Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 744 - 753
Received 05 March 2021; Accepted 01 April 2021.

Mechanical Properties of Epoxy/ Juteyarns Composite Materials

Alkaraishi Mohammed [1], Ali Talib Abdalzahra[2], Ahmed A. Taher[3]
1Mechanical Dept., Engineering Faculty, University of Kufa. E-mail: Mohammedh.alkaraisshi@uokufa.edu.iq
2Mechanical Dept., Engineering Faculty, University of Kufa. E-mail: alit.salman@uokufa.edu.iq
3Mechanical Dept., Engineering Faculty, University of Kufa. E-mail: Ahmed.abosabeeh@uokufa.edu.iq

ABSTRACT
During this paper, characterizing of tensile behavior of dry jute yarn and inseminated jute yarn is planned. The results from dry yarn tensile take a look as showed the presence of four zones on the load-displacement curve and people of inseminated yarn tensile tests showed the presence of only 1 linear zone. Average Young's modulus, average doggedness, and average breaking stress of inseminated yarn square measure superior to those of dry yarn whereas average breaking strain of inseminated yarn are less than that of dry yarn. Morphologies of tested yarns wherever mentioned elucidating harm mechanisms.

Keywords: Jute yarn, epoxy, tensile test, composite materials

1.INTRODUCTION

The fiber used as a reinforcing component for composites has attracted the attention of engineers and researchers throughout the last decade. The abundance and biodegradability of fibers containing polyester and hemicellulose, attribute to them the standard of excellent supply of renewable polymers [1, 3].

The environmental, economic, and technical impact of this fiber explains the growth got to them. Moreover, is also simply processed while not inflicting irritation to the skin and therefore, the systema respiratory of individuals managing this kind of fibers. Bio-composites have low weight the same as different composites that are the reason they square measure wide used in automotive [4, 6].

Among numerous natural fibers, jute occupies a decent place in bio-composites. it's wide offered with high ratio and toughness compared to different natural reinforcements. Smart resistance to cross forces or cracking and stabling properties are obtained by Bidirectional of the jute materials [7].

consequently, various studies were completed characterizing the behavior of jute primarily based composites, and their constituents. During this field, A. S Ullah et al. [8,10], analyzed the failure mechanisms of each jute yarns and jute fibers for reading of energy absorption. They noticed that the jute fiber exhibited a somewhat completely different instability pattern the same as a jute yarn, and failure was preceded by high instability in energy in each case.

A. Gopinath. [11] investigated the mechanical disposition for jute fiber strong composites for polyester, epoxy glue. They displayed the jute-epoxy offered smart mechanical properties and therefore the treatment time for jute- the polyester composite was relatively lower time than jute-epoxy.

M. R. Sanjay et al. [12] analyzed the hybrid influence of composites of jute/E-Glass fiber and noticed that the hybrid composite has smart strength compared with jute fiber fictional with fiber. inline with this study, the incorporation of fiber in jute fiber composites enhances the mechanical behavior and it ends up in the rise of the employment of natural fibers in varied applications.

Tensile tests and „Finite component Analysis were distributed by M. Severson [13] to characterize composite materials exploitation jute fibers as a reinforcing component. He remarked that the rise of ratio of fiber tends to decrease the modulus of physical property ab initio at a steep rate however eventually converges onto a lower limit. This shows however sensitive modulus issue with a tiny low modification in ratio and emphasizes the necessity to stay good management on this parameter throughout producing.

Investigations created by A. Saaidia et al. [14] on 320 jute yarn samples showed a vital dispersion of tensile check results and linear stress variation in typical stress-strain curve, followed by quasi-linear variation with an associate increase of strain till it reaches its highest worth. They explained this decrease by the partial failure of jute yarn succeeded by many drops in stress forming a stepwise behavior.

The analyze of Jute twine behavior is very important a cause to their large-scale use in the fabrication of bio-composites as reinforcing element. Thus, will be characterize the behavior of dry jute yarn and impregnated jute yarn by tensile tests and morphological observations.

2.EXPERIMENTAL WORK

Tensile proprieties of fertile jute yarn were checked within the light-weight of dry jute yarn proprieties mistreatment tensile testing machine (Instron 5567) with a (30 kN) load cell and (0,6 mm/ min) head speed. The yarn was extracted from two-dimensional jute material. 2 teams of yarn samples were used: twenty-four dry yarn samples and seven yarn samples fertile with epoxy glue. The low range of fertile samples selection was determined for the predictable repetitive nature of fertile yarn results and improvement. The tests were performed at a temperature in line with the quality ASTM customary D3822-07. Yarns were fixed to a paper frame with glue, placed over a hole of fifty-millimeter length, and glued between higher and lower grips of the tensile machine as shown in Fig. 1.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 744 - 753
Received 05 March 2021; Accepted 01 April 2021.

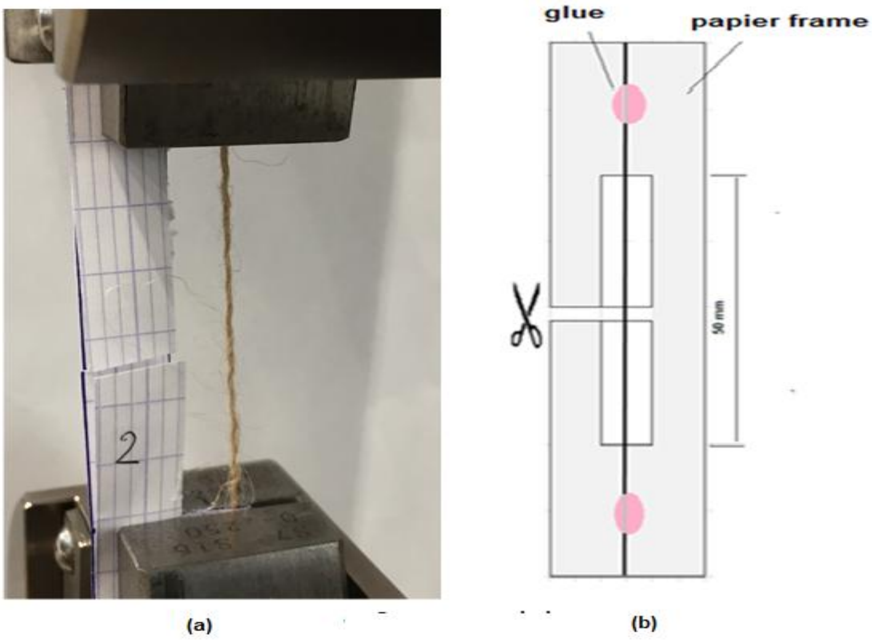


Fig. 1 a- dry yarn sample placed between grips of the machine, b- schematic representation of tested samples

Diameters of yarns were determined by calculation yarn density in line with the “Archimedes' Principle”. Thus, five samples of two meters length horse cart jute yarns were ready. to create five consideration measurements in water and outside of water (dry measurements) mistreatment semi-micro balance of zero.1 mg exactness. The average of these five measurements was taken into thought to calculate the typical density of yarn and to get its average diameter. Morphological observations were obtained by the utilization of Scanning microscopy SEM.

3.RESULTS AND DISCSSION

The results of dry yarn tensile tests showed the presence of four zones on the load-displacement curve Fig. 2-A. the primary party of the curve wasn't linear, however, it had been slowly increasing in slope till it finally became linear within the second party. The non-linearity of the primary half could be associated with the fibrous structure of yarn and its twisted kind [15,16]. The linear half (Zone B) of the curve was thought-about because the elastic party, that was wont to calculate the tensile stress and Young modulus. The elastic party reaches its limit once the force drops suddenly, and also the curve tries and maintains the dimensionality (zone C) that indicates that the yarn enters during an injury part. The last half (zone D) was characterized by fluctuations of force, that end by the rupture of yarn.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 744 - 753
Received 05 March 2021; Accepted 01 April 2021.

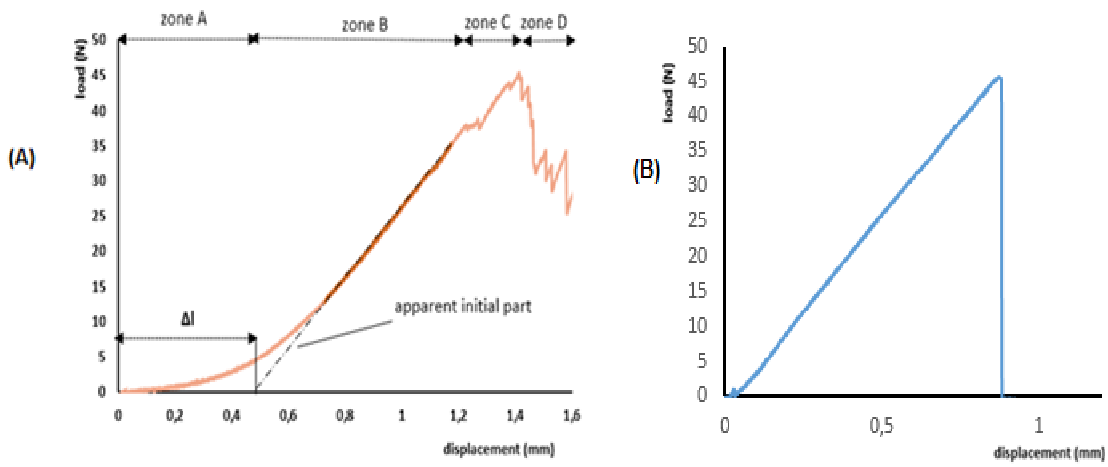


Fig.2 example of load displacement curve for dray yarn (A) and impregnated yarn (B)

So, the results of fertilized yarn showed that the force-displacement curve has only 1 elastic zone that finish by an unexpected call in force characterizing the breaking of yarn Fig. 2- B. length of non-linear half in dry yarn samples was extremely variable between the tested yarn samples (0.02-0.15 mm), and this hyperbolic the scatter of the determined stress - train curves among the same yarn kind. Thus, initiatives created to cut out this distinction between samplesBy rectilinear regression, the linear part of a curve was extended to the axis of displacement, and intrinsically this represents the apparent initial linear half Fig. 3-B.

the purpose of interception was understood as a gauge length addition (Δl). later, strain (ε) was calculated [17]:

$\varepsilon = X. \Delta L / X+\Delta L$……. (1)

Where x is displacement data and l is gauge length

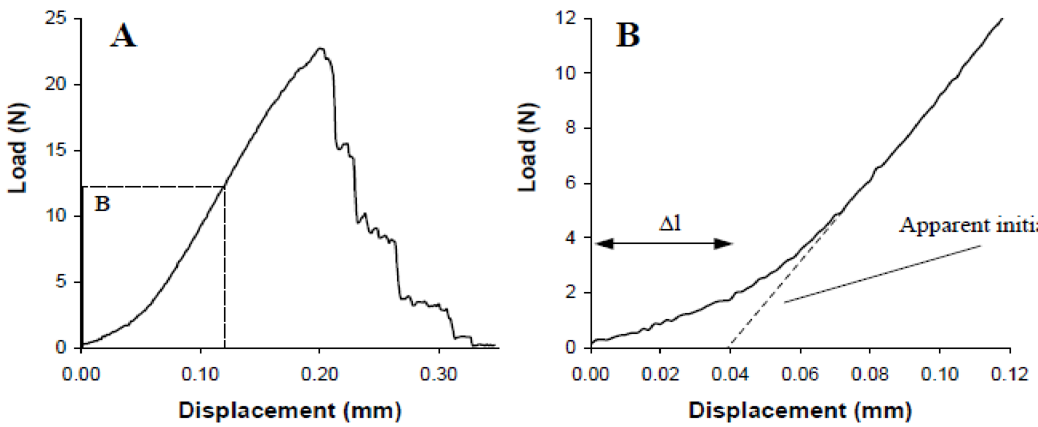


Fig.3: examples of load displacement curve, (A) is the complete curve, (B) is a close – up of the initial non-linear part [17].

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 744 - 753
Received 05 March 2021; Accepted 01 April 2021.

The yarn density was found to be up to one,367 g/cm3, and also the average diameter was calculated resulting in a draw Stress-strain curves. Consequently, the apparent stiffness "E" (the slope of the apparent initial linear part; GPa), the breaking stress"Ϭb (MPa), the breaking strain "εb" and also the breaking force Fb (N) was determined. The strength of yarn designed by "tenacity" (N/ denier) outlined the load magnitude relation desired to interrupt the specimen and also the linear density of that specimen. Thus, the pertinacity was determined in line with the equation:

tenacity = load required to break the specimen / liner density…….(2)

Fig. 4 shows some samples of stress-strain curves for dry and fertile yarns whereas tables (1 and 2) summarize the results obtained for dry and fertile samples severally. This figure indicates clearly that impregnation of yarns rises the breaking limit and reduces the breaking strain of those yarns

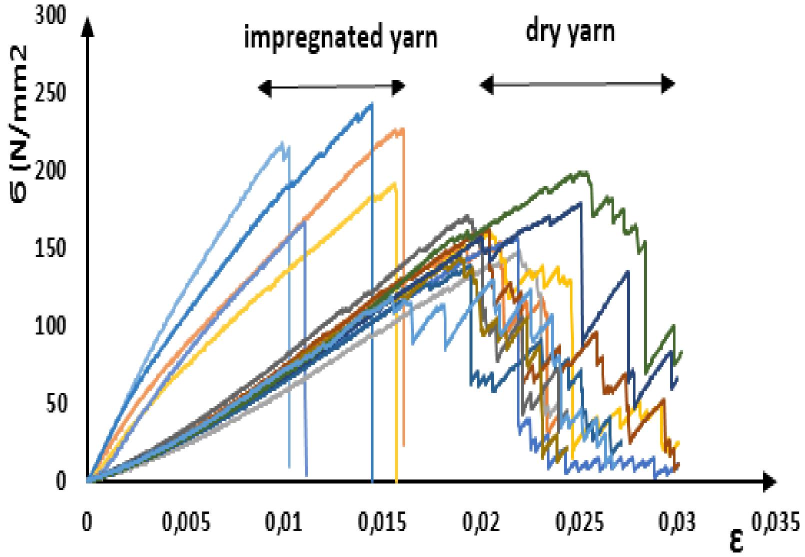


Fig. 4examples of stress-strain curves for dry and impregnated yarns

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 744 - 753
Received 05 March 2021; Accepted 01 April 2021.

Table (1) : results o imprenated jute yarn

sample number	6b (N/mm2)	ε%	E (Gpa)	Fb (N)	tenacity (N/denier)
1	153,69	2,1	8,9	43,44	1,03
2	148,2	2,1	7,6	41,88	0,99
3	161,45	2	9,9	48,08	1,14
4	156,31	2,1	8	46,54	1,1
5	150,13	1,8	10	44,71	1,06
6	139,33	1,9	10	41,49	0,98
7	162,93	2	9,3	48,52	1,15
8	170,99	1,9	9,5	48,3	1,15
9	144,8	1,8	8,7	40,92	0,97
10	179,041	2,5	8,6	50,6	1,2
11	199,04	2,5	9,5	56,3	1,34
12	129,61	2	8,2	36,6	0,87
13	208,97	2,1	11,1	59,06	1,4
14	168,22	2,3	8,3	47,5	1,13
15	178,76	2	11,1	50,52	1,2
16	218,68	2,5	11	61,81	1,47
17	166,52	2,1	9,9	47,06	1,12
18	224,44	2,5	10,9	63,43	1,51
19	131,6	1,76	9,9	37,2	0,88
20	146,67	2,2	7,4	41,45	0,98
21	148,9	2	10	42,08	1
22	175,85	2,1	9,7	49,7	1,18
23	174,27	1,98	9,7	49,25	1,17
24	146,37	1,91	8,74	41,37	0,985

sample number	6b (N/mm2)	ε%	E (Gpa)	Fb (N)	tenacity (N/denier)
1	217,23	0,99	20,29	61,26	1,45
2	226,73	1,6	13,2	63,94	1,52
3	162,09	1,74	9,69	45,71	1,08
4	191,19	1,55	11,01	53,91	1,28
5	166,47	1,1	14,9	46,94	1,11
6	156,69	0,72	19,81	44,18	1,05
7	242,94	1,44	15,29	68,51	1,63

Fig. 5-A shows comparative charts for dry and fertile jute yarns. It shows the common young modulus and therefore the average determination of fertile yarns samples are more than those of dry yarn samples. whereas Fig. 5-B shows the medium breaking stress for fertile yarn samples is more than that of dry samples. On the opposite hand, the average breaking strain of fertile yarns is under that of the dry.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 744 - 753
Received 05 March 2021; Accepted 01 April 2021.

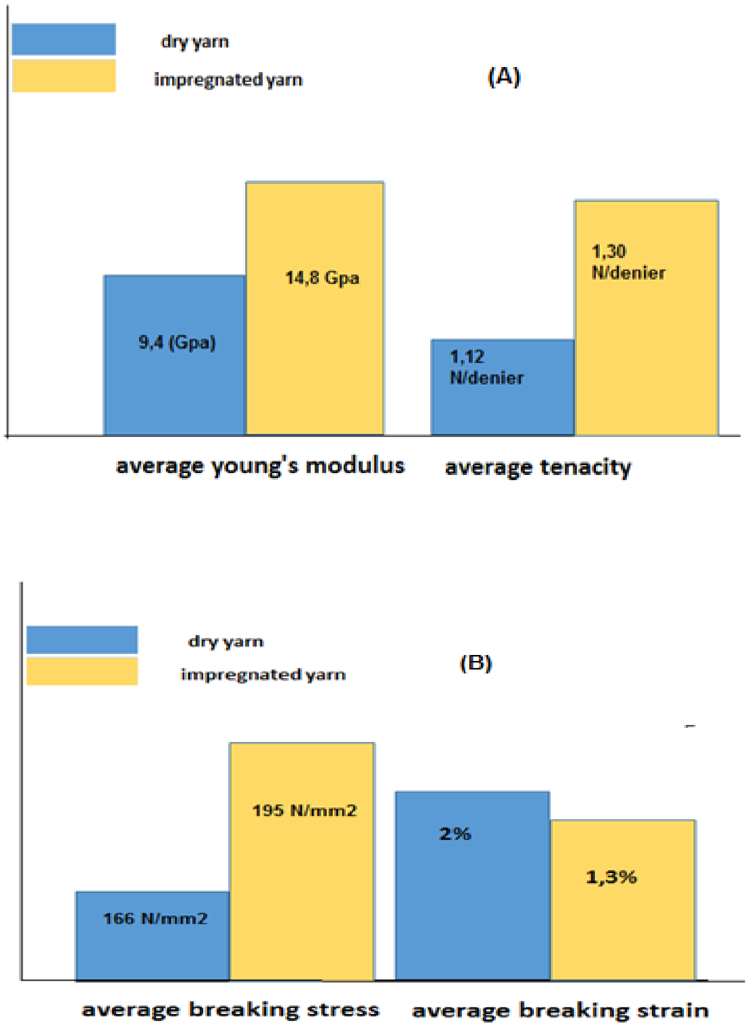
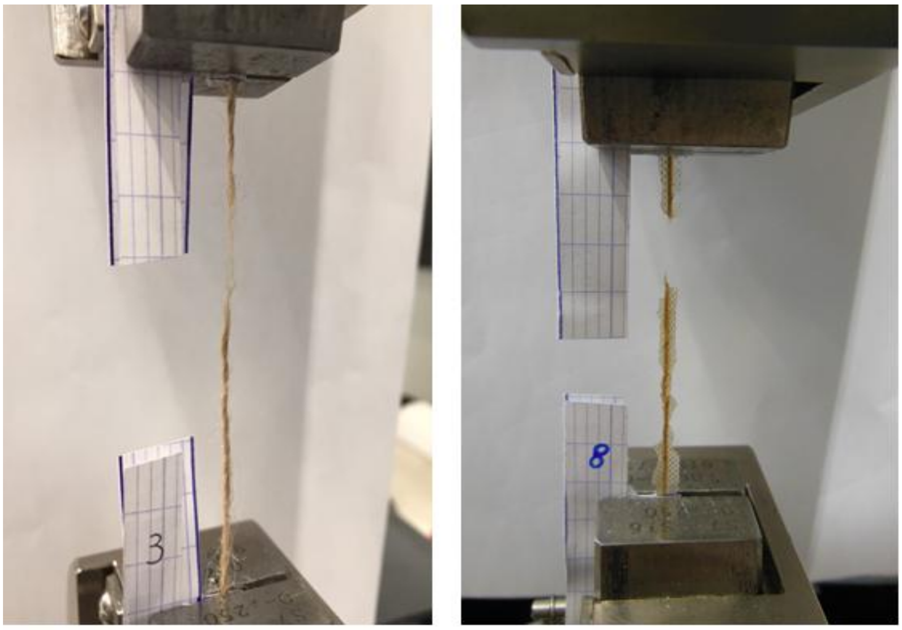


Fig. 5 :A- average Young's modulus, average tenacity B- average breaking stress, average breaking strain for dry jute and impregnated yarns.

Fig. 6 -A and Fig. 6-B), show the breakage aspects of dry and fertile yarns. we have a tendency to detect just in case dry yarn a progressive character of harm related to high elongation Fig. 6- A. the fertile yarn, we tend to detect a quasi-brutal facet of breakage related to little elongation Fig. 6- A.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 744 - 753
Received 05 March 2021; Accepted 01 April 2021.



(A) (B)

Figure (6) A- breakage aspect of dry yarn, B- breakage aspect of impregnated yarn.

Fig.7and Fig. 8 show SEM micrographs from the breakage surfaces of dry and fertile jute yarns.

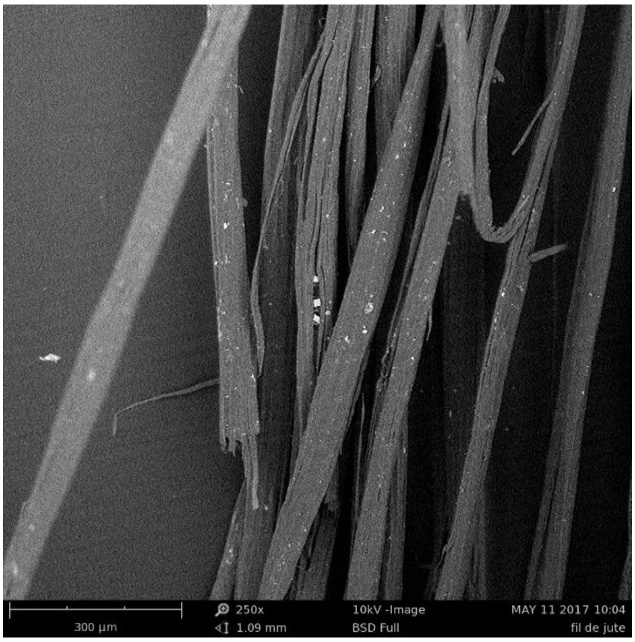


Fig. 7SEM micrograph from the breakage surface of dry jute yarn

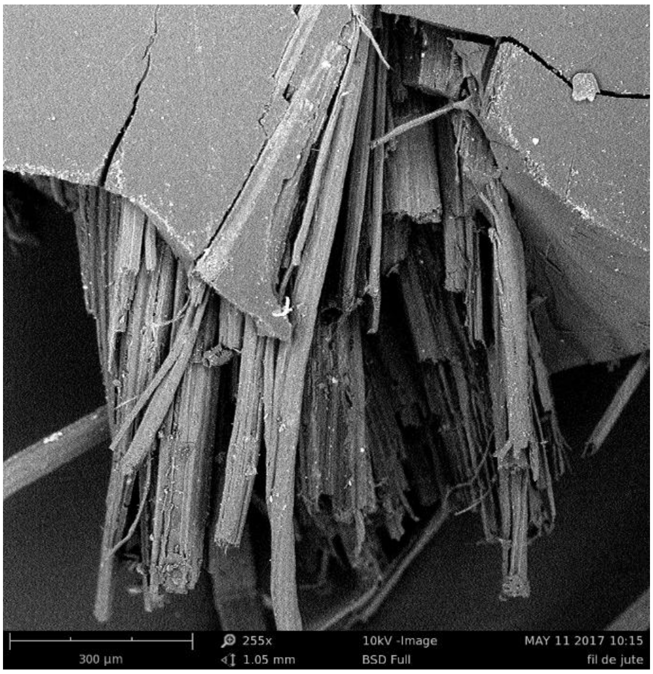


Fig. 8 SEM micrograph from the breakage surface of impregnated jute yarn

4.CONCLUSION

Tensile tests and morphological observations highlight many basic aspects of the behavior of dry and fertile jute yarns. The results of dry yarn tensile tests showed the presence of four zones on the load-displacement curve whereas those of fertile yarn showed the presence of 1 zone. Average young modulus and average determination of fertile yarns sample are more than those of dry yarn samples, whereas the common breaking stress of fertile yarn samples is more than dry samples. It is conjointly reported during this study that the common breaking strain of fertile yarn samples is under that of dry yarn samples. Dry jute yarn showed a progressive character of harm related to high elongation. fertile jute showed a quasi-brutal facet of breakage related to little elongation.

5.REFERENCES

[1] Nascimento, D. C. O., Lopes, F. P. D., and Monteiro S. N. 2010. Tensile behavior of lignocellulosic fiber reinforced polymer composites Part I piassava/epoxy”.RevistMatéria, Vol. 15, , pp. 199-205.

[2] Ahmed A. Taher, Ali Talib Abdalzahra " Experimental Study of Mechanical Properties of Polyester Matrix Reinforced with Hybrid Natural Material "2020, Solid State Technology, Vol 63, No 11616-11621.

[3] Al-Kaabi, K., Al-Khanbashi, A., and Hammami, A. 2005. Date Palm Fibers as Polymeric Matrix Rein forcement, Polymer composites, Vol. 26, pp. 486–497

[4] Harritte, L. B., J., M., and Martien J. A. V. D. O. 2006.Mechanical properties of short-flax-fibre reinforced compounds., Composites, Vol. 37, pp.1591– 1604.

[5] Ahmed A. Taher, Ayad M. Takhakh, Sabah M. Thahab" Experimental Study And Prediction The Mechanical Properties Of Nano-Joining Composite Polymers"2018, Journal of Engineering And Applied Science, Vol 13, No 23-24.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 744 - 753
Received 05 March 2021; Accepted 01 April 2021.

[6] Beg, M. D. H., and Pickering, L. 2008. Reprocessing of wood fibre reinforced polypropylene composites. Part II: Hygrothermal ageing and its effect. Composites: Part A, Vol. 39(9), pp. 1565–1571.
[7] Priyadarshi Tapas Ranjan SwainȦ* and SandhyaraniBiswasȦ. 2014.Physical and Mechanical Behavior of Al2O3 Filled Jute Fiber Reinforc Epoxy Composite.International Journal of Current Engineering and Technology, Special Issue-2.
[8] Ahmed A. Taher, Ayad M. Takhakh, Sabah M. Thahab " Experimental Study of Improvement Shear Strength and Moisture effect of PVP Adhesive Joint dy Addition PVA" 2018, Turkey,IConMEAS.
[9] Ahmed A. Taher, Ayad M. Takhakh, Sabah M. Thahab" Study and optimization of the mechanical properties of PVP/PVA polymer nanocomposite as a low temperature adhesive in nano-joining" 2020, IOP Conference Series: Materials Science and Engineering, 671(1), 012145
[10] AMM Sharif Ullah 1,*, Sweety Shahinur 2 and Hiroyuki Haniu. 2017. On Mechanic Properties and Uncertainties Jute Yarns. Materials , 10, 450; doi:10.3390/ma10050450.
[11] Ajith Gopinath, Senthil Kumar.M and Elayaperumal A. 2014. Experimental Investigations on Mechanical Properties Of Jute Fiber Reinforced Composites with Polyester and Epoxy Resin Matrices.- Procedia Engineering 97; 2052 – 2063; doi: 10.1016/j.proeng.2014.12.448.
[12] M. R. Sanjay and B.Yogesha. 2016. Studies on Mechanical Properties of Jute/E-Glass Fiber Reinforced Epoxy Hybrid Composites. Journal of Minerals and Materials Characterization and Engineering, 4; 15-25.
[13] Patrick Severson 2012. Analysis of Multi-Directional Recycled Jute Fiber Composite behavior using experimental, numerical, and analytical methods; PHD thesis, Wisconsin Milwaukee Univ. Milwaukee, Wisconsin,USA.
[14] Aziz Saaidia, abderrezakBezazi, Ahmed Belbah, Salah Amroune and Fabrizio Scarpa. 2015. Evaluation of mechanical proprieties of jute yarns by two- and three-parameters weilbull method., Structural integrity and life Vol, 15, No. 3 ,app 157-162.
[15] Almusawi A, Lachat R, Atcholi K.E, Traore B, Tie Bi S, Gomes S and Soulama S. 2016 Misen oeuvre et caracterisation à base de fil de chanvre et de pate de polystyrene expanse recycle par l'Acetone. Journées d'Etudes Techniques – JET 2016.
[16]Asmaa H. Dhiaa, Ahmed A. Taher, Abbas A. Diwan, S.M. Thahab, Rana J. Aze3 "Study the Thermal Properties of PVP/CuNPs CompositePrepared by Different Concentrations" 2020, IOP Conf. Series: Materials Science and Engineering 870 , 012153 ,doi:10.1088/1757-899X/870/1/012153
[17] Bo Madsen "Properties of Plant Fibre, 2004.Yarn Polymer Composites - An Experimental Study. TECHNICAL UNIVE RSITY OF DENMARK" Report BYG·DTU R-082 2004 ISSN 1601-2917 ISBN 87-7877-145-5