

Deskripsi Artikel

- Judul Jurnal : TEKNOSAINS: Jurnal Sains, Teknologi dan Informatika
- Volume Jurnal : Volume 11, Nomor 1, January 2024
- Akreditasi : Peringkat 4
- Judul Artikel : Rice husk ash as a substitute for silica gel
- Penulis : Rahmad Bonanza, **Dan Mugisidi.**
- Status Penulis : Kontributor

SERTIFIKAT

Direktorat Jenderal Pendidikan Tinggi, Riset dan Teknologi
Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi Republik Indonesia



Kutipan dari Keputusan Direktorat Jenderal Pendidikan Tinggi, Riset dan Teknologi
Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia

Nomor 105/E/KPT/2022

Peringkat Akreditasi Jurnal Ilmiah Periode 1 Tahun 2022

Nama Jurnal Ilmiah

Teknosains : Jurnal Sains, Teknologi dan Informatika

E-ISSN: 27214729

Penerbit: Sekolah Tinggi Teknologi Muhammadiyah Cileungsi

Ditetapkan Sebagai Jurnal Ilmiah

TERAKREDITASI PERINGKAT 4

Akreditasi Berlaku selama 5 (lima) Tahun, yaitu
Volume 7 Nomor 1 Tahun 2020 Sampai Volume 11 Nomor 2 Tahun 2024

Jakarta, 07 April 2022

Plt. Direktur Jenderal Pendidikan Tinggi,
Riset, dan Teknologi



Balai
Sertifikasi
Elektronik

Catatan :

1. UU ITE No 11 Tahun 2008 Pasal 5 Ayat 1 "Informasi Elektronik dan/atau hasil cetaknya merupakan alat bukti yang sah"
2. Dokumen ini telah ditandatangani secara elektronik menggunakan sertifikat elektronik yang diterbitkan oleh BSr-E

Prof. Ir. Nizam, M.Sc., DIC, Ph.D., IPU, ASEAN Eng
NIP. 196107061987101001

ISSN [print] 2087 3336 | ISSN [online] 2721 4729

TEKNOSAINS



TEKNOSAINS : Jurnal Sains, Teknologi dan Informatika
VOLUME 11, NOMOR 1, JANUARI 2024

Sekolah Tinggi Teknologi Muhammadiyah Cileungsi

<http://jurnal.sttmcileungsi.ac.id/index.php/tekno>

DOI: 10.37373/tekno.v11i1



Publikasikan oleh :
LPPMPK – Sekolah Tinggi Teknologi
Muhammadiyah Cileungsi



TEKNOSAINS : Jurnal Sains, Teknologi dan Informatika VOLUME 11, NOMOR 1, JANUARI 2024

Sekolah Tinggi Teknologi Muhammadiyah Cileungsi

Editorial Team

Editor In Chief :

- Wilarso, (Sekolah Tinggi Teknologi Muhammadiyah Cileungsi).

Editor Board :

- Firmansyah Azharul, (Sekolah Tinggi Teknologi Muhammadiyah Cileungsi, Indonesia).
- M. Ali Pahmi, (Sekolah Tinggi Teknologi Muhammadiyah Cileungsi, Indonesia).
- Tarsisius Kristyadi, (Institut Teknologi Nasional Bandung, Jawa Barat-Indonesia).
- Ashari Imamuddin, (Sekolah Tinggi Teknologi Muhammadiyah Cileungsi, Indonesia).
- Sulistyio Heripracoyo, (Universitas Bina Nusantara, Jakarta-Indonesia).
- Ahmad Marabdi Siregar, (Universitas Muhammadiyah Sumatera Utara).
- Fitriadi, (Universitas Teuku Umar, Meulaboh, Indonesia).
- Ambarwati (Universitas Muhammadiyah Surakarta, Surakarta-Indonesia).
- Teuku Muhammad Ridwan, (Universitas Malikussaleh).
- Sumardiono, (AMIK Purnama Niaga, Indramayu-Indonesia).
- M. Anas Sobarnas, (Sekolah Tinggi Teknologi Muhammadiyah Cileungsi).
- Asep Dharmanto, (Sekolah Tinggi Teknologi Muhammadiyah Cileungsi).
- Asep Saepudin, (Sekolah Tinggi Teknologi Muhammadiyah Cileungsi).
- Umar Tsani Abdurrahman, (Sekolah Tinggi Teknologi Muhammadiyah Cileungsi, Indonesia).

Peer Reviewer

- Muhtadi, (Universitas Muhammadiyah Surakarta, Surakarta-Indonesia).
- Mujiarto, (Universitas Muhammadiyah Tasikmalaya, Tasikmalaya-Indonesia).
- Dan Mugisidi, (Universitas Prof. Dr. UHAMKA Jakarta, Jakarta-Indonesia).
- M Chairul Basrun Umanailo, (Universitas Iqra Buru-Indonesia).
- Kholqillah Ardhian Ilman. (Universitas Muhammadiyah Surakarta, Surakarta-Indonesia).
- Rizal Broer Bahaweres, (Universitas Islam Negeri Syarif Hidayatullah Jakarta, Jakarta-Indonesia).
- Suswandari, (Universitas Prof. Dr. UHAMKA Jakarta, Jakarta-Indonesia).
- Che Wan Mohd Noor, (Department of Maritime Technology, Faculty of Ocean Engineering Technology and Informatics, Universiti Malaysia Terengganu, Malaysia).
- Richki Hardi, (Universitas Mulia, Indonesia).
- Ahmad Khoiri, (Universitas Sains Al Qur'an, Jawa Tengah, Indonesia).
- Prantasi Harmi Tjahjanti, (Universitas Muhammadiyah Sidoarjo, Jawa Timur-Indonesia).
- Wawan Trisnadi Putra, (Universitas Muhammadiyah Ponorogo, Ponorogo, Jawa Timur-Indonesia).
- Muhammad Erik Kurniawan, (Universitas Muhammadiyah Sinjai, Kabupaten Sinjai, Sulawesi Selatan-Indonesia).
- Ika Safitri Windiarti, (Universitas Muhammadiyah Palangkaraya, Kalimantan Tengah-Indonesia).
- Indriarto Yuniartoro, (Universitas Kebangsaan Republik Indonesia, Bandung, Jawa barat-Indonesia).
- Tedjo Darmanto, (STMIK AMIK Bandung, Bandung, Jawa barat-Indonesia).
- Citra Amalia, (Universitas Muhammadiyah Palangkaraya, Kalimantan Tengah-Indonesia).
- Achmad Fauzan Hery Soegiharto, (Universitas Muhammadiyah Malang, Jawa Timur-Indonesia).



TEKNOSAINS : Jurnal Sains, Teknologi dan Informatika VOLUME 11, NOMOR 1, JANUARI 2024

Sekolah Tinggi Teknologi Muhammadiyah Cileungsi

ARTIKEL

OPINION MINING TOWARD WORK FROM OFFICE POLICIES ON POST-PANDEMIC COVID-19 BY USING SUPERVISED LEARNING.

Author: Tri Hadi Wicaksono, Imam Yuadi, Ira Puspitasari Hal 01 – 07

LITERATURE REVIEW: POTENTIAL OF SECANG WOOD (CAESALPINIA SAPPAN L) DECOCTION ON LOWERING BLOOD PRESSURE IN HYPERTENSION SUFFERERS.

Author: Mira Nurazizah, Popi Sopiha, Rafika Rosyda Hal 08 – 12

DECISION SUPPORT SYSTEM FOR SELECTION OF THE BEST TEACHER AT SD MUHAMMADIYAH 18 MEDAN USING THE ANALYTICAL HIERARCHY PROCESS METHOD.

Author: Josua Nainggolan, Johannes Apriadi Parlinggoman Sirait, Muhammad Fadlan Ikromi, Putri Ameliya Lubis, Debi Yandra Niska Hal 13 – 20

ANALYSIS OF MILKFISH MEATBALLS WITH THE ADDITION OF LEGUME PROTEIN ISOLATE.

Author: Siti Munawaroh, Bayu Kanetro, Agus Slamet Hal 21 – 32

RED CHILI CLASSIFICATION USING HSV FEATURE EXTRACTION AND NAIVE BAYES CLASSIFIER.

Author: Hermawan Syahputra, Josua Nainggolan, Johannes Apriadi Parlinggoman Sirait, Muhammad Fadlan Ikromi, Putri Ameliya Lubis Hal 33 – 40

THE INTELLIGENT APPROACH IS USED BY DECISION SUPPORT SYSTEMS FOR TOURIST DESTINATIONS IN NORTH SUMATRA.

Author: Taufik Abdullah, Jeremia Jordan Sihombing, Maulana Malik Fajri, Debi Yandra Niska Hal 41 – 48

GEOGRAPHICAL INFORMATION SYSTEM FOR GARBAGE COLLECTION IN SANGGAU CITY AND SHORTEST PATH USING DIJKSTRA'S ALGORITHM.

Author: Reyhan, Rachmat Wahid Saleh Insani, Barry Ceasar Octariadi Hal 49 – 61

DETECTION OF MANGO LEAF DISEASE USING THE CONVOLUTION NEURAL NETWORK METHOD.

Author: Vinny Ramayani Saragih, Nur Azizi, Alfattah Atalarais, Reza Ananda Hatmi, Hermawan Syahputra Hal 62 – 70

ANALYSIS OF CHANGES IN BREAD DURING FROZEN STORAGE WITH PRE-COOKING AND STEAMING.

Author: Siti Nur Azizah, Wisnu Adi Yulianto, Ch. Lilis Suryani Hal 71 – 82

ANALYSIS OF EMPLOYEE'S WORK STRESS AS AN INTERVENING VARIABLE ON EMPLOYEE PERFORMANCE EFFECT OF PT. UTB USES PATH ANALYSIS METHOD.

Author: Denis Firda Khoiriyah, Muhamad Imron Zamzani, Mochamad Sulaiman Hal 83 – 90

OVERVIEW OF 5G SERVICES AND SPECTRUM DEPLOYMENT IN URBAN REGIONS.

Author: Suryanto, Yuli Kurnia Ningsih Hal 91 – 102

TRAVEL APPLICATION ITINERARY USING THE TRAVELING SALESMAN PROBLEM METHOD AND THE HELD-KARP ALGORITHM.

Author: Ade Zaldi Eureka Zendar Ade, Syarifah Putri Agustini Alkadri, Izhan Fakhruzi Hal 103 – 111

E-RETAILING STUDY: A BIBLIOMETRIC ANALYSIS AND SYSTEMATIC LITERATURE REVIEW.

Author: William Widjaja, Yudhi Widya Arthana Rustam, Adryan Rachman, Meilisa Alvita Hal 112 – 119

ANALYSIS OF RAW MATERIAL INVENTORY CONTROL FOR HINGE UPPER ASSEMBLY PRODUCTS USING THE ECONOMIC ORDER QUANTITY METHOD.

Author: Rifda Ilahy Rosihan, Suci Trisa Kartika, Jasan Supratman, Paduloh, Ratih Kumalasari Hal 120 – 125

APPLICATION OF BLOCKCHAIN TECHNOLOGY IN DECENTRALIZED MEDICAL DATA SECURITY AND PRIVACY SYSTEMS.

Author: Muhammad Fajar Dwi Setyoko, Muhamad Alief Firmansyah Putra, Muhammad Asghar Nazal, Remuz MB Kmurawak Hal 126 - 131



TEKNOSAINS : Jurnal Sains, Teknologi dan Informatika VOLUME 11, NOMOR 1, JANUARI 2024

Sekolah Tinggi Teknologi Muhammadiyah Cileungsi

ARTIKEL

COMPARISON OF NAIVE BAYES AND DECISION TREE ALGORITHMS TO ASSESS THE PERFORMANCE OF PALEMBANG CITY FIRE AND DISASTER MANAGEMENT EMPLOYEES.

Author: Dewi Sartika, Rendra Gustriansyah Hal 132 – 138

STUDY OF ORIENTATION EFFECTS TO POOL BOILING HEAT TRANSFER PERFORMANCE FROM THE CIRCULAR PIN FINS STRUCTURE.

Author: Yasirul Khoiri, Indro Pranoto, Muhammad Aulia Rahman Hal 139 – 148

RICE HUSK ASH AS A SUBSTITUTE FOR SILICA GEL.

Author: Rahmad Bonanza, Dan Mugisidi Hal 149 – 153

EXHAUST GAS EMISSIONS IN DAIHATSU GRANMAX VEHICLES BASED ON THE YEAR OF MANUFACTURE.

Author: Fikri Setiawan, Ali Akbar, Mulyadi Hal 154 – 159

DESIGN OF A FUEL OIL MEASURING DEVICE FOR ON ARDUINO MEGA BASED SPBT TANK AT INDONESIAN ARMY UNIT.

Author: Faris Handika Faris, Jeki Saputra, Maariful Huda, Dekki Widiatmoko, Kasiyanto Hal 160 – 165

DESIGN OF AUTOMATIC CONTROL-BASED PNEUMATIC SYSTEM FOR MATERIAL THICKNESS MEASUREMENT.

Author: Alfian Ady Saputra, Dan Mugisidi, Riyan Ariyansah Hal 166 – 175

QUALITY CONTROL TO REDUCE PRODUCTION DEFECTS USING CONTROL CHART, FISHBONE DIAGRAM, AND FMEA.

Author: Yudha Adi Kusuma, Halwa Annisa Khoiri, I Made Aryantha A., Bagus Herlambang Hal 176 – 186

ANALYSIS OF THE USE OF A 4 KW BLDC MOTOR TO DRIVE A 1GT ELECTRIC PASSENGER BOAT.

Author: Anggara Fuad Al Amin, Supari, Satria Pinandita Hal 187 – 193

ANALYSIS OF CRACK DEFECTS IN THE HANGER WELDING AREA USING THE DMAIC METHOD IN THE HEAVY EQUIPMENT INDUSTRY.

Author: Rahayu Budi Prahara, Nur Imam, Indra Setiawan Hal 194 – 200

ADVANTAGE POWER TRANSFORMER LOW LOSSES WITH A CASE STUDY ON 30/60 MVA 150/20/10 KV TRANSFORMERS.

Author: Asep Saepudin; Hilman Sholih Hal 201 – 208

ISSN [print] 2087 3336 | ISSN [online] 2721 4729

TEKNOSAINS

**TEKNOSAINS : Jurnal Sains, Teknologi dan Informatika
VOLUME 11, NOMOR 1, JANUARI 2024**

Sekolah Tinggi Teknologi Muhammadiyah Cileungsi

Bismillahirrahmanirrahim

Assalaum'alaikum Wr. Wb.

Puji syukur ke hadirat Allah SWT. Salawat serta salam kepada Junjungan Nabi Besar Muhammad saw, terima kasih kepada semua pihak yang telah membantu terbitnya Jurnal Teknosains edisi Januari 2024 ini. Meskipun sejumlah kendala dihadapi dalam proses pembuatan jurnal ilmiah ini, namun dengan dukungan rekan-rekan dosen dan lembaga, maka jurnal edisi ini dapat hadir.

Pada edisi ini memuat 25 (dua puluh lima) judul artikel, salah satunya membahas mengenai “*OPINION MINING TOWARD WORK FROM OFFICE POLICIES ON POST-PANDEMIC COVID-19 BY USING SUPERVISED LEARNING*”.

Harapan redaksi, dengan terbitnya jurnal ilmiah ini akan menciptakan nuansa ilmiah di lingkungan STTM Cileungsi, serta jumlah judul dan kualitas jurnal dapat ditingkatkan.

Kepada pembaca kami harap berkenan memberikan masukan, kritik dan saran untuk kemajuan jurnal ilmiah ini di masa mendatang. Semoga jurnal ini memberikan manfaat kepada kita semua, aamiin.

Billahitaufik walhidayah,

Wassalamu'alaikum Wr. Wb.

Redaksi



Diterbitkan oleh :
**Lembaga Penelitian, Pengabdian Kepada Masyarakat,
Publikasi dan Kerjasama (LPPMPK)
Sekolah Tinggi Teknologi Muhammadiyah – Cileungsi**

Alamat Redaksi :
Jl. Anggrek No. 25, Perum PT Semen Cibinong – Cileungsi 16820
Telpon : (021) 8249 5502 Fax : (021) 8249 5502

Website : www.sttmcileungsi.ac.id
E-Mail : lppm@sttmcileungsi.ac.id

ISSN Print



ISSN Online



Rice husk ash as a substitute for silica gel

Rahmad Bonanza, Dan Mugisidi*

*Mechanical Engineering Study Program, Faculty of Industrial Technology and Information Technology,
Muhammadiyah University Prof DR HAMKA, Indonesia

*✉ dan.mugisidi@uhamka.ac.id

Submitted: 12/12/2023

Revised: 27/12/2023

Accepted: 07/01/2024

ABSTRACT

Silica gel has been widely used as a dryer for food, medicine and various other purposes. Silica gel is basically a safe material, but because of its hygroscopic nature, silica gel is easily contaminated with dangerous materials. Apart from that, silica gel cannot decompose easily naturally, so using large amounts of silica gel will cause piles of silica gel waste. Therefore, efforts are being made to find replacement materials, one of which is using rice husk ash which can easily decompose naturally. This research aims to test the ability of rice husk ash as a substitute for silica gel. Tests used commercial silica gel (SG), silicon gel in non-woven geotextile bags (SG-N), and rice husk ash in non-woven geotextile bags (AS-N). In this study, AS-N was compared with SG and SG-N. The water vapor absorption test was carried out on a weight of 15 grams for 180 minutes. Each of the three samples was placed in a closed jar to avoid contamination with water vapor in the environment. The relative humidity of each jar was measured with a hygrometer. The jar lid was kept closed throughout the test. The results showed that SG, SG-N and AS-N reduced humidity by 23%, 22% and 24% respectively. Modeling with the Avrami equation is used to extrapolate the absorption results. The research results showed that 15 gram non-woven geotextile rice husk ash had superior water vapor absorption capabilities compared to silica gel and silica gel non-woven geotextiles. So it can be concluded that dryers with rice husk ash as the basic material can be used for needs such as clothes dryers, food dryers and other needs.

Keywords: Dryer; rice husk ash; silica gel.

1. INTRODUCTION

Silica is widely used in various industries such as ceramics, rubber, plastics, microelectronics, food, pharmaceuticals, cosmetics and structural materials [1], [2]. Silica that has been used becomes waste, especially silica gel. Silica gel is produced through condensation polymerization of silicic acid ($\text{Si}(\text{OH})_4$) [3]–[5] which can be used as an absorbent. Although some of the silica gel is reused, much more is an environmental problem. Basically, silica gel itself is not toxic, but it becomes dangerous after it binds to toxic compounds [2]. Therefore, to avoid health and environmental problems, it is necessary to consider replacing silica gel with other adsorbent materials, for example using rice husk ash.

Rice husks are often found in countries where farmers make a living, apart from being cheap and abundant in quantity, rice husks contain around 90% silica by dry weight after complete combustion [4]. Burning at high temperatures to remove the organic fraction, so that only the inorganic fraction remains [6]. Amorphous silica which is an inorganic material is dissolved and continued with precipitation using HCl. Amino-silica hybrid adsorbent was successfully synthesized through a sol gel process using sodium silica derived from rice husk ash [7]–[9]. The elements in silica gel contain various elements, including silica with a concentration of 42319 ppm as seen in Table 1. Meanwhile, rice husk ash contains 2333350 ppm or 96.97% as seen in Table 2. Based on this table, it can be seen that the silica content in rice husk ash is much higher than in silica gel. This shows that rice husk ash has potential as a substitute for silica gel in various applications involving humidity control.



This research specifically compares the water absorption capabilities of silica gel in original packaging (SG), silica gel in non-woven geotextile packaging (SG-N) and husk ash in non-woven geotextile packaging (AS-N). As far as is known, there have been no publications comparing rice husk ash and silica gel in packaging.

Table 1. Silica gel content

Sample Code	As ppm	Ca ppm	Cd ppm	Cu ppm	Fe ppm	Ga ppm	K ppm	Mn ppm
Silica gel	1.5	35453	7.1	15.2	17910	9.0	667	96.9
	Pb ppm	Rp ppm	Sb ppm	Se ppm	Si ppm	Sr ppm	Ti ppm	Zn ppm
	4.7	11.7	39.6	1.3	42319	148	856	31.4

Table 2. Ash content of rice husks

Sample Code	Ca ppm	Cu ppm	Fe ppm	K ppm	Mn ppm
Rice husk ash	1612	2.4	2.4	624738	
	Rb ppm	Si ppm	Sr ppm	Zn ppm	488
	26.4	233350	10.1	40.6	

2. METHOD

In this experiment, rice husk ash was put into a non-woven bag (AS-N) and compared with commercial silica gel which was still in its original packaging (SG) and repackaged into a non-woven bag (SG-N). Husk ash and silica gel were tested with the same weight, namely 15 grams. Each type of packaging is placed in a 350 ml glass bottle and measured using the tool in Table 3.

Table 3. Research tools

No	Tools	Specifications
1	Hygrometer Digital	range 0 – 100%
2	Glass Bottles	350 ml
3	Analytical scales	0 – 1000 gr (0,0001 g)
4	Styrofoam box	39 cm x 26 cm x 17,5 cm
5	Filter	Maximum pore size 20-25 mm
6	Measuring cup	20 ml

Data collection was carried out in the materials laboratory of the Faculty of Industrial Technology and Informatics, UHAMKA using a research scheme as in Figure 1. The control bottle is an empty bottle which is used to compare the decrease in humidity if no material is added. Data collection was carried out using three samples [10] for 180 minutes, and recorded every 5 minutes. The results of data collection will be processed using the Avrami equation. The results of data collection will be processed using the Avrami equation. Avrami's equation is usually used in metal casting processes to determine the kinetics of phase changes, but some researchers have extended its use to absorption processes [11], [12] and even to analyze solar still results [13].

The Avrami equation is a mathematical equation used to describe the way a material changes shape in various situations. This equation is similar to a simple mathematical function used to describe the change process as written in equation 1 and equation 2.

$$Y = 1 - \text{Exp}(-Kt^n) \tag{1}$$

$$\ln \left[\ln \left(\frac{1}{1-Y} \right) \right] = n \ln nt + \ln K \tag{2}$$

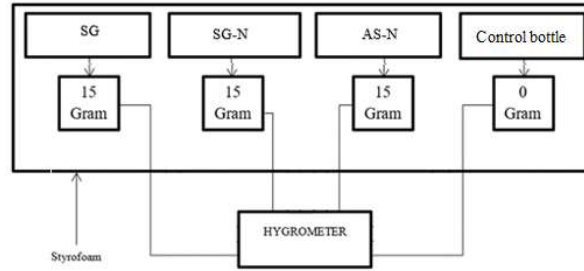


Figure 1. Research scheme

3. RESULTS AND DISCUSSION

The humidity test results were measured using 3 variations which were tested on empty bottles producing several data in the form of the Rh (Relative Humidity) value and temperature shown by the hygrometer. Each variation has a different Rh value and temperature depending on the sample variations used within the specified time interval. The measurement results can be seen in [Table 4](#)

Table 4. Research data 15 gr

No	t, second	SG Rh (%)	SG-N Rh (%)	AS-N Rh (%)	No	t, second	SG Rh (%)	SG-N Rh (%)	AS-N Rh (%)
1	300	84	84	84	19	5700	65	66	64
2	600	83	80	78	20	6000	64	66	64
3	900	82	79	70	21	6300	63	66	64
4	1200	80	78	69	22	6600	62	65	63
5	1500	78	78	68	23	6900	62	65	63
6	1800	77	74	68	24	7200	62	65	62
7	2100	76	73	68	25	7500	69	64	62
8	2400	76	70	66	26	7800	68	64	62
9	2700	76	68	65	27	8100	68	64	62
10	3000	76	68	65	28	8400	68	64	62
11	3300	75	68	64	29	8700	67	64	62
12	3600	75	68	64	30	9000	67	63	62
13	3900	66	65	64	31	9300	66	63	62
14	4200	65	66	64	32	9600	66	63	61
15	4500	65	66	64	33	9900	66	62	61
16	4800	65	66	64	34	10200	66	62	61
17	5100	65	66	64	35	10500	66	62	60
18	5400	65	66	64	36	10800	66	62	60

Using equation (2), the experimental data [Table 4](#) is linearized. Time t is linearized to Ln t while humidity is linearized to Ln[Ln(1/(1-Y))] then entered into **Error! Reference source not found.**

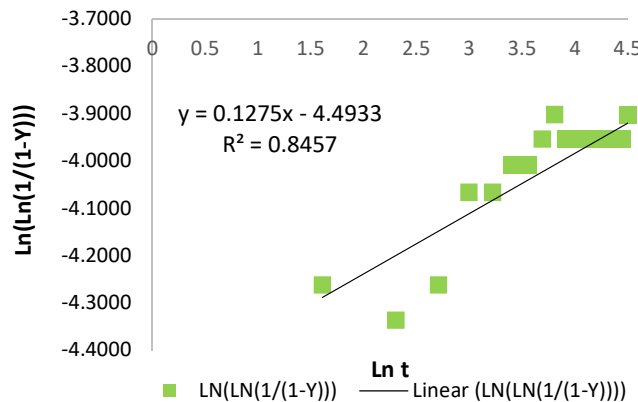


Figure 2. Linearization of humidity data

Error! Reference source not found. you can see $\ln t$ plotted on the x-axis and $\ln[\ln(1/(1-Y))]$ plotted on the Y-axis. Using linearized data, the trend formed from the experiment was analyzed using linear regression and a straight line was obtained with the equation $y = 0.1275x - 4.4933$ with a coefficient of determination of 0.8457. The coefficient of determination (R²) is calculated to determine the effect of the independent variable on the dependent variable [14] or suitability of data with regression [15], [16]. Generally a goodness-of-fit above 0.8 is considered representative of the data.

By using the equation $Y=0.1275x - 4.4933$, the values of K and n can be obtained in equation (2). Because $n \ln t$ is equal to $0.1275x$, then x can be considered as $\ln t$, so the value of n is $0.1275x$. Furthermore, the K value can be obtained because $\ln K$ is -4.4933 . By calculating the exponential value (-4.4933), we obtain a K value of 0.011184. With a similar approach, we can determine the K and n values of SG, SG-N and AS-N absorption. as shown in Table 5. Next, the K and n values are used in equation 1, the results of which are shown in Figure 3.

Table 5. K and n values

No.	Adsorbent	K	n
1	SG 15 grams	0.000523	0.75
2	SG-N 15 grams	0.001986	0.49
3	RH-N 15 grams	0.006729	0.25

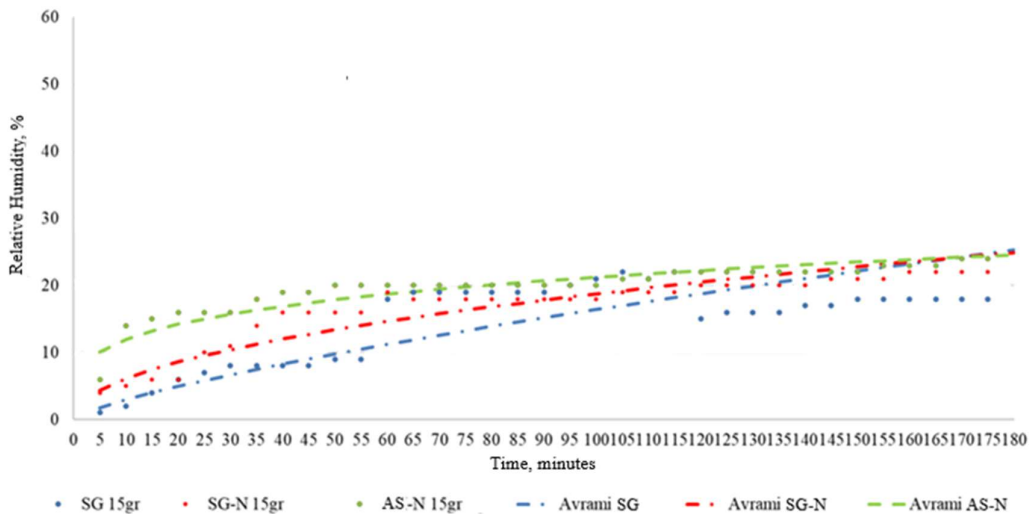


Figure 3. Research data and Avrami modeling results

Figure 3 depicts absorption (Rh) in three different variations using three different types of absorbent materials, namely SG, SG-N and AS-N. It can be seen that AS-N has more dominant water vapor absorption than the other two samples. This shows that rice husk ash has better absorption potential at the beginning of the absorption process, and the results are in accordance with the Avrami equation. The results of experiments and calculations show that non-woven geotextile rice husk ash has better water vapor absorption capabilities compared to silica gel and silica gel non-woven geotextiles at a weight variation of 15 grams with a capacity of 24% with absorption measured at maximum absorption. the percentage that an absorbent material can reach at a given time. The ash capacity of non-woven geotextile rice husks tends to increase with increasing weight variations.

4. CONCLUSION.

Based on the test results, it was found that non-woven geotextile rice husk ash had better water vapor absorption capabilities than silica gel with original packaging and silica gel with non-woven geotextile packaging. Especially with a weight of 15 grams. These results show that non-woven geotextile rice husk ash has better water vapor absorption capacity compared to silica gel. The difference in the range

of absorption values also reflects the absorption characteristics of each absorbent material. Thus, non-woven geotextile rice husk ash can replace silica.

REFERENCE

- [1] L. Sun and K. Gong, "Silicon-based materials from rice husks and their applications," *Industrial and Engineering Chemistry Research*, vol. 40, no. 25. American Chemical Society, pp. 5861–5877, Dec. 12, 2001. doi: 10.1021/ie010284b.
- [2] A. K. Singh and V. Sudhakar, "Highly efficient method of utilizing waste silica hazards," *Process Safety and Environmental Protection*, vol. 153, pp. 239–248, Sep. 2021, doi: 10.1016/j.psep.2021.07.007.
- [3] A. A. Chirsty and P. Sivarukshy, "Comparison of adsorption properties of commercial silica and rice husk ash (RHA) silica: A study by NIR spectroscopy," *Open Chem*, vol. 19, no. 1, pp. 426–431, Jan. 2021, doi: 10.1515/chem-2021-0044.
- [4] J. P. Nayak and J. Bera, "Preparation of an efficient humidity indicating silica gel from rice husk ash," 2011.
- [5] V. P. Della, I. Kühn, and D. Hotza, "Rice husk ash as an alternate source for active silica production." [Online]. Available: www.elsevier.com/locate/matlet
- [6] P. A. Handayani, E. Nurjanah, and W. D. P. Rengga, "PEMANFAATAN LIMBAH SEKAM PADI MENJADI SILIKA GEL," *Jurnal Bahan Alam Terbarukan*, vol. 3, no. 2, Dec. 2014, doi: 10.15294/jbat.v3i2.3698.
- [7] hendriwan fahmi, "Analisa Daya Serap Silika Gel Berbahan Dasar Abu SekamPadi," *Jurnal Iptek Terapan*, vol. 10, no. 3, pp. 176–182, 2016, doi: 10.22216/jit.2016.v10i3.425.
- [8] Y. Zou and T. Yang, "Rice husk, rice husk ash and their applications," in *Rice Bran and Rice Bran Oil: Chemistry, Processing and Utilization*, Elsevier, 2019, pp. 207–246. doi: 10.1016/B978-0-12-812828-2.00009-3.
- [9] S. K. S. Hossain, L. Mathur, and P. K. Roy, "Rice husk/rice husk ash as an alternative source of silica in ceramics: A review," *Journal of Asian Ceramic Societies*, vol. 6, no. 4. Taylor and Francis Ltd., pp. 299–313, Oct. 02, 2018. doi: 10.1080/21870764.2018.1539210.
- [10] F. Azharul, Rahmawati, Choiruddin, and Wilarso, "RANCANG BANGUN ALAT KALIBRASI PENGUKUR SUHU BERBASIS DIGITAL TEMPERATUR CONTROLLER," *TEKNOSAINS: Jurnal Sains, Teknologi dan Informatika*, vol. 8, no. 2, pp. 109–116, Jul. 2021, doi: 10.37373/tekno.v8i2.103.
- [11] D. Mugisidi, A. Ranaldo, J. W. Soedarsono, and M. Hikam, "Modification of activated carbon using sodium acetate and its regeneration using sodium hydroxide for the adsorption of copper from aqueous solution," *Carbon N Y*, vol. 45, no. 5, 2007, doi: 10.1016/j.carbon.2006.12.009.
- [12] E. C. N. Lopes, F. S. C. Dos Anjos, E. F. S. Vieira, and A. R. Cestari, "An alternative Avrami equation to evaluate kinetic parameters of the interaction of Hg(II) with thin chitosan membranes," *J Colloid Interface Sci*, vol. 263, no. 2, pp. 542–547, 2003, doi: 10.1016/S0021-9797(03)00326-6.
- [13] D. Mugisidi, "Penggunaan Persamaan Avrami Untuk Menentukan Koefisien Konveksi Solar Still," vol. 6, 2021.
- [14] Alessandro Di Bucchianico, "Coefficient of Determination (R2)," in *Encyclopedia of Statistics in Quality and Reliability*, Wiley Online Library, 2008. doi: <https://doi.org/10.1002/9780470061572.eqr173>.
- [15] J. P. Barrett, "The coefficient of determination-some limitations," *American Statistician*, vol. 28, no. 1, pp. 19–20, 1974, doi: 10.1080/00031305.1974.10479056.
- [16] N. J. D. Nagelkerke, "A Note on a General Definition of the Coefficient of Determination," 1991.

Dan Mugisidi - Rice husk ash as a substitute for silica gel

by Layanan Perpustakaan UHAMKA

Submission date: 27-Jan-2024 01:48PM (UTC+0700)

Submission ID: 2279546902

File name: Rice_husk_ash_as_a_substitute_for_silica_gel.pdf (1.06M)

Word count: 2527

Character count: 12063

Rice husk ash as a substitute for silica gel

Rahmad Bonanza, Dan Mugisidi*

*Mechanical Engineering Study Program, Faculty of Industrial Technology and Information Technology, Muhammadiyah University Prof DR HAMKA, Indonesia

*dan.mugisidi@uhamka.ac.id

Submitted: 12/12/2023

Revised: 27/12/2023

Accepted: 07/01/2024

ABSTRACT

Silica gel has been widely used as a dryer for food, medicine and various other purposes. Silica gel is basically a safe material, but because of its hygroscopic nature, silica gel is easily contaminated with dangerous materials. Apart from that, silica gel cannot decompose easily naturally, so using large amounts of silica gel will cause piles of silica gel waste. Therefore, efforts are being made to find replacement materials, one of which is using rice husk ash which can easily decompose naturally. This research aims to test the ability of rice husk ash as a substitute for silica gel. Tests used commercial silica gel (SG), silicon gel in non-woven geotextile bags (SG-N), and rice husk ash in non-woven geotextile bags (AS-N). In this study, AS-N was compared with SG and SG-N. The water vapor absorption test was carried out on a weight of 15 grams for 180 minutes. Each of the three samples was placed in a closed jar to avoid contamination with water vapor in the environment. The relative humidity of each jar was measured with a hygrometer. The jar lid was kept closed throughout the test. The results showed that SG, SG-N and AS-N reduced humidity by 23%, 22% and 24% respectively. Modeling with the Avrami equation is used to extrapolate the absorption results. The research results showed that 15 gram non-woven geotextile rice husk ash had superior water vapor absorption capabilities compared to silica gel and silica gel non-woven geotextiles. So it can be concluded that dryers with rice husk ash as the basic material can be used for needs such as clothes dryers, food dryers and other needs.

Keywords: Dryer; rice husk ash; silica gel.

1. INTRODUCTION

Silica is widely used in various industries such as ceramics, rubber, plastics, microelectronics, food, pharmaceuticals, cosmetics and structural materials [1], [2]. Silica that has been used becomes waste, especially silica gel. Silica gel is produced through condensation polymerization of silicic acid (Si(OH)₄) [3]–[5] which can be used as an absorbent. Although some of the silica gel is reused, much more is an environmental problem. Basically, silica gel itself is not toxic, but it becomes dangerous after it binds to toxic compounds [2]. Therefore, to avoid health and environmental problems, it is necessary to consider replacing silica gel with other adsorbent materials, for example using rice husk ash.

Rice husks are often found in countries where farmers make a living, apart from being cheap and abundant in quantity, rice husks contain around 90% silica by dry weight after complete combustion [4]. Burning at high temperatures to remove the organic fraction, so that only the inorganic fraction remains [6]. Amorphous silica which is an inorganic material is dissolved and continued with precipitation using HCl. Amino-silica hybrid adsorbent was successfully synthesized through a sol gel process using sodium silica derived from rice husk ash [7]–[9]. The elements in silica gel contain various elements, including silica with a concentration of 42319 ppm as seen in Table 1. Meanwhile, rice husk ash contains 2333350 ppm or 96.97% as seen in Table 2. Based on this table, it can be seen that the silica content in rice husk ash is much higher than in silica gel. This shows that rice husk ash has potential as a substitute for silica gel in various applications involving humidity control.



This research specifically compares the water absorption capabilities of silica gel in original packaging (SG), silica gel in non-woven geotextile packaging (SG-N) and husk ash in non-woven geotextile packaging (AS-N). As far as is known, there have been no publications comparing rice husk ash and silica gel in packaging.

Table 1. Silica content

Sample Code	As ppm	Ca ppm	Cd ppm	Cu ppm	Fe ppm	Ga ppm	K ppm	Mn ppm
Silica gel	1.5	35453	7.1	15.2	17910	9.0	667	96.9
	Pb ppm	Rp ppm	Sb ppm	Se ppm	Si ppm	Sr ppm	Ti ppm	Zn ppm
	4.7	11.7	39.6	1.3	42319	148	856	31.4

Table 2. Ash content of rice husks

Sample Code	Ca ppm	Cu ppm	Fe ppm	K ppm	Mn ppm
Rice husk ash	1612	2.4	2.4	624738	
	Rb ppm	Si ppm	Sr ppm	Zn ppm	488
	26.4	233350	10.1	40.6	

2. METHOD

In this experiment, rice husk ash was put into a non-woven bag (AS-N) and compared with commercial silica gel which was still in its original packaging (SG) and repackaged into a non-woven bag (SG-N). Husk ash and silica gel were tested with the same weight, namely 15 grams. Each type of packaging is placed in a 350 ml glass bottle and measured using the tool in Table 3.

Table 3. Research tools

No	Tools	Specifications
1	Hygrometer Digital	range 0 – 100%
2	Glass Bottles	350 ml
3	Analytical scales	0 – 1400 gr (0,0001 g)
4	Styrofoam box	39 cm x 26 cm x 17,5 cm
5	Filter	Maximum pore size 20-25 mm
6	Measuring cup	20 ml

Data collection was carried out in the materials laboratory of the Faculty of Industrial Technology and Informatics, UHAMKA using a research scheme as in Figure 1. The control bottle is an empty bottle which is used to compare the decrease in humidity if no material is added. Data collection was carried out using three samples [10] for 180 minutes, and recorded every 5 minutes. The results of data collection will be processed using the Avrami equation. The results of data collection will be processed using the Avrami equation. Avrami's equation is usually used in metal casting processes to determine the kinetics of phase changes, but some researchers have extended its use to absorption processes [11], [12] and even to analyze solar still results [13].

The Avrami equation is a mathematical equation used to describe the way a material changes shape in various situations. This equation is similar to a simple mathematical function used to describe the change process as written in equation 1 and equation 2.

$$Y = 1 - \text{Exp}(-Kt^n) \tag{1}$$

$$\ln \left[\ln \left(\frac{1}{1-Y} \right) \right] = n \ln nt + \ln K \tag{2}$$

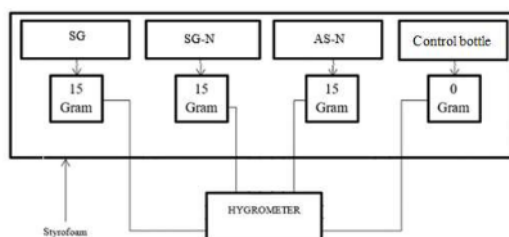


Figure 1. Research scheme

3. RESULTS AND DISCUSSION

The humidity test results were measured using 3 variations which were tested on empty bottles producing several data in the form of the Rh (Relative Humidity) value and temperature shown by the hygrometer. Each variation has a different Rh value and temperature depending on the sample variations used within the specified time interval. The measurement results can be seen in Table 4

Table 4. Research data 15 gr

No	t, second	SG Rh (%)	SG-N Rh (%)	AS-N Rh (%)	No	t, second	SG Rh (%)	SG-N Rh (%)	AS-N Rh (%)
1	300	84	84	84	19	5700	65	66	64
2	600	83	80	78	20	6000	64	66	64
3	900	82	79	70	21	6300	63	66	64
4	1200	80	78	69	22	6600	62	65	63
5	1500	78	78	68	23	6900	62	65	63
6	1800	77	74	68	24	7200	62	65	62
7	2100	76	73	68	25	7500	69	64	62
8	2400	76	70	66	26	7800	68	64	62
9	2700	76	68	65	27	8100	68	64	62
10	3000	76	68	65	28	8400	68	64	62
11	3300	75	68	64	29	8700	67	64	62
12	3600	75	68	64	30	9000	67	63	62
13	3900	66	65	64	31	9300	66	63	62
14	4200	65	66	64	32	9600	66	63	61
15	4500	65	66	64	33	9900	66	62	61
16	4800	65	66	64	34	10200	66	62	61
17	5100	65	66	64	35	10500	66	62	60
18	5400	65	66	64	36	10800	66	62	60

Using equation (2), the experimental data Table 4 is linearized. Time t is linearized to Ln t while humidity is linearized to $\text{Ln}[\text{Ln}(1/(1-Y))]$ then entered into Error! Reference source not found..

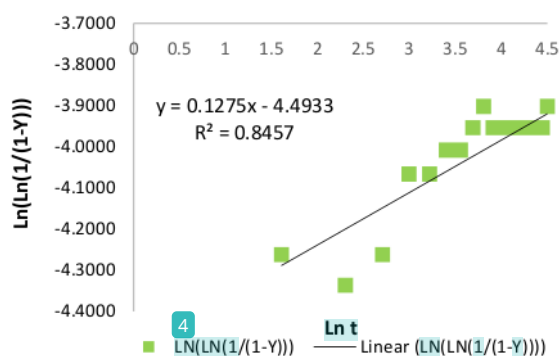


Figure 2. Linearization of humidity data

Error! Reference source not found. you can see $\ln t$ plotted on the x-axis and $\ln[\ln(1/(1-Y))]$ plotted on the Y-axis. Using linearized data, the trend formed from the experiment was analyzed using linear regression and a straight line was obtained with the equation $y = 0.1275x - 4.4933$ with a coefficient of determination of 0.8457. The coefficient of determination (R^2) is calculated to determine the effect of the independent variable on the dependent variable [14] or suitability of data with regression [15], [16]. Generally a goodness-of-fit above 0.8 is considered representative of the data.

By using the equation $Y=0.1275x - 4.4933$, the values of K and n can be obtained in equation (2). Because $n \ln t$ is equal to $0.1275x$, then x can be considered as $\ln t$, so the value of n is $0.1275x$. Furthermore, the K value can be obtained because $\ln K$ is -4.4933 . By calculating the exponential value (-4.4933), we obtain a K value of 0.01118 . With a similar approach, we can determine the K and n values of SG, SG-N and AS-N absorption. as shown in Table 5. Next, the K and n values are used in equation 1, the results of which are shown in Figure 3.

19
Table 5. K and n values

No.	Adsorbent	K	n
1	SG 15 grams	0.000523	0.75
2	SG-N 15 grams	0.001986	0.49
3	RH-N 15 grams	0.006729	0.25

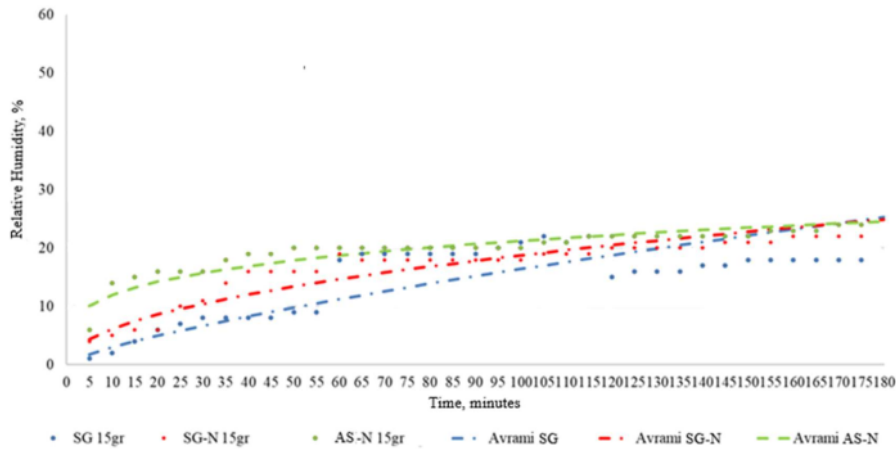


Figure 3. Research data and Avrami modeling results

Figure 3 depicts absorption (Rh) in three different variations using three different types of absorbent materials, namely SG, SG-N and AS-N. It can be seen that AS-N has more dominant water vapor absorption than the other two samples. This shows that rice husk ash has better absorption potential at the beginning of the absorption process, and the results are in accordance with the Avrami equation. The results of experiments and calculations show that non-woven geotextile rice husk ash has better water vapor absorption capabilities compared to silica gel and silica gel non-woven geotextiles at a weight variation of 15 grams with a capacity of 24% with absorption measured at maximum absorption, the percentage that an absorbent material can reach at a given time. The ash capacity of non-woven geotextile rice husks tends to increase with increasing weight variations.

4. CONCLUSION.

10
Based on the test results, it was found that non-woven geotextile rice husk ash had better water vapor absorption capabilities than silica gel with original packaging and silica gel with non-woven geotextile packaging. Especially with a weight of 15 grams. These results show that non-woven geotextile rice husk ash has better water vapor absorption capacity compared to silica gel. The difference in the range

of absorption values also reflects the absorption characteristics of each absorbent material. Thus, non-woven geotextile rice husk ash can replace silica.

REFERENCE

- [1] L. Sun and K. Gong, "Silicon-based materials from rice husks and their applications," *Industrial and Engineering Chemistry Research*, vol. 40, no. 25. American Chemical Society, pp. 5861–5877, Dec. 12, 2001. doi: 10.1021/ie010284b.
- [2] A. K. Singh and V. Sudhakar, "Highly efficient method of utilizing waste silica hazards," *Process Safety and Environmental Protection*, vol. 153, pp. 239–248, Sep. 2021, doi: 10.1016/j.psep.2021.07.007.
- [3] A. A. Chirsty and P. Sivarukshy, "Comparison of adsorption properties of commercial silica and rice husk ash (RHA) silica: A study by NIR spectroscopy," *Open Chem*, vol. 19, no. 1, pp. 426–431, Jan. 2021, doi: 10.1515/chem-2021-0044.
- [4] J. P. Nayak and J. Bera, "Preparation of an efficient humidity indicating silica gel from rice husk ash," 2011.
- [5] V. P. Della, I. Kühn, and D. Hotza, "Rice husk ash as an alternate source for active silica production." [Online]. Available: www.elsevier.com/locate/matlet
- [6] P. A. Handayani, E. Nurjanah, and W. D. P. Rengga, "PEMANFAATAN LIMBAH SEKAM PADI MENJADI SILIKA GEL," *Jurnal Bahan Alam Terbarukan*, vol. 3, no. 2, Dec. 2014, doi: 10.15294/jbat.v3i2.3698.
- [7] hendiwan fahmi, "Analisa Daya Serap Silika Gel Berbahan Dasar Abu SekamPadi," *Jurnal Iptek Terapan*, vol. 10, no. 3, pp. 176–182, 2016, doi: 10.22216/jit.2016.v10i3.425.
- [8] Y. Zou and T. Yang, "Rice husk, rice husk ash and their applications," in *Rice Bran and Rice Bran Oil: Chemistry, Processing and Utilization*, Elsevier, 2019, pp. 207–246. doi: 10.1016/B978-0-12-812828-2.00009-3.
- [9] S. K. S. Hossain, L. Mathur, and P. K. Roy, "Rice husk/rice husk ash as an alternative source of silica in ceramics: A review," *Journal of Asian Ceramic Societies*, vol. 6, no. 4. Taylor and Francis Ltd., pp. 299–313, Oct. 02, 2018. doi: 10.1080/21870764.2018.1539210.
- [10] F. Azharul, Rahmawati, Choiruddin, and Wilarso, "RANCANG BANGUN ALAT KALIBRASI PENGUKUR SUHU BERBASIS DIGITAL TEMPERATUR CONTROLLER," *TEKNOSAINS : Jurnal Sains, Teknologi dan Informatika*, vol. 8, no. 2, pp. 109–116, Jul. 2021, doi: 10.37373/tekno.v8i2.103.
- [11] D. Mugisidi, A. Ranaldo, J. W. Soedarsono, and M. Hikam, "Modification of activated carbon using sodium acetate and its regeneration using sodium hydroxide for the adsorption of copper from aqueous solution," *Carbon N Y*, vol. 45, no. 5, 2007, doi: 10.1016/j.carbon.2006.12.009.
- [12] E. C. N. Lopes, F. S. C. Dos Anjos, E. F. S. Vieira, and A. R. Cestari, "An alternative Avrami equation to evaluate kinetic parameters of the interaction of Hg(II) with thin chitosan membranes," *J Colloid Interface Sci*, vol. 263, no. 2, pp. 542–547, 2003, doi: 10.1016/S0021-9797(03)00326-6.
- [13] D. Mugisidi, "Penggunaan Persamaan Avrami Untuk Menentukan Koefisien Konveksi Solar Still," vol. 6, 2021.
- [14] Alessandro Di Bucchianico, "Coefficient of Determination (R2)," in *Encyclopedia of Statistics in Quality and Reliability*, Wiley Online Library, 2008. doi: <https://doi.org/10.1002/9780470061572.eqr173>.
- [15] J. P. Barrett, "The coefficient of determination-some limitations," *American Statistician*, vol. 28, no. 1, pp. 19–20, 1974, doi: 10.1080/00031305.1974.10479056.
- [16] N. J. D. Nagelkerke, "A Note on a General Definition of the Coefficient of Determination," 1991.

Dan Mugisidi - Rice husk ash as a substitute for silica gel

ORIGINALITY REPORT

12%

SIMILARITY INDEX

9%

INTERNET SOURCES

9%

PUBLICATIONS

2%

STUDENT PAPERS

PRIMARY SOURCES

- 1** eprints.mercubuana-yogya.ac.id 2%
Internet Source
- 2** jurnal.sttmcileungsi.ac.id 1%
Internet Source
- 3** Eijer, Jochen, Peter Wasserscheid, and Andreas Jess. "Deep desulfurization of oil refinery streams by extraction with ionic liquids", Green Chemistry, 2004. 1%
Publication
- 4** Hirosawa, S.. "Effects of Mg addition on the kinetics of low-temperature precipitation in Al-Li-Cu-Ag-Zr alloys", Materials Science & Engineering A, 199802 1%
Publication
- 5** fdocuments.us 1%
Internet Source
- 6** Lidya Novita, Iswadi Idris. "Effectiveness of silica gel from palm kernel shell ash as a moisture absorber of bottle packaging 1%

medicine", IOP Conference Series: Earth and Environmental Science, 2022

Publication

7	ejournal.utp.ac.id Internet Source	1 %
8	www.degruyter.com Internet Source	1 %
9	www.ijisae.org Internet Source	<1 %
10	123dok.org Internet Source	<1 %
11	D Mugisidi, R S Cahyani, O Heriyani, D Agusman, Rifky. "Effect of Iron Sand in Single Basin Solar Still: Experimental Study", IOP Conference Series: Earth and Environmental Science, 2019 Publication	<1 %
12	Mega Kurnia, Suprpto Suprpto, Yatim Lailun Ni'mah. "Bio-Adsorbent for Remazol Brilliant Blue R (RBBR) Dye", South African Journal of Chemical Engineering, 2023 Publication	<1 %
13	idoc.pub Internet Source	<1 %
14	5col-museums.campus.ads.umass.edu Internet Source	<1 %

15	acta.fih.upt.ro Internet Source	<1 %
16	etd.cput.ac.za Internet Source	<1 %
17	www.hindawi.com Internet Source	<1 %
18	www.ijresm.com Internet Source	<1 %
19	Been-Huang Chiang, Su-Tze Chou, Cheng-Kuang Hsu. "Yam affects the antioxidative and gel-forming properties of surimi gels", <i>Journal of the Science of Food and Agriculture</i> , 2005 Publication	<1 %
20	Rafat Siddique, Mohammad Iqbal Khan. "Chapter 5 Rice Husk Ash", Springer Science and Business Media LLC, 2011 Publication	<1 %

Exclude quotes Off
Exclude bibliography On

Exclude matches Off