro Mechanics of the Flexural Strength. *Molecules* **2020**, *25*, 2242. https://doi.org/10.3390/molecules25092242

https://pixabay.com/photos/straw-straws-field-nature-609924/
https://pixabay.com/photos/stalks-straws-node-wheat-609904/
https://pixabay.com/photos/barley-grain-grain-field-stalks-2424214/

Films based on oxidized starch and cellulose from barley

Shanise Lisie Mello El Halal [a,*], Rosana Colussi [a], Vinícius Gonçalves Deon [b], Vânia Zanella Pinto [a], Franciene Almeida Villanova [a], Neftali Lenin Villarreal Carreño [b], Alvaro Renato Guerra Dias [a], Elessandra da Rosa Zavareze [a]

2.4. *Cellulose fibers isolation*

The cellulose fibers were isolated according to Johar and Ahmad (2012), with some modifications. The barley husks were washed, dried, milled and subsequently subjected to a mixture of toluene and ethanol (2:1, v/v) for 16 h in order to remove lipids, followed by a drying process at 50 °C for 24 h. The removal of lignin and hemicellulose was performed using an alkali treatment. The barley husks were dispersed in a 4% (v/w) solution of NaOH in a glass reactor with mechanical stirring (IKA, RW20, German) at 80 °C for 4 h. At the end of the treatment, the solids were filtered and washed with distilled water. This alkali treatment was carried out three times. After alkali treatment, a bleaching step was performed to remove the remaining lignin from the barley husks. The bleaching was carried out by adding the husks in a mixture of equal parts of buffer solution of sodium acetate (27 g of NaOH and 75 mL of glacial acetic acid for 1 L of water) and aqueous solution of sodium chlorite (1.7%). This material was placed in a jacketed glass reactor with controlled temperature conditions at 95 °C for 4 h and with mechanical stirring (IKA, RW20, German). Subsequently, the material was filtered using a 200-mesh sieve and washed with distilled water. The bleaching process was carried out four times. The cellulose fibers were dried in an oven with air circulation (Nova Ética, 400-6ND, São Paulo, Brazil) at 50 °C for 24 h and stored in a sealed container.

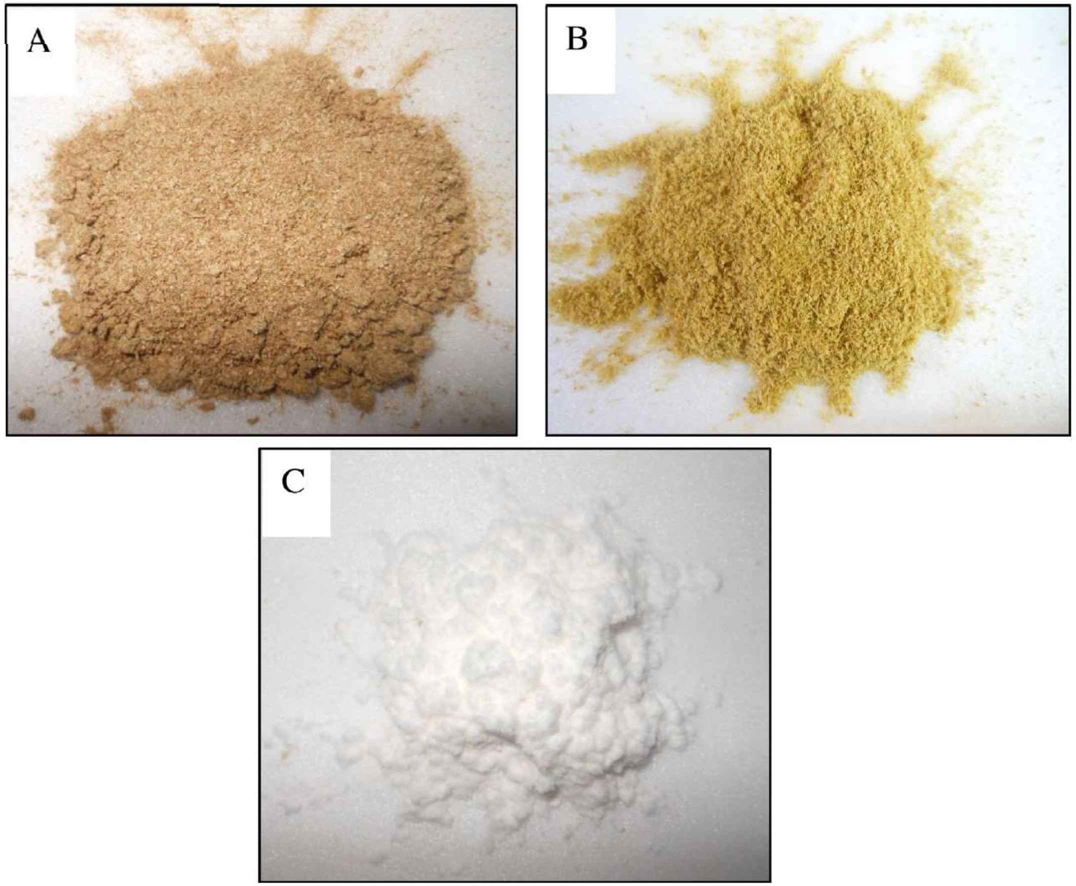


Fig. 1. Photographs of the fibers of the milled barley husk (A) treated with alkali (B) and bleached (C).

Shanise Lisie Mello El Halal, Rosana Colussi, Vinícius Gonçalves Deon, Vânia Zanella Pinto, Franciene Almeida Villanova, Neftali Lenin Villarreal Carreño, Alvaro Renato Guerra Dias, Elessandra da Rosa Zavareze, Films based on oxidized starch and cellulose from barley, Carbohydrate Polymers, Volume 133, 2015, Pages 644-653, ISSN 0144-8617, https://doi.org/10.1016/j.carbpol.2015.07.024.

PŠENICA

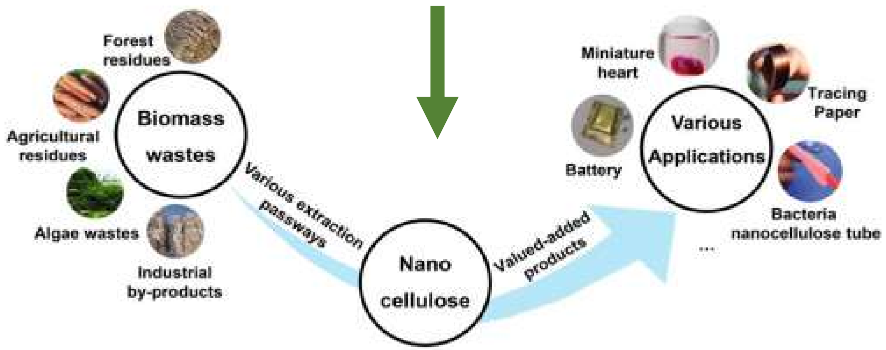


Systematic comparison for effects of different scale mechanical-NaOH coupling treatments on lignocellulosic components, micromorphology and cellulose crystal structure of wheat straw

Chongfeng Gao , Jie Yang , Lujia Han *

Visoka kristaličnost
Visoka čvrstoća
Niska gustoća

Mogućnost dobivanja nanoceluloze mehaničkim izdvajanjem vlakana i naknadnom kemijskom obradom



Chongfeng Gao, Jie Yang, Lujia Han,
Systematic comparison for effects of different scale mechanical-NaOH coupling treatments on lignocellulosic components, micromorphology and cellulose crystal structure of wheat straw, Bioresource Technology, Volume 326, 2021, 124786, ISSN 0960-8524, https://doi.org/10.1016/j.biortech.2021.124786.

Sujie Yu, Jianzhong Sun, Yifei Shi, Qianqian Wang, Jian Wu, Jun Liu, Nanocellulose from various biomass wastes: Its preparation and potential usages towards the high value-added products, Environmental Science and Ecotechnology, Volume 5, 2021, 100077,ISSN 2666-4984, https://doi.org/10.1016/j.ese.2020.100077.

https://pixabay.com/photos/straws-spike-threshed-harvested-3562311/
https://pixabay.com/photos/straw-straw-bales-pile-of-straw-3362771/

14

The use of wheat straw fibres as reinforcements in composites

S. PANTHAPULAKKAL and M. SAIN, University of Toronto, Canada

DOI: 10.1533/9781782421276.4.423

14.7. Potential applications of wheat straw fibre-reinforced composites

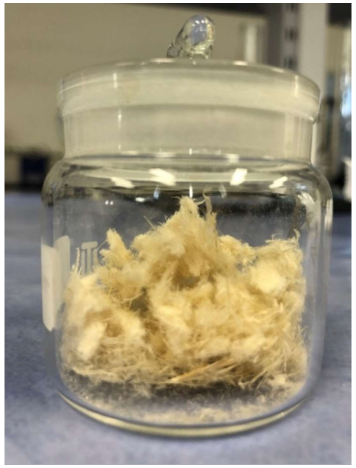
Traditionally, fibres from straw have been used in the pulp and paper industry as a fibre source, for manufacturing particleboards, as a building material, and for animal feed and bedding. Other applications of straw fibres include the housing and building sector, composite manufacturing, thermal insulation, and the energy sectors (Schirp *et al.*, 2006). Wheat straw-based composites can be used in semi-structural and structural applications in automotive interiors, where natural fibres are currently being used.

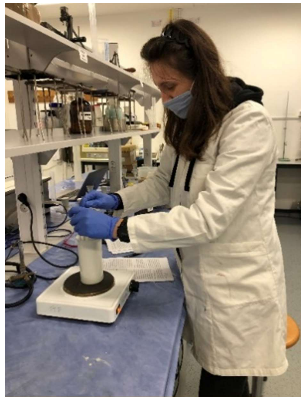
14.9 Conclusions

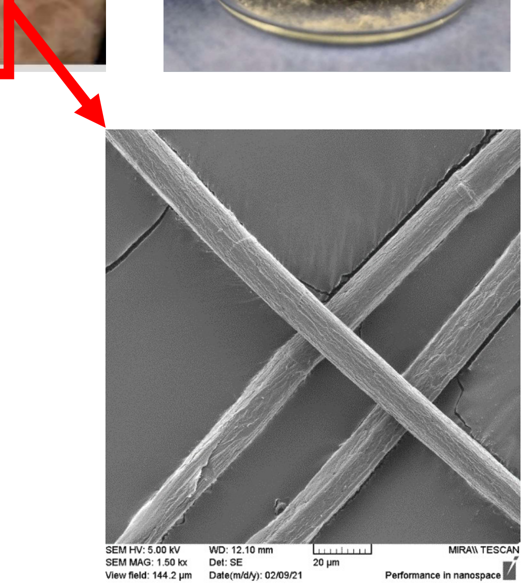
Wheat straw is an abundant and inexpensive raw material for the bio-refinery sector. There is great research interest in the utilization of the major components such as cellulose, hemicellulose and lignin for various industrial applications. Since straw contains about 30–50% of cellulose, it is used as a reinforcement for thermoplastic as well as thermoset polymer matrices. Straw-based thermoplastics were generally prepared by melt blending followed by injection, extrusion or compression molding. The mechanical properties of the composites demonstrate their suitability as an alternative to wood flour or other bast fibre composites with similar density. Similarly, incorporation of wheat straw could considerably reduce the cost of the product and can be used as an immediate alternative to the expensive bast fibres. The processing temperature window and high water absorption are the limitation of the composites as in any other lignocellulosic composites. Research in this direction is needed to improve the performance of wheat straw composite materials. Converting wheat straw into novel high-performance, low-cost marketable materials surely benefits wheat farmers by generating additional income by selling the straw, benefits industry by generating cost-effective high-performing materials, and benefits the environment by reducing the burning of the straw as well as acting as a carbon sink.

S. Panthapulakkal, M. Sain,
14 - The use of wheat straw fibres as reinforcements in composites, Editor(s): Omar Faruk, Mohini Sain, Biofiber Reinforcements in Composite Materials, Woodhead Publishing, 2015, Pages 423-453, ISBN 9781782421221, https://doi.org/10.1533/9781782421276.4.423.

MISCANTHUS GIGANTEUS







Uporaba za ojačalo kod kompozitnih materijala i za izradu nanoceluloznih vlakana koja će svoju uporabu naći u proizvodnji biofilmova i biofiltera.

↓

Pulpa nakon organosolv procesa

↓

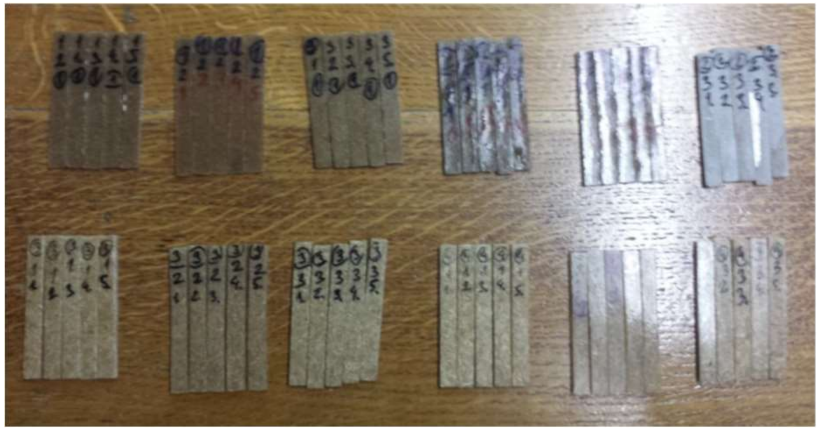
Kisela hidroliza

↓

Ultrazvuk → Nanoceluloza

Slika 21. Osušene stabljike miskantusa

Slika 22. Usitnjavanje stabljike miskantusa



https://pixabay.com/photos/miscanthus-elephant-grass-biomass-5121997/

Vurnek V.: Biokompoziti ojačani Miskantusom, diplomski rad, Fakultet strojarstva i brodogradnje, Sveučilište u Zagrebu, 2015

SIDA HERMAPHRODITA

glasnik zaštite bilja 61 godina

Krička Tajana[1], Mateja Grubor[1], Vanja Jurišić[1], Leto J.[1], Voća N.[1], Bilandžija N.[1], Ana Matin[1]

Pregledni rad

Nova energetska kultura Sida hermaphrodita u Republici Hrvatskoj

Do 80-ih god. 20. st. Koristila se u Poljskoj kao tekstilna biljka, a poslije kao vrijedan izvor za proizvodnju bioenergije

Velika količina suhe tvari u stabljici neposredno nakon berbe. Kalorična vrijednost biljke oko 15-17 MJ/kg suhe tvari

agronomy

MDPI

Review

Two Novel Energy Crops: *Sida hermaphrodita* (L.) Rusby and *Silphium perfoliatum* L.—State of Knowledge

Laura Cumplido-Marin [1], Anil. R. Graves [1,*], Paul J. Burgess [1,*], Christopher Morhart [2], Pierluigi Paris [3], Nicolai D. Jablonowski [4], Gianni Facciotto [5], Marek Bury [6], Reent Martens [7] and Michael Nahm [2]

The potential use of *S. hermaphrodita* as a source of fibre for the paper and pulp industry is also mentioned in the literature [9]. After studying more than ten herbaceous plants and three woody species, Slepetys et al. [21] found *S. hermaphrodita* to contain the highest amount of fibre.

Klímek et al. [162] have demonstrated the suitability of *S. perfoliatum* stems to be used to manufacture particleboards of standard density, 600 kg m^{-3}. Despite displaying weaker mechanical properties than boards made of spruce (*Picea abies* L.) particles, particleboards using methylene diphenyl diisocyanate (MDI) as adhesive, still met the Class P2 EN312 standards for general-purpose items in dry conditions.

According to Martens [163], *S. hermaphrodita* also has the potential to be used in the manufacturing of natural fibre products, such as alternative turf, and it could even be used as raw material to produce 3D printing resin. Rumpf et al. [164] found that through organosolv pulping, they could achieve a high quality lignin yield of 15.7% from *S. perfoliatum* that could be used to manufacture biodegradable plastics.

Cumplido-Marin, L.; Graves, A.R.; Burgess, P.J.; Morhart, C.; Paris, P.; Jablonowski, N.D.; Facciotto, G.; Bury, M.; Martens, R.; Nahm, M. Two Novel Energy Crops: *Sida hermaphrodita* (L.) Rusby and *Silphium perfoliatum* L.—State of Knowledge. *Agronomy* **2020**, *10*, 928. https://doi.org/10.3390/agronomy10070928

ARUNDO DONAX

fibers

Article

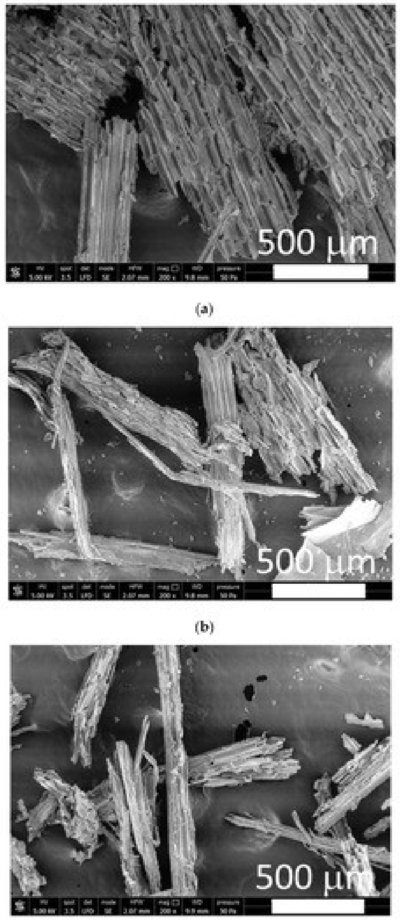
Assessment of *Arundo donax* Fibers for Oil Spill Recovery Applications

Vincenzo Fiore [1,*], Elpida Piperopoulos [2] and Luigi Calabrese [2]

4. Conclusions

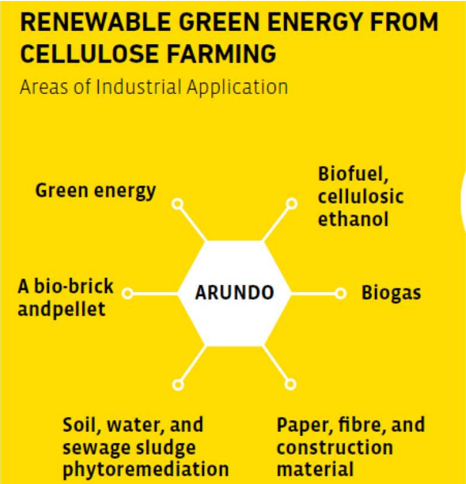
In this paper, the oil sorption capability of natural fibers extracted from the stem of the giant reed *Arundo donax* L. was assessed. Sorption tests were performed in several pollutants (e.g., kerosene, virgin naphtha, pump oil, and crude oil) and water as a reference. The fibers evidenced absorption capacities about five to six times their weight. Furthermore, depending on the fiber size, different sorption capabilities were observed at varying pollutant viscosity. Large-sized fibers evidenced higher sorption performances on low viscosity pollutants. On the other hand, the best sorption capacity in high viscosity liquids were evidenced in small-sized AD fibers. Eventually, the adsorption properties were related to the microstructure and morphology of *Arundo donax* fibers scheming the main sorption mechanisms that acts during the pollutant uptake.

Although the sorption performances are lower than other conventional green materials, their oil/water selectivity makes them a cost-effective and reliable solution to oil spillage. Even if these results are promising, further focused studies in order to improve the knowledge on performances–morphology relationship and on surface treatments are welcome and at the same time improving the kinetic oil sorption capabilities and to reduce the water interaction of the vegetable fiber surface is another relevant issue for future activities.



(a) (b) (c)

Fiore, V.; Piperopoulos, E.; Calabrese, L. Assessment of *Arundo donax* Fibers for Oil Spill Recovery Applications. *Fibers* **2019**, *7*, 75. https://doi.org/10.3390/fib7090075



Mehanički izdvajanje vlakana

Fig. 1. Arundo fibers isolated from the stem.

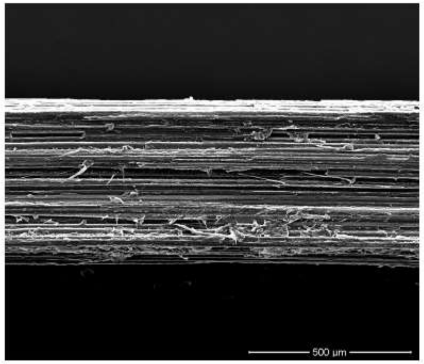


Fig. 3. SEM micrograph of longitudinal view of arundo fibers.

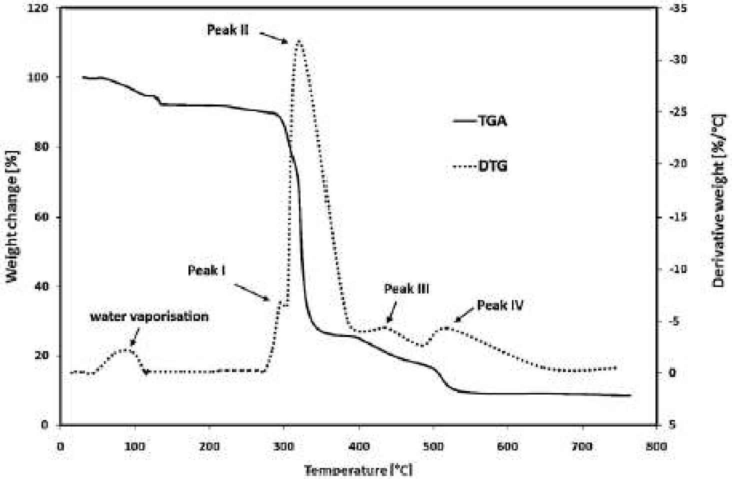


Fig. 2. TG and DTG curves of arundo fibers.

V. Fiore, T. Scalici, A. Valenza,
Characterization of a new natural fiber from Arundo donax L. as potential reinforcement of polymer composites, Carbohydrate Polymers, Volume 106, 2014, Pages 77-83, ISSN 0144-8617,
https://doi.org/10.1016/j.carbpol.2014.02.016.

Briquette size is much larger than that of pellet and is similar to firewood. It can be used as fuel in fireplaces, tile stoves and multi-fuel firing boilers.

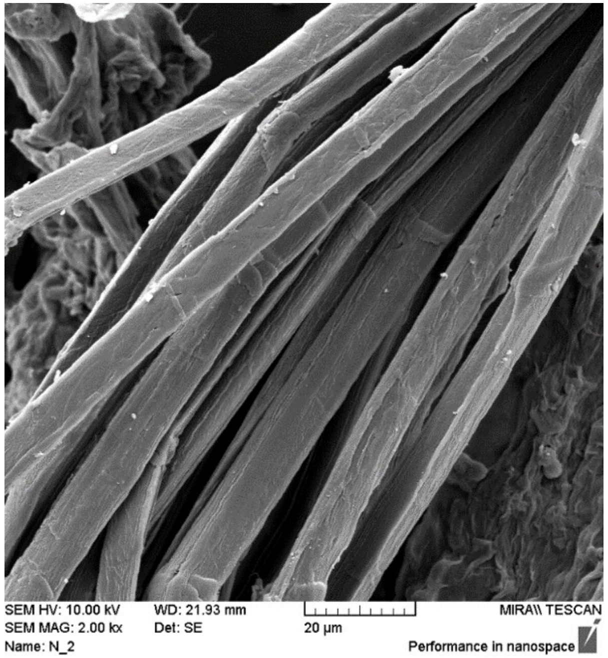
Features of pelleted Arundo include:

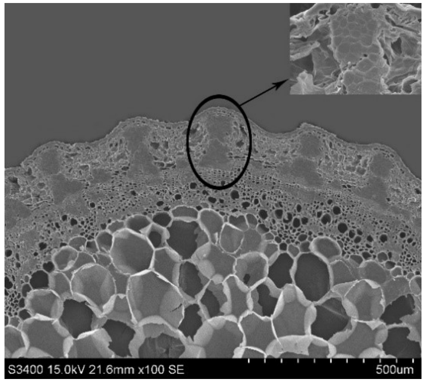
Mehaničko usitnjavanje stabljike → Ekstrakcija s alkoholom → Obrada s NaOH → Filtracija, ispiranje, bijeljenje → Kisela hidroliza → **Mikrokristalična celuloza** → **Kompoziti**

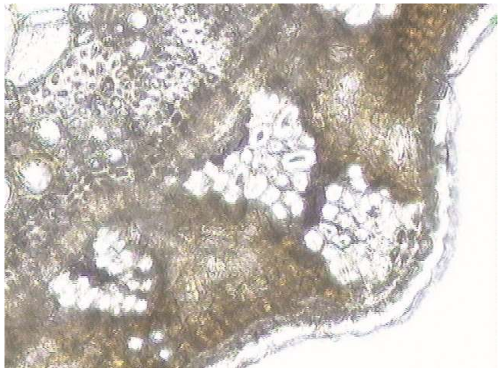
Kompoziti (← Fig. 2)

Wissam Bessa, Ahmed Fouzi Tarchoun, Djalal Trache, Mehdi Derradji,
Preparation of amino-functionalized microcrystalline cellulose from Arundo Donax L. and its effect on the curing behavior of bisphenol A–based benzoxazine, Thermochimica Acta, Volume 698, 2021, 178882, ISSN 0040-6031,
https://doi.org/10.1016/j.tca.2021.178882.

SPARTIUM JUNCEUM



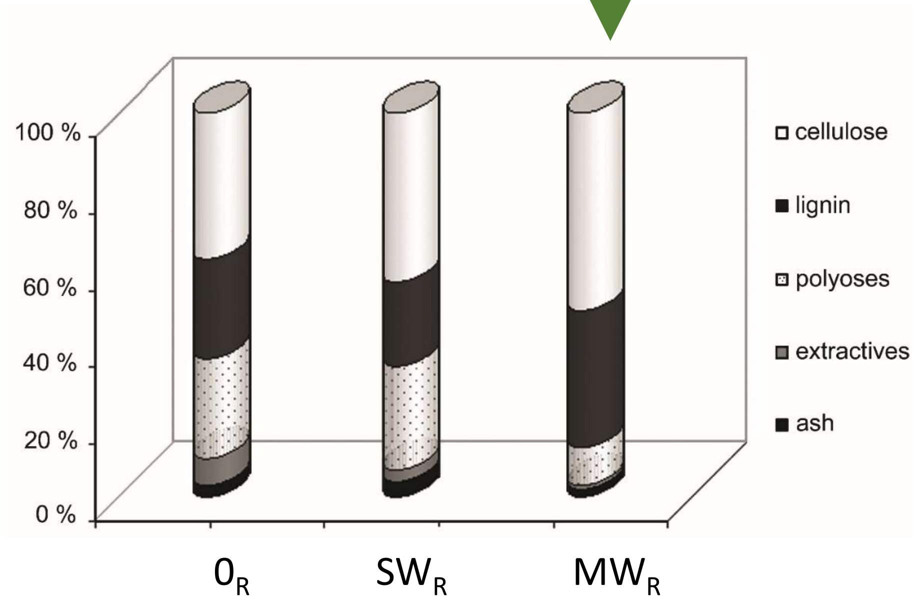




Nakon obrade stabljike mikrovalovima prinos vlakana je približno 15%.
85% ostatka pokazuje povećanje u količini lignina.
Kalorična vrijednost biljke je od 16,69 MJ/kg do 18,16 MJ/kg

Sirovina za dobivanje čvrstog biogoriva



ZAKLJUČAK

- Ne postoji otpad – otpad jedne industrije je ulazna sirovina druge industrije

- Lignocelulozna biomasa - obnovljiva sirovina za proizvodnju vlakana koja će se kasnije koristiti kao ojačala za kompozitne materijale, u građevinskoj i automobilskoj industriji, ili u proizvodnji biofiltera, a ostatak zaostao nakon proizvodnje vlakana je izvrsna sirovina za proizvodnju 2. generacije tekućih i/ili čvrstih biogoriva

- Poštivanjem načela kružnosti i održivosti utječe se na smanjenje emisije stakleničkih plinova, a posljedično i na globalne klimatske promjene

https://pixabay.com/photos/abstract-background-ball-cord-21764/

ZAHVALA

Istraživanja su napravljena u okviru projekata

- BIOKOMPOZITI KK.01.1.1.04.0091 https://biokompoziti.eu/
- KLIMA KK.05.1.1.02.0016 https://projekt-klima.eu/

Za sva pitanja slobodno nas kontaktirajte:

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